IBM Systems Reference Library

Report Program Generator (on Disk) Operating Procedures
IBM 1401 and 1460

Program 1401-RG-032, Version 2

This reference publication, which contains operating
procedures for IBM 1401 and 1460 Report Program
Generator (on Disk), should be used in conjunction with
these SRL publications:

Report Program Generator (on Disk) Specifications, IBM 1401, 1440
and 1460, Form C24-3261.

Autocoder (on Disk) Program Specifications and Operating Procedures,
IBM 1401, 1440, and 1460, Form C24-3259.

Input/Output Control System (on Disk) Operating Procedures, IBM 1401
and 1460, Form C24-3298.

Input/Output Control System (on Disk) for IBM 1401 and 1460:
Specifications, Form C24-1489.

This publication contains a description of the RPG
program deck, system file preparation, input deck for
the RPG run, Autocoder control cards, operating
instructions for generating and executing an object program,
the edit listing, and halts and messages.
    For a list of associated publications and abstracts,
see the IBM 1401 and 1460 Bibliography, Form A24-1495.

PREFACE

This publication contains operating procedures for
programs written in the Report Program Generator
(on Disk) language and used on an IBM 1401-1311,
IBM 1460-1301, or IBM 1460-1311 Data Processing
System. This publication should be used in conjunc-
tion with the Systems Reference Library publication
Report Program Generator (on Disk) Specifications,
IBM 1401, 1440, and 1460, Form C24-3261 which
contains information concerning machine require-
ments, language specifications, output options, POR
files, and RPG control cards.

RPG PROCESSOR PROGRAM-DECK DESCRIPTION

The Report Program Generator processor program is supplied in punched cards. As shown in Figure 1, the deck consists of a card boot (first 17 cards) routine, SYSTEM ASGN card, AUTOCODER RUN card, SYSTEM OPTN card and the RPG phases. Each phase is preceded by three introductory phase cards.

The phases may be arranged in any order provided:
1. The cards comprising each phase are in the correct sequence.
2. The three introductory cards preceding the corresponding phase are in the correct order.

The user can identify the first introductory card by the following format:

Columns	Contents
6-10	Phase Name
16-26	UPDATHEADER
79-80	C1

The second introductory card may be identified by:

Columns	Contents
1-5	Phase Name
6-25	Descriptive information for the phase
79-80	C2

The third introductory card may be identified by:

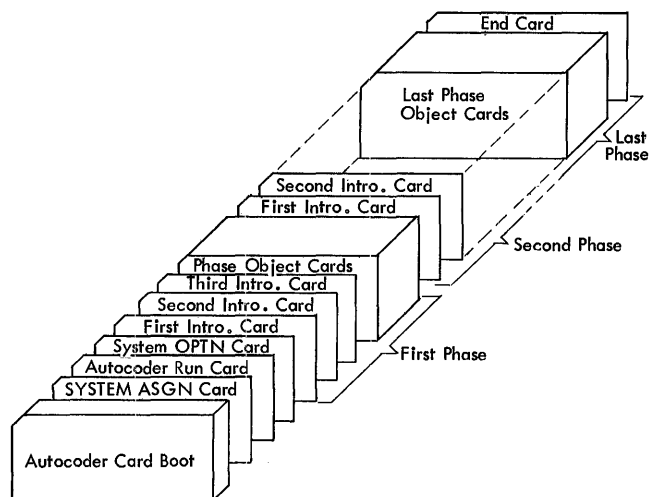| Columns	Contents
6-10	Phase Name
16-23	UPDATNEW
79-80	C3

Figure 1. Processor Program Deck

Example: The first phase name will appear as RPGbb. The actual phase cards are in disk Autocoder condensed-loader format as follows:

Columns	Contents
1-3	The 3-character machine address of the first storage position to be loaded.
4-5	The number of characters to be loaded from the card. Word-separator characters are not counted.
6-72	The instructions and/or data to be loaded. A word-separator character (0-5-8 punch) precedes every character requiring a word mark in core storage.
73-75	Sequence number of the card within the phase.
76-80	RPG phase name.

The last card in the processor deck is punched END in columns 16-18.

SYSTEM FILE PREPARATION

The RPG (on Disk) processor program must be written on the same disk unit that contains the Autocoder (1401-AU-008) processor program. The area of the disk unit that contains the Autocoder and RPG processor programs is called the system file.

To build a system file containing Autocoder and RPG, the user needs a program deck for both of these IBM-supplied programs. The 1401 and 1460 Disk Utility Programs (1401-UT-053) are also required. To build the Autocoder system, see Autocoder (on Disk) Program Specifications and Operating Procedures, IBM 1401, 1440, and 1460, Form C24-3259. An Autocoder library file, which may reside on the same disk unit as the system file, must contain the 1401 and 1460 IOCS library routines (1401-IO-068, Version 2). To add IOCS to the library file, see Input/Output Control System (on Disk) for IBM 1401 and 1460: Specifications, Form C24-1489 and Input/Output Control System (on Disk) Operating Procedures, IBM 1401 and 1460, Form C24-3298-0.

After Autocoder has been added to the system file, and IOCS has been added to the Autocoder library file, the user may then add RPG to the system file. The RPG processor program will reside on the system file from 000900 through 002499.

To add RPG to the system when it is to reside on 1311:
1. Ready the pack on disk drive 0.
2. Set the I/O check-stop switch off.
3. Set the check-stop switch and disk-write switch on.
4. Set the mode switch to RUN.

5. In the SYSTEM ASGN card (18th card of the processor deck), punch 1311 in columns 21-24.
6. Press CHECK RESET and START RESET.
7. Place RPG processor deck in 1402 read hopper.
8. To load the program, press LOAD on the 1402.
9. When the system attempts to read the last card, press START.

To add RPG to the system when it is to reside on 1301:
1. Ready 1301 module.
2. Set the I/O check-stop switch off.
3. Set the check-stop switch and disk-write switch on.
4. Set the mode switch to RUN.

5. Press CHECK RESET and START RESET.
6. In the SYSTEM ASGN card (18th card of the processor decks), punch 1301 in columns 21-24.
7. Place RPG processor deck in 1402 read hopper.
8. To load the program, press LOAD on the 1402.
9. When the system attempts to read the last card, press START on the reader.

In addition to IOCS, the user must make certain that his library file includes these IBM-supplied macro instructions for use with the object program:

    Multiply
    Divide
    Modify Address

Two runs are required to generate an object pro-
gram for a report program:
1. An RPG run.
2. An Autocoder run.

If an object deck is punched, the user will need
an additional run to execute his program.

If the load-and-go option was selected, the exe-
cution run follows the Autocoder run immediately,
without a halt.

If the symbolic-deck option was chosen, the user
can (in the Autocoder run) obtain an object program
either written on disk or punched into cards.

RPG RUN

Input Decks for RPG Run

Depending on the option selected by the user,
slightly different input deck configurations are
necessary. The order of these decks is shown in
Figures 2 and 3.

The RPG control cards in the deck are explained
in detail in Report Program Generator (on Disk)
Specifications, IBM 1401, 1440, and 1460, Form
C24-3261. However, information pertinent to their
placement in the input deck is given in this section
along with a description of the source-program
deck.
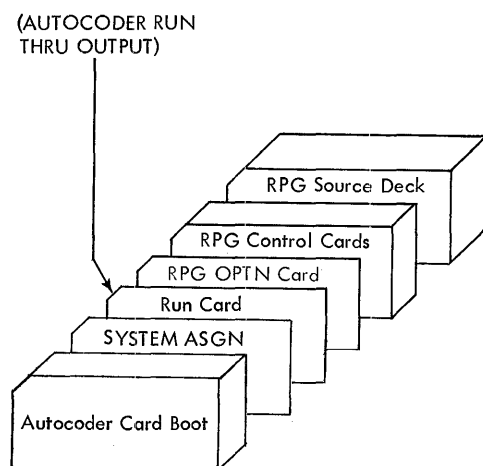
Figure 2. Input Deck for RPG Run Using Symbolic or Object Deck
Options

Sequence of RPG Control Cards

Although no application of RPG can use all six con-
trol cards, here is the complete list of them in the
relative order in which they must appear:
1. RPG
2. TAPOUT
3. TAPIN
4. MAS
5. TRL
6. POR

Source-Program Deck

A source program deck consists of:
1. Asterisk card
2. Input specifications cards
3. Asterisk card
4. Data specifications cards
5. Asterisk card
6. Calculation specifications cards
7. Asterisk card
8. Format specifications cards
9. Asterisk card
The proper card order is ascending sequence by
page and line number (columns 76-80).

The source deck can also be arranged in the
Basic RPG sequence (format specifications first and
input specifications last).

Figure 3. Input Deck for RPG Run Using Load-and-Go Option

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ASTERISK CARDS. These cards contain only an asterisk (11-4-8 punch) in column 1. As indicated in the preceding list of cards for the input deck, one asterisk card precedes each group of specifications, and the last asterisk card follows the last specification. In the case of an application that requires no calculation specifications, two asterisk cards must follow the data specifications.

INPUT SPECIFICATIONS CARDS. These cards are punched from the Input Specifications sheet, Form X24-6590. The user prepares them by punching one card for each line he writes on the input sheet.
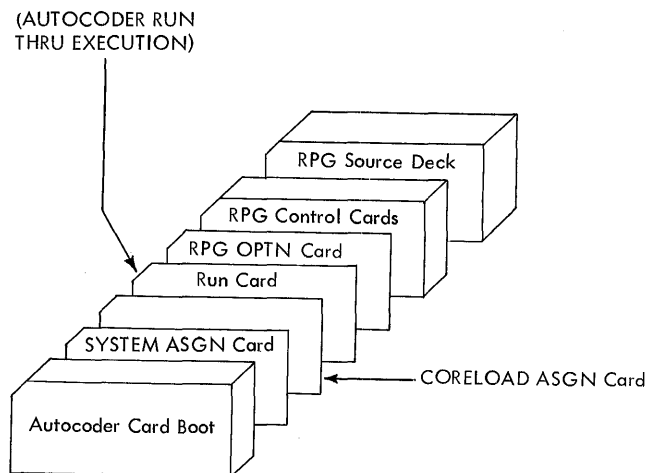
DATA SPECIFICATIONS CARDS. In a manner similar to that of the input cards, the user prepares the data specifications cards from the Data Specifications sheet, Form X24-6591.

CALCULATION SPECIFICATIONS CARDS. These cards are punched from the Calculation Specifications sheet, Form X24-6592.

FORMAT SPECIFICATIONS CARDS. These cards are punched from the Format Specifications sheet, Form X24-6593.

Sequence of RDLIN Cards

When using more than one RDLIN card, arrange them in this order:
1. Disk input-file RDLIN cards (1311 only) (can be either of these arrangements, depending on the input file).
   a. Master disk-file RDLIN, followed by the trailer disk-file RDLIN if trailers are used.
   b. Main disk-file RDLIN, followed by additions disk-file RDLIN.
2. POR-file RDLIN.
3. Output-file RDLIN.
4. Tape input-file RDLIN.

System Preparation for RPG Run

1. Insert the desired forms in the printer. Install an appropriately punched carriage tape (punched in channels 1 and 12).
2. If using a 1311, mount the systems pack on disk drive 0. Press the disk drive start-stop key to turn on the drive ready light. If using a 1301, ready the module.
3. Set the disk-write switch and the check-stop switch on (to the up position). Set the I/O check stop switch off.
4. Place the input deck for this RPG run in the 1402 read hopper. (See Input Deck for RPG Run for the contents of the input deck.)
5. If column 11 of the user's RPG control card specifies a punched symbolic program deck, place blank cards in the 1402 punch hopper.

Loading and Executing RPG

When the IBM 1401 and 1460 system preparation is completed, press the LOAD key on the 1402. In most cases the RPG run proceeds with no halts. All halts that can occur are detailed in Figure 7 in the Halts and Messages section. RPG thus performs its analysis of all of the user's control cards and report specifications. Unacceptable entries in the control cards and the specifications cards are noted on the RPG edit listing, but they do not halt the RPG program.

Output of RPG Run

1. An edit listing is printed out for all options.
2. If the user selects a symbolic deck, the symbolic program is punched, the message END OF RPG is printed out, and the program halts.
3. If the user selects the object deck or the load-and-go option, the messages END OF RPG and BEGIN AUTOCODER are printed out, and the program halts. The RPG processor has completed generating the report program in symbolic (Autocoder) language and has written it in an Autocoder area of the systems pack.

The user should check the edit listing for diagnostic messages and undefined labels and conditions. If he finds no errors, he proceeds to the Autocoder run. If the edit listing reveals errors for which RPG made assumptions, he must determine whether the assumptions apply for this report program. Correct any errors that are found in the specifications cards and the control cards. Remove the error cards from the input deck, insert the correct cards in the proper places, and begin the RPG run again.

SYMBOLIC-DECK OPTION

Input Deck for Autocoder Run

The symbolic-program deck option is completed at the end of the RPG run. The user can continue his program in two ways. Use of the Run card (AUTO-CODER RUN THRU OUTPUT) in the input deck will produce a punched deck. Use of the Run card (AUTOCODER RUN THRU EXECUTION) will cause the object program to be written on disk, thus changing the program to a load-and-go option. A CORELOAD ASGN card must always be used with the Run card (AUTOCODER RUN THRU EXECU-TION). Figure 4 depicts the input decks for either choice.

System Preparation

1. If using 1311, mount the systems pack on disk drive 0. Ready the drive. If using 1301, ready the module.
2. Install forms and a 1- and 12-channel carriage tape in the printer. Ready the printer.
3. Set these switches on: DISK WRITE, CHECK STOP, and SENSE SWITCH A. Set the I/O check stop switch off.
4. Press the check reset and the start reset keys.

If using the Run card (AUTOCODER RUN THRU OUTPUT):
5. Place the proper input deck in the 1402 read hopper.
6. Place blank cards in the 1402 punch hopper.
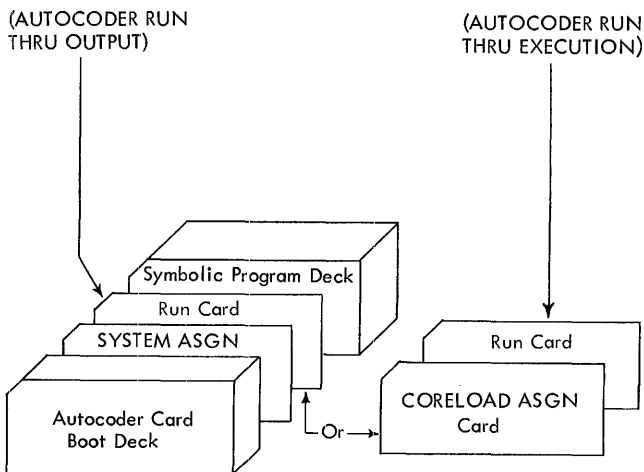
Figure 4. Input Deck for Assembly Option Using Symbolic Deck

7. Ready the 1402.
8. Press the LOAD key.

If using the Run card (AUTOCODER RUN THRU EXECUTION):
9. Place the proper input deck in the 1402 read hopper.
10. Ready the disk unit assigned in the CORELOAD ASGN card.
11. Press the LOAD key on the 1402.

HALTS DURING AUTOCODER RUN. See Figure 8 in the Halts and Messages section of this manual.

Output

Using Run Card (AUTOCODER RUN THRU OUT-PUT). The output is the same as for the object-program deck option.
Using Run card (AUTOCODER RUN THRU EXECU-TION). The output is the same as for the load-and-go option.

LOAD AND GO OPTION

There is no input deck; the symbolic program is written on the systems pack.

System Preparation

1. POR-file.
    a. If the POR-file is contained in disk, place the POR-FILE LIMITS card in the 1402 read hopper.
    b. If a POR-file is used, supply the file and ready the unit containing it.
2. Set the CHECK STOP switch on and the I/O CHECK STOP switch off. If the object program is to write disk output, set the DISK WRITE switch on. Set sense switches B, C, D, as required by the user's program.
3. Make ready the proper input unit(s). If the output file is to be written on a pack mounted on drive 0, do not perform this step. See Execut-ing.
4. Make ready the necessary output unit(s). If the output file is to be written on a pack mounted on drive 0, do not perform this step. (See Exe-cuting.)
5. Press the START key.

HALTS DURING AUTOCODER RUN. See Figure 8 in the Halts and Messages section of this manual.

Output of Autocoder Run

After the assembly is completed, a program listing is printed. The object program is written in an area of the pack which the user assigned in the CORELOAD ASGN card.

The following messages are then printed:

END OF LISTING XXX ERRORS
CORELOAD OUTPUT COMPLETE ON 1311 UNIT X,
START nnnnnn, END nnnnnn

If using 1301, the message is altered to indicate 1301 disk storage. The program does not halt; the execution begins immediately.

Executing

The object program remains on the disk pack and is available for execution at a later time. The CORE-LOAD message gives the user the information for his INPUT ASGN card, which is necessary for later execution. See the Autocoder (on Disk) publication for details.

Autocoder loads the object program from disk storage and transfers control to the object program. If the user specified 1311 disk input or output from his object program, the object program halts at this point. The B-address register contains 005 when this halt occurs. The purpose of this halt is to permit the user to remove his systems pack prior to executing his object program, and if necessary, to mount another pack on disk drive 0 for input and/or output. After he readies drive 0, the user can begin executing the object program by pressing the start key.

For applications in which there is no disk input or disk output, the object program does not include halt 005. In such cases, the object program begins processing the input data file upon receiving program control from Autocoder.

All other halts are detailed in Figure 9.

OBJECT-DECK OPTION

There is no input deck; the symbolic program is written on the systems pack.

System Preparation for Autocoder Run

1. Place blank cards in the 1402 punch feed.
2. Ready the punch unit.
3. Press the START key.

HALTS DURING AUTOCODER RUN. See Figure 8 in the Halts and Messages section of this manual.

Output of Autocoder Run

After the program listing is printed, the program prints:

END OF LISTING XXX ERRORS

and punches an object program deck in condensed-loader format. The program then attempts to read another Autocoder control card.

Thus, for batched jobs, the user follows his source cards with the necessary Autocoder control cards for his next job. These control cards do not include the card-boot deck or the SYSTEM ASGN card.

The source cards for the last batched job can be followed by a card with HALT in columns 16-19. This same HALT card can be used if the user does not batch his jobs.

Executing the Object Program

Input Deck

Under certain conditions, the object program deck must be altered. A description of the key cards for the alteration follows.

DATE CARD. Whenever the retention period of an output disk or tape file is to be checked or an output disk or tape header label is to be written by an RPG-generated program, the user must supply the current date to his object program. He does this by punching this information in the DATE card.

Columns	Contents
1-3	082 \} fixed information
4-5	05 /
6	Word-separator character (0-5-8 punch)
7-8	Year (for example, 64)
9-11	Day of year (001 represents January 1, 365 represents December 31).

He then inserts the DATE card in the object-program deck immediately behind the 6-card loader.

Figure 5 shows the input deck for the execution run as it would be with all possible cards inserted.

RDLIN CARDS. Insert the appropriate RDLIN cards immediately behind the first EXECUTE card (identified by 006 in columns 1-3) if one or more of the following conditions exist:

1. The object program will check header labels of a disk or tape input-data file.
2. The object program will check the header label of a disk or tape POR file.
3. The object program will check the old header label and write a new header label for a disk or tape output file.
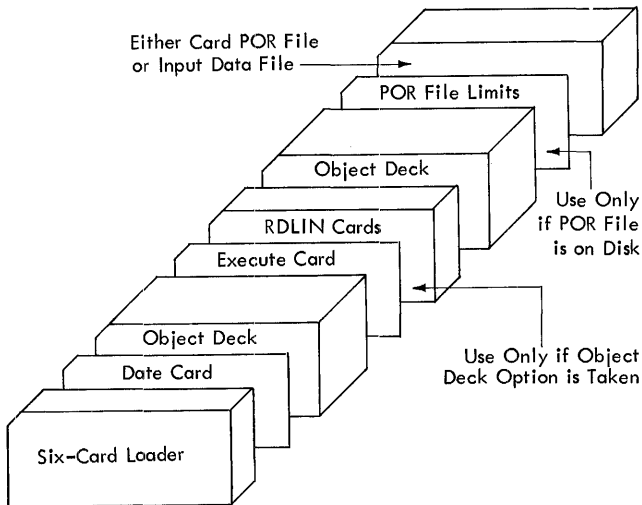
Figure 5. Input Deck for Execution Run

When using more than one RDLIN card, arrange them in this order:
1. Disk input-file RDLIN cards (1311 only).
   (Can be either of these arrangements, depending on the input file.)
   a. Master disk file RDLIN followed by the trailer disk file RDLIN if trailers are used.
   b. Main disk file RDLIN, followed by additions disk file RDLIN.
2. POR-file RDLIN.
3. Output-file RDLIN.
4. Tape input-file RDLIN.

POR-FILE LIMITS CARD. Whenever the user elects to put his POR file on disk, he must provide the object program with the starting and ending disk sector addresses in a POR FILE LIMITS card. The POR file may be on disk only for random processing.

If the user chose the load-and-go option (2-punch in column 11 of the RPG control card), he places his POR FILE LIMITS card in the 1402 read hopper. It will be the only card there.

If the user chose either of the remaining two options, he places this card in the 1402 read hopper following any RDLIN cards.

This POR FILE LIMITS CARD is punched:

Columns	Contents	Explanation
1-6	xxxxxx	Starting address of the POR file
7-12	xxxxxx	Ending address of the POR file

If the upper limit is unknown, the user should specify the maximum expected limit. The processing will stop when 1EOF, the end of file, is sensed in the POR file.

System Preparation for Object Run

1. Make ready the proper output unit(s).
2. Place the object-program deck, followed by either the POR-file cards (if file is in cards) or the POR-FILE LIMITS Card (if file is on disk), in the 1402 read hopper.
   If POR-file is on tape, ready the tape unit.
   If the input data is in cards and hence requires no POR-file, place the data file behind the object deck.
3. Set sense switches B, C or D as required by the user's program.
   If the card reader is being used, set sense switch A ON.
   Set the CHECK STOP switch ON and the I/O CHECK STOP switch OFF.
   If the object program is to write disk output, set the DISK WRITE switch ON.
   Press CHECK RESET and START RESET.
4. Press the 1402 LOAD key.

NOTE: All halts that can occur during this object run are detailed in Figure 9.

EDIT LISTING

This is a listing printed on the IBM 1403 Printer. It contains a record of the user's RPG specifications cards and his control cards, together with references to diagnostic notes when applicable. A diagnostic note calls the user's attention to either an error in a report specification or a control card, or an unusual calculation specification. An unusual calculation specification may not be an error. However, because it is unusual it deserves attention to ensure that its use is intentional. RPG also includes in the edit listing other items of information that are valuable documentation for the source program. These items are mentioned in the following discussion of the contents of the edit listing.

RPG Assumptions

For certain errors that the user might make, RPG not only notes them but also makes assumptions. This permits the user to proceed if the assumed information is correct for his application.

Example 1. If the user does not specify the control-field length (columns 47-48 of the input specifications), RPG detects the error, prints his input specification exactly as he punched it, and on the next line prints the card number of the input specification and the words, NOTE 88. Then, after it lists all of the specifications and control cards,

RPG prints in numerical order all of the diagnostic notes that apply. In this group appears the message:

NOTE 88 NO CONTROL FIELD LENGTH SPECIFIED.
LENGTH OF 06 IS ASSUMED.

Example 2. If the user does not specify in the RPG control card the core capacity of the 1401 or 1460 system on which he will run his object program, RPG detects this error. It prints the words, NOTE 2 on the line that lists the analysis of column 5 of the RPG control card. After it completes the control-card analysis, it prints the diagnostic notes that apply, including:

NOTE 2 NO MACHINE SIZE SPECIFIED. PROCESSING
CONTINUES ASSUMING 4K.

See Figure 6 for an example of an edit listing with specification errors.

Specifications Cards

The first line of this listing contains the title, 1401/60 RPG EDIT LISTING. The next two lines contain headings for six columns:

CD PAGE
SEQ NO LINE CARD IMAGE DIAGNOSTIC

These six columns pertain to the analysis of the specifications cards. In the sequence column, RPG prints SEQ if a specification contains no line number or if it is not in sequence by page number and line number. The card number column identifies the specification card in the order it appears in the deck. The page and line columns print as punched in the specifications cards. The card image column contains the contents of the first 75 columns of the

```
                              1401/60  RPG  EDIT  LISTING

         CD  PAGE
   SEQ   NO  LINE  CARD IMAGE                                                    DIAGNOSTIC

                    *

   SEQ   1          CAA                                   01

                    *

   SEQ   2          DRECORD              CAA 080
         2                                                                       NOTE 62

                    *


                    *

   SEQ   3          LDAAX                02
   SEQ   4          F                         RECORD210
   SEQ   5          LDAA
         5                                                                       NOTE 15
         5                                                                       NOTE 14
   SEQ   6          F                         BOXER  30

                    *

          RPG CONTROL CARD     COL.   INFORMATION              PUNCHED

                               1-3    CTL. CARD IDENT.         RPG
                               4      MACH. SIZE GEN. PROG.    1
                               5      MACH. SIZE OBJ. PROG.    1
                               6      SENSE SWITCHES           -NO-
                               7      MULTIPLY-DIVIDE          -NO-
                               8      ADVANCED PROGRAMMING     -NO-
                               9      MODIFY ADD FEATURE       -NO-
                               10     DIRECT SEEK              -NO-
                               11     CONDENSED DECK           -YES-
                               14-17  INPUT MEDIA              CARD
                               18     PRINTER OUTPUT           100
                               19     PUNCH OUTPUT             -NO-
                               20     DISK OUTPUT              -YES-
                               21     DRIVE NUMBER                        NOTE 6
                               22-27  LOWER LIMIT                         NOTE 7
                               28-33  UPPER LIMIT                         NOTE 7
                               34-37  BLOCK SIZE                          NOTE 9
                               38-40  RECORD SIZE                         NOTE 8
                               41-42  BLOCKING FACTOR                     NOTE 101
                               43     RESERVED                 BLANK
                               44     LABEL FOR OUTPUT FILE    -NO-
                               76-80  IDENTIFICATION
```

Figure 6. Edit Listing with Specification Errors (part 1 of 3)

```
        NOTE 1      UNIDENTIFIED CONTROL CARD TYPE. PROCESSING CONTINUES IGNORING THIS CARD.

        NOTE 6      NO DISK OUTPUT DRIVE-CONTROL NUMBER STATED. DRIVE 0 IS ASSUMED.

        NOTE 7      NO DISK OUTPUT LIMIT STATED. PROCESSING CONTINUES ASSUMING 000000 FOR LIMIT.

        NOTE 8      NO DISK OUTPUT RECORD SIZE. PROCESSING CONTINUES ASSUMING 100 CHARACTERS.

        NOTE 9      NO DISK OUTPUT BLOCK SIZE. PROCESSING CONTINUES ASSUMING BLOCK SIZE 100.

        NOTE 14     THIS L FORMAT ENTRY HAS NO OUTPUT CONDITIONS IN COLUMNS 20-28. CONDITION 00 ASSUMED.

        NOTE 15     COLUMNS 5-7 DO NOT INDICATE AN OUTPUT MEDIUM. PRINTED OUTPUT IS ASSUMED.

        NOTE 62     NO FIELD LENGTH SPECIFIED IN COLUMNS 8-10. A LENGTH OF 006 IS ASSUMED.

        NOTE 101    NO BLOCKING FACTOR. PROCESSING CONTINUES ASSUMING 1.


  LINE      LABEL       END POSITION ERROR      POSITION  USED

  DAA       RECORD           210                    210              EXCEEDS OUTPUT AREA

  DAA       BOXER             30                    030

  NOTE 201    DIFFERENT OUTPUT SPECIFIED IN FORMAT SPECIFICATIONS AND CONTROL CARD.


            ORDERED CALC SPECS




                                   UNDEFINED CONDITIONS

                                         02


                                   RESULTING CONDITIONS

     F1    S00        F2    S01        F3    S02        F4    S03        F5    S04

     F6    S05        LC    S06        1P    S07        00    S08        OF    S09

     SB    S10        SC    S11        SD    S12        01    S14
```

Figure 6. Edit Listing with Specification Errors (part 2 of 3)

specifications cards. The diagnostic column contains NOTE XXX in those cases when RPG detects an error. This refers to a specific diagnostic message in the list of all the errors RPG detects up until the time the list is printed.

Control Cards

The next portion of the edit listing is a printed analysis of the user's control cards. RPG prints a heading line that identifies the control cards and the columns on the listing. It then prints the analysis of the card, one line per control-card field, giving the card columns, the meaning of the field, and either the contents of the field or a word that represents the coded contents. If the user makes an error in punching a control-card field, RPG flags the line by printing a reference to a numbered diagnostic note at the right end of the line.

To illustrate, the first five lines of the control-card analysis that RPG printed are given.

```
RPG CONTROL CARD  COL.  INFORMATION              PUNCHED
                  1-3  CTL CARD IDENT.     RPG
                  4    MACH. SIZE GEN. PROG.   NOTE 2
                  5    MACH. SIZE OBJ. PROG.   NOTE 2
                  6    SENSE SWITCHES      -NO-
```

This analysis of the RPG control card discloses two errors, flagged by the references to diagnostic note 2. (Note 2 will be printed, along with any others that apply, after RPG prints the control-card analysis.)

Numbered Diagnostic Notes

A section of the edit listing containing one or more lines for every referenced note is printed next. This listing of the numbered diagnostic notes is printed in numeric sequence. It indicates not only

```
                                              LITERALS AND CONSTANTS
                   ADDRESS      DESCRIPTION
                   LABEL        LEN DEC  TYPE
        RECORD      S15         06       ALPHANUMERIC



                                           UNDEFINED LABELS

                                   BOXER    F FORMAT ENTRY







                                          END OF RPG

                                     BEGIN AUTOCODER
```

Figure 6. Edit Listing with Specification Errors (part 3 of 3)

the errors RPG has detected up to this point, but in
most cases it also indicates the action taken by the
RPG processor (such as the assumptions made or
that the specification is bypassed).

Field-End Error

If any format field specification card contains an in-
valid entry for field end (columns 35-37), RPG
prints a line that indicates the line identification,
the field label, the erroneous-end position, and the
position used. If columns 35-37 contain one or two
blanks, RPG inserts zeros in the blank positions.
     Furthermore, if the entry for the field end is
greater than the size of the output area, RPG prints
the diagnostic message:

                   EXCEEDS OUTPUT AREA

     Example. If the 1403 printer has a maximum of
132 print positions, the end position should be no
greater than 132.
     In the edit listing shown in Figure 6, the end
position is 210, a definite error. An error of this
nature must be corrected before the object program
is run.

Additional Program Diagnostics

Any of four program diagnostics may come at the
end of the edit listing of the calculation specifica-
tions. These do not indicate errors in a specific
card as do the ordered calculation specifications.
Instead, they refer to general conditions that are
not defined on the input or format specification
sheet, or to conditions on the input or format spec-
ification sheets that differ from those on the control
card. These errors must be corrected before pro-
ceeding with the object run.

Ordered Calculation Specifications

The next portion of the edit listing shows the cal-
culation specifications, with their grouping re-
arranged if necessary, so that they are in this
order: all detail calculations first, in the order
specified; all total calculations next, in the order
specified; and all conversion calculations last, in
the order specified. If RPG detected errors in its
first analysis of the calculation specifications and
made assumptions because of the errors, this list-
ing reflects the assumptions that RPG has made.

Undefined Conditions

If the source program (the report specifications)
contains any condition numbers that are not defined
by either field-status entries on the data or the cal-
culation specifications sheets or resulting-condition
entries on the input sheet, RPG prints a list of these,
under the heading UNDEFINED CONDITIONS.

Resulting Conditions

Next, RPG prints the RESULTING CONDITIONS list.
To the right of each two-character condition, there
appears a three-character label that RPG assigned
to the condition. The first 13 conditions (are always)
listed, because RPG automatically defines them.
The list includes these conditions: F1-F6, LC, 1P,
00, OF, SB-SD, and any resulting condition the user
has defined in his input, data, and calculation spec-
ifications. Note: A resulting condition that is used
but not defined does not appear in this list.

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Literals and Constants

The next portion of the edit listing is a list of all literals and constants used in the source program. The listing contains these six columns of information: the RPG-assigned label, length, decimal length, type (whether alphanumeric or numeric), the literal or the constant, and, if applicable, a diagnostic comment indicating an error.

To illustrate, this portion of the edit listing for the sample program in the Appendix is shown.

		LITERALS AND CONSTANTS		
ADDRESS LABEL	DESCRIPTION LEN. DEC.		TYPE	
S16	23		ALPHANUMERIC	CURRENT ACCOUNTS REPORT
S17	02		ALPHANUMERIC	OK
S18	04	0	NUMERIC	500?
S19	05	0	NUMERIC	2000?
CLIENT	S20	10	ALPHANUMERIC	
AREA	S21	10	ALPHANUMERIC	
DEL. INQ.	S22	06	ALPHANUMERIC	
DND	S23	10	0	NUMERIC
QUOT.	S24	07	0	NUMERIC
REMAIN	S25	04	0	NUMERIC

WORDXX

Next, RPG prints a list of all WORDXX constants or edit control words defined by W-entries in the format specifications. This list is like the previous one, except for an additional column on the left in which WORDXX is printed.

Unreferenced Words

If the user has not used a WORDXX that he has defined by a W-entry, RPG lists each such word under the heading UNREFERENCED WORDS. Each line gives, in addition to WORDXX, the RPG-assigned label, the length of the word, and its decimal length.

Defined Field Names

In the next list appears every field that the user defined as a field name in his specifications. This list consists of these six columns: field name as defined by the user, RPG-assigned label, field length, decimal length, type (whether alphanumeric or numeric), and, if applicable, a diagnostic comment indicating an error.

Undefined Labels

Undefined labels (field names) are listed next. If RPG detects a field used in a calculation or a format specification that is not defined in a specification, it prints a line that shows the name of the undefined field and the kind of specification in which it appears under the heading Undefined Labels.

Control Fields

If the input specifications define control fields, RPG lists them, giving the length of each field. If a control field were defined more than once with different lengths (an error), the line on this listing would contain the notation MULTI. DEFINED.

Additional Calculation Diagnostics

RPG performs two separate tests for calculation specifications. The results of the first test are printed in the first part of the edit listing, as described previously. The results of the second error test are printed here. This list includes only the calculation specifications that contain errors revealed by the second test. Each line is printed in this form:

CALC. SPEC. # xxx NOTE xxx.

The number of the specification printed here refers to the sequence number of that specification as it appears in the leftmost column of the sorted-calculation-specification list, described previously. The reference to a numbered note indicates the specification error.

After all of these lines are listed, the numbered diagnostic notes that are applicable are printed, in sequential order.

Final Messages

For the user who chose the symbolic-program-deck output option, RPG prints the message, END OF RPG, and halts. For the other two options (that is, load-and-go and object deck in condensed-loader format) RPG prints the two messages, END OF RPG and BEGIN AUTOCODER, and halts.

Numbered Diagnostic Notes

A list in numeric order of the numbered diagnostic notes in the RPG program follows. Headings indicate the control card or specifications card to which the notes apply.

Control Cards

NOTE 1 UNIDENTIFIED CONTROL CARD TYPE. PROCESS-
ING CONTINUES IGNORING THIS CARD.

NOTE 2 NO MACHINE SIZE SPECIFIED. PROCESSING CON-
TINUES ASSUMING 4K.

NOTE 3 NO GENERATED OUTPUT SPECIFIED. PROCESSING
CONTINUES ASSUMING MACHINE LANGUAGE DECK.

NOTE 4 NO INPUT MEDIUM SPECIFIED. CARD INPUT IS
ASSUMED.

NOTE 5 NO DISK OUTPUT STATED, BUT COLUMNS 21-44
NOT BLANK. DISK OUTPUT IS ASSUMED.

NOTE 6 NO DISK OUTPUT DRIVE-CONTROL NUMBER
STATED. DRIVE 0 IS ASSUMED.

NOTE 7 NO DISK OUTPUT LIMIT STATED. PROCESSING
CONTINUES ASSUMING 000000 FOR LIMIT.

NOTE 8 NO DISK OUTPUT RECORD SIZE. PROCESSING CON-
TINUES ASSUMING 100 CHARACTERS.

NOTE 9 NO DISK OUTPUT BLOCK SIZE. PROCESSING CON-
TINUES ASSUMING BLOCK SIZE 100.

Format Specifications

NOTE 11 COLUMN 1 IS NOT L, B, F, K, OR W. THIS CARD
IS BYPASSED.

NOTE 12 COLUMN 2 IS NOT H, D, OR T. THIS L FORMAT
CARD IS BYPASSED.

NOTE 13 NO FIELD END HAS BEEN SPECIFIED IN COLUMNS
35-37. POSITION 120 IS ASSUMED.

NOTE 14 THIS L FORMAT ENTRY HAS NO OUTPUT CONDI-
TIONS IN COLUMNS 20-28. CONDITION 00
ASSUMED.

NOTE 15 COLUMNS 5-7 DO NOT INDICATE AN OUTPUT
MEDIUM. PRINTED OUTPUT IS ASSUMED.

Data Specifications

NOTE 22 NO D IN COLUMN 1. THIS DATA CARD IS BY-
PASSED.

NOTE 23 OP CODE IN COLUMNS 32, 49, OR 66 IS NOT BLANK,
-, &, S, A, Y, OR D. BLANK IS ASSUMED.

Calculation Specifications

NOTE 33 NO A IN COLUMN 1. THIS CALCULATION CARD IS
BYPASSED.

NOTE 34 COLUMN 46 DOES NOT CONTAIN D, T, OR C. THE
CALCULATION TYPE OF THE PREVIOUS CARD IS
ASSUMED, UNLESS THIS IS THE FIRST CARD. IN
THIS CASE, A D IS ASSUMED.

NOTE 36 OP IN COLUMN 36 IS NOT A, S, &0, -0, OR BLANK.
A MOVE IS USED.

NOTE 37 STATUS IN COLUMN 14, 17, OR 20 IS NOT U, E, H,
L, B, Z, N, P, OR BLANK. BLANK IS ASSUMED.

NOTE 39 COLUMN 29 IS NOT C, /, X, -, &, OR BLANK.
FACTOR 1 IS IGNORED.

Input Specifications

NOTE 41 NO SCF CARD. SCF1 IS ASSUMED.

NOTE 42 NO RESULTING CONDITION IN COLUMNS 42-43.
CONDITION 00 IS ASSUMED.

NOTE 44 NO C, D, T, OR S IN COLUMN 1. THIS INPUT CARD
IS BYPASSED.

Format Specifications

NOTE 51 THIS F FORMAT ENTRY HAS NO FIELD NAME IN
COLUMNS 29-34.

NOTE 52 NO @ AT RIGHT END OF LITERAL COLUMNS 50-75.
AN @ IS ASSUMED IN COLUMN 75.

NOTE 53 THIS K FORMAT CARD HAS NO CONSTANT SPECI-
FIED IN COLS. 48-75. THIS CARD IS BYPASSED.

NOTE 54 COLS. 29-32 OF THIS W CARD DOES NOT DEFINE
A WORD. THIS CARD IS BYPASSED.

NOTE 55 THIS W CARD HAS NO CONSTANT SPECIFIED IN
COLS. 48-75. THIS CARD IS BYPASSED

NOTE 56 A PREVIOUS LINE OF THE SAME TYPE HAS BEEN
GIVEN THE SAME DESIGNATION AS THIS LINE.

NOTE 57 THIS IS NOT THE NEXT LINE AS SPECIFIED BY THE
PREVIOUS LINE.

Data Specifications

NOTE 60 INVALID STATUS IN COL. 13, 16, OR 19. NOT B, Z,
N, OR P. B IS ASSUMED.

NOTE 62 NO FIELD LENGTH SPECIFIED IN COLUMNS 8-10.
A LENGTH OF 006 IS ASSUMED.

NOTE 65 NO FIELD SOURCE ENTRY. THIS CARD IS
BYPASSED.

NOTE 66 FIELD END SPECIFIED, BUT NO FIELD SOURCE.
THE PREVIOUS FIELD SOURCE IS ASSUMED.

NOTE 67 NO FIELD END SPECIFIED. A FIELD END OF 006
IS ASSUMED.

NOTE 68 DECIMAL LENGTH GREATER THAN FIELD LENGTH.
THE LENGTHS ARE INTERCHANGED.

NOTE 69 UNDEFINED FIELD SOURCE IN COLUMNS 22-24,
39-41, 56-58. THE PREVIOUS SOURCE IS ASSUMED.

Calculation Specifications

NOTE 71 NO FIELD LENGTH SPECIFIED IN COLUMNS 8-10.
A LENGTH OF 006 IS ASSUMED.

NOTE 76 REMAINDER NAME SPECIFIED ON DIVIDE, NO RE-
MAINDER LENGTH GIVEN. LENGTH OF 06 AS-
SUMED.

Input Specifications

NOTE 85 NUMERIC SEQUENCE RECORD HAS NO 1 OR N IN
COL. 4. N IS ASSUMED.

NOTE 86 NO Z, D, OR C IN COLUMN 10, 16, 22, 28, 34, OR
40. C IS ASSUMED.

NOTE 87 NO RECORD CODE POSITION SPECIFIED. POSITION
006 IS ASSUMED.

NOTE 88 NO CONTROL FIELD LENGTH SPECIFIED. A
LENGTH OF 06 IS ASSUMED.

NOTE 89 NO CONTROL FIELD END SPECIFIED. AN END OF
006 IS ASSUMED.

Calculation Specifications

NOTE 90 NO FACTOR 2 SPECIFIED. THIS ENTRY IS
BYPASSED.

NOTE 91 OP-CODE IN COL. 29 WITH NO FACTOR 1 SPECI-
FIED. THIS CARD IS BYPASSED.

NOTE 93 ALPHAMERIC TO NUMERIC COMPARE SPECIFIED.
NUMERIC COMPARE WILL BE PERFORMED.

NOTE 94 COMPARE OP WITH NONBLANK IN COL. 36. A
BLANK IN COL. 36 IS ASSUMED.
NOTE 95 COMPARE OP WITH FIELD NAME ENTRY. FIELD
NAME IS IGNORED.
NOTE 96 COMPARE OP WITH COLUMNS 14-16 BLANK. PROC-
ESSING ASSUMES U00.
NOTE 97 COMPARE-OP WITH FIELD STATUS NOT E, H, L,
U, OR BLANK. U IS ASSUMED.
NOTE 98 *ALPHAMERIC COMPARE WITH DIFFERENT FIELD
LENGTHS. OPERATION WILL BE PERFORMED.
NOTE 99 *ARITHMETIC OPERATION WITH ALPHAMERIC
FACTOR OR FIELD NAME. OPERATION WILL BE
PERFORMED.
NOTE 100 *RESULTING CONDITION WITH NO FIELD STATUS
SPECIFIED. THIS STATUS MUST BE SPECIFIED.

Control Cards

NOTE 101 NO BLOCKING FACTOR. PROCESSING CONTINUES
ASSUMING 1.
NOTE 102 NO TAPE UNIT SPECIFIED. PROCESSING CON-
TINUES ASSUMING 1.
NOTE 103 NO RECORD LENGTH SPECIFIED. 100 CHARAC-
TERS IS ASSUMED.
NOTE 104 NO BLOCK LENGTH SPECIFIED. 100 CHARACTERS
IS ASSUMED.
NOTE 105 TAPE LABEL IS NOT IBM 1401 STANDARD 80, 84,
OR 120 CHARACTERS. ASSUME 80.
NOTE 106 INVALID OR MISSING ENTRY IN COLUMN. COR-
RECT THIS CARD WITH A VALID ENTRY.
NOTE 108 TAPE LABEL OPTION NOT BLANK NOR A VALID
ENTRY. ASSUME CHECK-ALL OPTION.
NOTE 109 NO CONTROL DATA FIELD COMPLETELY DE-
FINED. DIRECT ADDRESSING IS ASSUMED.
NOTE 110 NO DISK DRIVE AND/OR ADDRESS SCHEME FOR
DISK FILE. ASSUME DRIVE 0, SCHEME 0.
NOTE 111 NO DISTANCE BETWEEN POR FIELDS STATED.
ASSUME 07.
NOTE 112 NO MAXIMUM NUMBER OF TRAILERS SPECIFIED.
1 IS ASSUMED.
NOTE 113 NO PROCESSING ORDER RECORD MEDIUM SPEC-
IFIED. CARD IS ASSUMED.
NOTE 114 NO MODE OF PROCESSING STATED FOR DISK FILE.
ASSUME RANDOM MODE.
NOTE 115 POR CARD COLUMN 17 CONTAINS INCORRECT
ENTRY. ASSUME DISK ADDRESSES.
NOTE 116 POR CARD ENTRY FOR CONTROL-DATA LENGTH
MISSING. ASSUME 07.
NOTE 117 LENGTH OF DISK ADDRESSES NOT 6, 7, OR 8.
ASSUME 7.
NOTE 118 MAXIMUM NUMBER OF CONTROL-DATA OR DISK
ADDRESS FIELDS PER POR MISSING. ASSUME 1.
NOTE 119 NO LOCATION OF CONTROL DATA OR DISK
ADDRESS FIELD GIVEN. ASSUME 007.
NOTE 120 NO LENGTH OF NEXT RECORD FIELD GIVEN.
ASSUME LENGTH OF DISK ADDRESS.
NOTE 121 MISSING RPG CONTROL CARD. RUN SHOULD BE
DISCONTINUED.
NOTE 122 TAPE INPUT MEDIUM SPECIFIED, TAPIN CARD
MISSING. RUN SHOULD BE DISCONTINUED.
NOTE 123 MAS AND/OR POR CARDS MISSING WITH DISK
INPUT. RUN SHOULD BE DISCONTINUED.

Calculation Specifications

NOTE 190 *FIELD OR FACTOR LENGTH LESS THAN DECIMAL
LENGTH.
NOTE 191 *ADD OR SUBTRACT OP WITH RESULT FIELD
DECIMAL LENGTH LESS THAN FACTOR DECIMAL
LENGTH.
NOTE 192 *ADD OR SUBTRACT OP WITH RESULT FIELD
LENGTH LESS THAN NORMALLY REQUIRED TO
CONTAIN FULL ANSWER.
NOTE 193 *MULTIPLY OP WITH RESULT FIELD DECIMAL
LENGTH LESS THAN THE SUM OF THE DECIMAL
LENGTHS OF FACTORS 1 AND 2.
NOTE 194 *MULTIPLY OP WITH RESULT FIELD LENGTH
LESS THAN THE SUM OF THE LENGTHS OF FAC-
TORS 1 AND 2.
NOTE 195 *DIVIDE OP WITH DECIMAL LENGTH OF DIVIDEND
LESS THAN THE DECIMAL LENGTH OF THE
DIVISOR.
NOTE 196 *DIVIDE OP WITH DECIMAL LENGTH OF THE
RESULT FIELD NOT EQUAL TO THE DECIMAL
LENGTH OF THE DIVIDEND MINUS THE DECIMAL
LENGTH OF THE DIVISOR.
NOTE 197 *DIVIDE OP WITH LENGTH OF THE RESULT FIELD
LESS THAN THE LENGTH OF THE DIVIDEND.
NOTE 198 *DIVIDE OP WITH LENGTH OF THE REMAINDER
LESS THAN THE LENGTH OF THE DIVISOR.

Additional Program Diagnostics

NOTE 200 DIFFERENT INPUT SPECIFIED IN INPUT SPECIFI-
CATIONS AND CONTROL CARD.
NOTE 201 DIFFERENT OUTPUT SPECIFIED IN FORMAT
SPECIFICATIONS AND CONTROL CARD.
NOTE 202 NO INPUT SPECS IN RPG PROGRAM. PROCESSOR
CANNOT CONTINUE.
NOTE 203 NO FORMAT SPECS IN RPG PROGRAM. PROC-
ESSOR CANNOT CONTINUE.
NOTE * THESE MESSAGES PROBABLY DO NOT INDICATE
ERRORS BUT ARE POINTS THAT REQUIRE CARE.

HALTS AND MESSAGES

Figure 7 lists the halts that can occur while the
RPG-generating run is performed. Figure 8 lists
the Autocoder-run halts. Figure 9 lists the object-
program-run halts. No printed messages accompany
these object-time halts.

All the halts can be identified by the contents of
the A-, B- or I-address register or the A-register.

Each figure cites the contents of the appropriate
registers, the reason for the halt, the procedure to
follow to restart the program, and the results of
restarting the program.

A-REGISTER	B-ADDRESS REGISTER	MESSAGE	REASON	PROCEDURE
1			This halt indicates an error condition in reading or punching a card.	For punch errors, the card in the stacker is the card in error. Press START to punch another card to replace the error card. For read errors, remove the cards from the hopper and run out the cards in the feed. To restart, place the card in error (and subsequent cards) back in the hopper and press the start keys.
2			This means that either a wrong-length record or a no-address-compare disk error occurred during a disk-read or disk-write operation. Three additional attempts to read or write are made automatically by Autocoder processor before the halt occurs.	Pressing the start key causes one retry.
2 1			This means that a data check disk error occurred on a disk-read or disk-write operation. The Autocoder processor tries to perform the operation three more times before the halt occurs.	Pressing the start key causes one retry.
4			This means that a not-ready condition occurred on a disk-read or disk-write operation.	Place disk drive 0, which contains the systems pack, in a ready status and press the start key.
4 1			This means that the name of the run was incorrectly punched into the RUN card.	Repunch the RUN card and restart the run from the beginning.
C A 4		NO PUNCHING ALLOWED FOR UPDATE LINES. PUNCHING IS SUPRESSED. PRESS START TO CONTINUE.	This is a diagnostic halt caused by a coding error in the use of the update function.	
B 8 1		FOR BLOCKED RECORDS INDEX REG. ARE REQUIRED. PUSH START IF OBJECT MACHINE HAS INDEX REGISTERS.	This halt indicates that index registers were not indicated in the RPG Control Card as required when using the update function with blocked records.	
B A 5		UPDATE PROGRAM NOT CORRECTLY GENERATED.	This halt is due to a self-checking routine in the RPG processor.	Check the source coding to ensure that no rules regarding the use of the update function have been violated.
	222		Seven unequal-address-compare conditions have been detected during a disk operation.	Press START twice to attempt the disk operation ten more times.
	333		Seven parity errors have been detected during a disk operation.	Press START twice to attempt the disk operation ten more times.
	444		Access-inoperable error.	Determine the drive number, by examining the core-storage position contained in the A-address register. Alter in a different number, if required. Press START to retry with the same or the altered drive number.
	555		Seven wrong-length-record conditions have been detected during a disk operation.	Press START twice to attempt the disk operation ten more times.
	31bb	PROGRAM TOO LARGE	This means that the amount of core storage required to store the program being generated exceeds the available core capacity of the generating 1401/1460 system.	Terminate the run at this point.
	32bb	END OF RPG	This means that the RPG processor has finished generating the report program in symbolic (Autocoder) language, and has punched the symbolic report-program desk.	Proceed with the next step, which is the Autocoder run. Press START to begin assembly.
		(or) END OF RPG BEGIN AUTOCODER	This two-line message means that the RPG processor has finished generating the report program in symbolic (Autocoder) language, and has written it in an Autocoder area of the systems pack.	Proceed with the next step, which is the Autocoder run. Press 1447 console START to begin assembly.
	33bb	NOTE 202 NO INPUT SPECS IN RPG PROGRAM. PROCESSOR CANNOT CONTINUE.	This source-program deck is incomplete. It contains no input specification cards.	Remove the cards from the reader-punch, make up a complete source-program deck, and prepare again for the RPG generating run.
		(or) NOTE 203 NO FORMAT SPECS IN RPG PROGRAM. PROCESSOR CANNOT CONTINUE.	This source-program deck is incomplete. It contains no format specification cards.	Remove the cards from the reader-punch, make up a complete source-program deck, and prepare again for the RPG generating run.

Figure 7. RPG-Generating Run Halts

A-ADDRESS REGISTER	MESSAGE	REASON	PROCEDURE
001	WRONG SYSTEM	Autocoder pack not mounted on drive specified in ASGN card.	Correct SYSTEM ASGN card or mount correct pack and restart the run.
002	TEN RD TRIES PRESS START FOR TEN MORE.		Press START to attempt read ten more times.
003	SYSTEM ASGN NOT SENSED	The SYSTEM ASGN card did not immediately follow the card boot.	Place SYSTEM ASGN card in reader and press reader and console START.
004		Parity error, wrong-length record, or no-address compare error sensed ten successive times.	Press START to retry the operation ten more times.
005		End of file sensed in system file during disk boot-strap operation.	Restart the run.
006	HALT	Card reader end of file.	End of run.
007		Card punch error.	Press the NPRO key. Discard the last three cards and press START.
008		Card read error.	Press the NPRO key on the reader to remove the unread cards. Place cards in the read hopper and press START.
009		Printer error.	Press START to print the line again.
013		An ASGN card is incorrectly punched.	Press NPRO. Correct the ASGN card. Place the non-processed cards in the reader and press START.
500		Disk not ready.	Ready the disk unit and press START.
629		Parity check, wrong-length record, or no-address compare error sensed ten times.	Press START to retry the operation ten times.
1833	NOTE-DIAGNOSTICS-PRESS START TO ASSEM-BLE, START RESET AND START TO BYPASS ASSEMBLY		As indicated in the message.

Figure 8. Autocoder-Run Halts

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A-REGISTER	REASON	PROCEDURE
8 2 1	Error in RDLIN card: Various size tape labels used, but no type A, B, or C label specified in col 80 of the RDLIN card.	Correct the RDLIN card, the last card in the stacker. Press NPRO to get the cards out of the feed. Replace the cards in the correct order in the read hopper. Press START, START RESET, and START to read the RDLIN card.
B A 8 2 1	RDLIN card missing for tape file.	Obtain the necessary RDLIN card. Press NPRO. Replace the cards in the hopper in order. Press START, START RESET, and START to read the RDLIN card.
B 8 2	Expiration date for this tape has not been reached.	Press START twice to check the retention period again. Press START, START RESET, and START to use the reel anyway, otherwise--change reels.
B 2 1	Parity error detected while writing tape header label.	Press START to write label again.
C B 8 2 1	Tape input header label does not check with the user's specifications.	Press START twice to check the header label again. Press START, START RESET, and START again to process the reel anyway.
C A 1	Parity error detected while reading tape trailer label.	Press START to read label again.
C A 4 2 1	End-of-reel condition but no alternate tape drive has been specified.	Mount next reel of data for this file. Press START.
C B A 8 4	Parity error detected while reading tape header label.	Press START to read header label again.
1	Disk-error condition not elsewhere defined in this list.	Press START twice to attempt the disk operation again.

Figure 9. Object-Program Halts (part 1 of 3)

A-REGISTER	REASON	PROCEDURE
2	Lower and upper disk-address limits of the output-file header label do not check.	Visually check the disk pack's label information. If necessary, mount another pack, then press START twice to check the header labels. If the new pack does not have the address range that corresponds to the address limits given in the output-pack RDLIN card, this halt will occur again. Select the desired output pack, determine the range of addresses to be used, prepare a corresponding RDLIN card, and restart the job from that point. To write on an output pack regardless of halt 2, press START, START RESET, and START; processing continues from here.
C 2 1	Disk-header label does not contain 1HDRb in the first five positions if disk light is off. If the disk light is on, an access-inoperable condition exists on a header-label read or write operation.	Press START, START RESET, and START to recheck, beginning with the first header label on the label track.
4	Parity, wrong-length-record, or unequal-address-compare error detected while reading or writing a disk header label.	Press START to recheck, beginning with the first header label.
C 4 1	No header label found corresponding to that specified for the input file.	Visually check the disk pack's external label information. Correct the condition and restart the job. Proceed in the same way as for A-register halts above except press START only once (do not press START RESET) to assure that the proper pack is on-line before processing proceeds.
C 4 2	RDLIN information card missing for a disk file.	Remove cards from the feed hopper and run the remaining cards out of the feed. Place the proper cards, including correct RDLIN card, in the card reader. Press START, START RESET, and START.
4 2 1	Card read error.	Remove the cards from the hopper and run out the cards in the feed. To restart, place the card in error (and subsequent cards) back in the hopper and press the start key.
8	Card punch error.	Press NPRO, remove the last three cards in the stacker and discard them. Press START to repunch the error card and continue.
C A 8 2 1	Parity error detected while writing tape trailer label.	Press START to write label again.
A 8 4	A total of thirty parity errors have been detected while attempting to write a block of data.	Press START to attempt thirty more tries .
C B A 8 2	100 consecutive tape errors have occured on one tape read operation.	Turn on to diagnostic switch.. Turn off the check stop switch. Press START to reread error block for scanning.

Figure 9. Object-Program Halts (part 2 of 3)

I-ADDRESS REGISTER	REASON	PROCEDURE
One position after IOCSCN (IOCSCN + 1)	Second halt during read-correction routine	Select Storage-Scan on Mode switch and scan card for parity-error character and correct if possible. Turn off the diagnostic switch. Turn on the check stop switch. Press CHECK RESET, START RESET, and START to process a corrected block. Press START to bypass an incorrect block and resume processing.

B-ADDRESS REGISTER	REASON	PROCEDURE
001	When processing disk-input files, either: 1. Control-data comparison between a master record and a processing-order record (POR) is not equal, or 2. The search through all the records of a chain has ended, but no record was found whose control data matches that of the POR.	Press START to continue processing, ignoring the record not found.
002	Disk-output-file upper limit has been reached.	Check output file to insure that all the records have been processed. If not, the output area must be made larger to accommodate the output file.
003	Regardless of the medium of the input file, this halt means that either: 1. An undefined input-record type has been detected, or 2. A numeric-sequence input record is out of sequence.	Press START to continue processing, ignoring the record that caused the halt.
004	This is the end-of-job halt for the report program.	
005	This halt permits both load-and-go operation and the use of disk drive 0 for disk input and/or disk output. This halt occurs after Autocoder has loaded the object program from the systems pack. This halt does not occur unless load-and-go operation and disk input and/or disk output have been specified.	Remove the systems pack from drive 0. If drive 0 is used by the object program, mount the appropriate disk pack and ready the drive. Press START to begin execution of the object program.
222	Seven unequal-address-compare conditions have been detected during a disk operation.	Press START twice to attempt the disk operation ten more times.
333	Seven parity errors have been detected during a disk operation.	Press START twice to attempt the disk operation ten more times.
444	Access-inoperable error.	Determine the drive number, by examing the core-storage-position contained in the A-address register. Alter in a different number, if required. Press START to retry with the same or altered drive number.
555	Seven wrong-length-record conditions have been detected during a disk operation.	Press START twice to attempt the disk operation ten more times.
666	This halt occurs for labeled-output disk files only. It means that the drive number specified in the object program and the drive number contained in the output header label do not agree.	If the wrong pack is mounted, mount the correct one. If the correct one is mounted but the wrong drive number is specified, alter in the correct number of the core address contained in the A-address register. Press START to recheck all header labels.
777	This halt occurs only for labeled-output disk files and when using a date card. It means that the area specified for disk output contains active records.	First determine if the wrong pack is on-line, or if the wrong output address limits are specified. If the wrong pack is on-line, correct that condition and press START twice to check all header labels. If the wrong output limits are specified, correct them by altering in the correct disk-limit addresses in the DTF area. (These are the FILESTART and FILEND DTF specifications. If the indexing and store address register special feature is specified for the object machine, the A-address register contains the high-order address of the DTF area. Otherwise, it contains the low-order address of the DTF area.) Press START twice to recheck the labels. To use the initial output pack without altering the output-limits specifications, press START, START RESET, and START. This procedure automatically deletes the data in the file-identification field of the header label.
888	This label-check halt means that the pack serial numbers of the labeled pack and the corresponding RDLIN information do not agree.	Press START twice to check the label again. Press START, START RESET, and START to proceed regardless of the halt.

Figure 9. Object-Program Halts (part 3 of 3)

AUTOCODER CONTROL CARDS

In addition to the RPG control cards, the user must also supply several Autocoder control cards. See Report Program Generator (on Disk) Specifications, IBM 1401, 1440, and 1460, Form C24-3261 for a discussion of the RPG control cards. The Autocoder control cards and their contents are listed here.

SYSTEM ASGN Card

This card is always required and follows the last card of the card-boot routine. The user punches the information:

Columns	Contents
6-11	SYSTEM
16-19	ASGN
21-31	1301 Unit 0
	or
	1311 Unit 0

Run Card (AUTOCODER RUN THRU OUTPUT)

If the user wants an object deck or a symbolic deck as output, he punches this card and places it in front of the RPG OPTN card. In it he punches:

Columns	Contents
6-14	AUTOCODER
16-18	RUN
21-24	THRU
26-31	OUTPUT

CORELOAD ASGN Card

This card is used for the load-and-go option, and it precedes the Run card (AUTOCODER RUN THRU EXECUTION). If the user has only one 1311 disk drive, the START and END address shown here must be used.

Columns	Contents
6-13	CORELOAD
16-19	ASGN
21-57	1311 UNIT 0, START 000000, END 000200

If the user has only one module of 1301 disk storage, he must use the START and END address shown here.

Columns	Contents
6-13	CORELOAD
16-19	ASGN
21-57	1301 UNIT 0, START 000000, END 000200
	or
	1301 UNIT 0, START 030000, END nnnnnn
	(up to 199999)

If the user has more than one 1311 disk drive or 1301 module, he may enter any unit number other than 0 and any START and END address.

Run Card (AUTOCODER RUN THRU EXECUTION)

If the load-and-go option was chosen, this card precedes the RPG OPTN card.

Columns	Contents
6-14	AUTOCODER
16-18	RUN
21-24	THRU
26-34	EXECUTION

RPG OPTN Card

This card must always be used and precedes the RPG control cards.

Columns	Contents
6-8	RPG
16-19	OPTN

RDLIN CARDS

RPG allows the user three label-checking options; the user can check the file-identification field, the entire label, or none of the label. Users of the load-and-go option, however, cannot check any portion of the label. Whenever an object program is to process a disk- or tape-input file or use a POR file for which label checking has been specified, a RDLIN card must provide label information.

Disk RDLIN Card (1311 only)

Whenever a disk-file label is to be checked or written by an RPG-generated program, the user must supply the label information. This is the information that will be compared against (on the input and/or the POR file) and written (on the output file). Furthermore, the initial disk-drive assignments made in the RPG control cards can be changed.

Example 1. If the user chooses to check the file-identification field of a labeled disk-input file (a 2-punch in column 40 of his MAS control card), he must prepare a RDLIN card with columns 11-20 and 30-39 punched.

Example 2. If he chooses to check the entire label (a 3-punch in column 40 of MAS control card), he must punch all columns, 11-66.

Example 3. If the user does not check the labels (a 1-punch in column 40 of MAS control card), no RDLIN card is required.

The format and contents of a disk RDLIN card are:

Columns	Contents
11	Control number of the drive with a pack containing addresses referenced to 0. See Note.
12	Same as column 11, except referenced to 2.
13	Same as column 11, except referenced to 4.
14	Same as column 11, except referenced to 6.
15	Same as column 11, except referenced to 8.
16-20	RDLIN
21-24	File-retention period (days).
25-29	File creation date (of the form 62032 for Feb. 1, 1962).
30-39	File identification.
40-44	File serial number.
45-49	Pack serial number.
50	Blank.
51-54	File-sequence number.
55-60	Lower-limit disk address
61-66	Upper-limit disk address.
67-80	Blank.

NOTE: The user's disk-drive assignments must always be punched in the appropriate columns. The user's application determines how many drive-control numbers to punch in columns 11-15.

Example. If the user's addresses are referenced to 2, 4, and 8, and if he is using drives 0, 2, and 4; he leaves columns 11 and 14 blank and punches 0 in column 12, 2 in 13 and 4 in 15.

Example. The term, addresses referenced to 0, describes sector addresses 000000-019999.

In the case of checking the label of a disk-input file that will be processed in the control-sequential mode (POR card column 16 contains a 2-punch), two input-file RDLIN cards are required: one for the main-file area and another for the additions area. If there is not an additions area, a duplicate of the card used for the main-file area must be used.

When a disk-input file consists of both master and trailer records, two RDLIN cards are required: one for the master-record area and one for the trailer-record area.

Tape RDLIN Card

When writing the header for a tape-output file, the RDLIN cards must contain all header information (except LABEL IDENTIFIER and TAPE SERIAL NUMBER), not just the fields that are changed. These cards are punched in Autocoder format, with RDLIN in the operation field and the header information in the operand field in the same sequence as the header label.

The header information must correspond to the fields of the particular standard header label that is used for the file. The format of the RDLIN card associated with each of the three types of standard header labels is given in the following lists.

RDLIN card for 120-character standard header label, when fields 9-19 are not processed:

Columns	Header Information	Header-Label Field Number
16-20	RDLIN	
21-24	Retention Period	2
25-29	Creation Date	3
30-39	File Identification	4
40-44	File Serial Number	5
45-48	Reel Sequence Number	7
80	A, if all tape labels used are not 120-character standard labels. Otherwise, leave blank.	

RDLIN card for 120-character standard header label, when fields 9-19 are processed:

Columns	Header Information	Header-Label Field Number
16-20	RDLIN	
21-24	Retention Period	2
25-29	Creation Date	3
30-39	File Identification	4
40-44	File Serial Number	5
45-48	Reel Sequence Number	7
49-52	blank	8
53	Density	9
54	Checksum	10
55	Block Sequence	11
56	Tape Checking/Interpreting	12
57	Tape Data Recording Technique	13
58	Tape Data Processing Technique	14
59-62	Creating System	15
63	Record Format	16
64-68	Record Length	17
69-73	Blocking Factor/Size	18
74	Checkpoint	19
75	I, to indicate the presence of fields 9-19	
80	A, if all tape labels used are not 120-character standard labels. Otherwise, leave blank.	

RDLIN card for 80-character standard header label:

Columns	Header Information	Header-Label Field Number
16-20	RDLIN	
21-25	File Serial Number	3
26	-(minus sign)	4
27-29	Reel Sequence Number	4
30	blank	4
31-40	File Identification	5
41-45	Creation Date	6
46	-(minus sign)	7
47-49	Retention Period	7

Columns	Header Information	Header-Label Field Number
50	blank	7
80	B, if all tape labels used are not 80-character standard labels. Otherwise, leave blank.	

RDLIN card for 84-character standard header label:

Columns	Header Information	Header-Label Field Number
16-20	RDLIN	
21	blank	3
22-26	File-Serial Number	3
27	blank	4
28-31	Reel Sequence Number	4
32	blank	4
33-34	Creation Date: Year	5
35	blank	5
36-38	Creation Date: Day	5
39-41	blank	6
42-44	Retention Period	6
45-50	Label Information: blank Density Character Coding Checksum Block Sequence Checkpoint Record	7
51-68	File Identification	8
80	C, if all tape labels do not contain 80-character standard labels. Otherwise, leave blank.	

Example 1. If the user desires to check just the file-identification field (a 2-punch in column 18 of TAPIN card), his RDLIN card only needs to have columns 16-20 and the file-identification field punched.

Example 2. If the entire label is to be checked (a 3-punch in column 18 of TAPIN card), all columns need to be punched as just directed.

Example 3. If none of the label is to be checked (a 1-punch in column 18 of TAPIN card), no RDLIN card is needed.

IBM 1401 RPG TRANSLATOR

Description

This is an IBM 1401 program that translates a report program that was written for the IBM 1401 Report Program Generator to a corresponding report program acceptable to the IBM 1401 and 1460 Report Program Generator (on Disk). The report

programs that can be translated are those that process card input files and fixed-length-record magnetic-tape input files. The Translator requires one control card. In it the user must specify whether he wants a translation listing.

The RPG Translator operates upon the user's existing 1401 RPG source-program deck. (This deck consists of the cards he punched from the 1401 RPG Input, Data, Calculation, and Format specifications sheets.) As the Translator reads each specification card, it translates that 1401 RPG specification into the language and the form of the corresponding IBM 1401 and 1460 Report Program Generator (on Disk) specification, and punches the translated specification in an output card. If the user chose the print option, the Translator program prints on the printer both the source specification and the translated specification.

Machine Requirements

The IBM 1401 RPG Translator program requires an IBM 1401 Data Processing System equipped with at least 4,000 positions of core storage and one IBM 1402 Card Read-Punch. The user's option to print a translation listing requires an IBM 1403 Printer, Model 1, or an IBM 1404 Printer.

Program Deck Description

The Translator program is supplied in punched cards. This card deck consists of 80 cards. Each card is identified by RPGTR punched in columns 76-80. The format is the same condensed, machine-language card format as that of IBM 1401 Autocoder. That is, columns 1-71 contain program instructions and the necessary loading instructions; columns 72-75 contain the card-sequence number; and columns 76-80 contain the program identification RPGTR.

Use the Translator program deck as a unit — no card insertion within the Translator program deck is necessary.

Print Control Card

As previously mentioned, the user must specify to the Translator whether he wants a translation listing. He does this by using this card. In it, he punches either:

> *PRINT   in columns 1-6, or
> *NO PRINT in columns 1-9.

Then he places this card immediately in front of his 1401 RPG specifications cards.

Input Deck for Translator Run

The following list gives the input-deck components and their required order.
1. IBM 1401 RPG Translator Deck
2. Translator PRINT Control Card
3. User's Source Program Deck

The user's source-program deck consists of 1401 RPG specifications cards. If the specifications cards of the source deck contain page and card numbers in columns 76-80, as recommended in the 1401 RPG specifications publication, these cards can be arranged in sequence by page and card number. Here is the order of the sections of the user's source-program deck:

    a. input specifications cards
    b. data specifications cards
    c. calculation specifications cards
    d. format specifications cards

Operating Instructions for Translator Run

System Preparation

1. If a translation listing is specified, insert forms in the printer, insert a carriage tape appropriately punched in channels 1 and 12 for the listing, and ready the printer.
2. Place blank cards in the 1402 punch feed and ready that unit.
3. Set these console switches on; SENSE SWITCH A, CHECK STOP, and I/O CHECK STOP. Set DISK WRITE off.
4. Place in the 1402 read feed the input deck. The composition of this deck is given under Input Deck for Translator Run.
5. To start the translator run, press the 1402 load key.

Translator Output

Punched Cards

The IBM 1401 RPG Translator program punches one output card for every 1401 RPG specification input card, except for two kinds of cards. These two cards are a 1401 RPG data specification card with more than one field source specified (columns 37-70), and a 1401 RPG calculation specification card with either or both half adjust and position adjust specified (columns 50-53). These two kinds of cards are each translated properly. They each yield more than one output card.

    NOTE: Although the Translator does generate certain labels that consist of a mixture of alphabetic and numeric characters (such as CALC01), the generated specifications operate correctly.

The cards punched by the Translator program are selected into stacker pocket 4 of the 1402, except for one condition. This condition is that if a 1401 RPG calculation specification card (in the source program being translated) contains a position-adjust entry greater than 05 (columns 52-53), extra word-entry format specification cards are punched. These extra word-entry cards fall in the NP pocket of the 1402. Insert the cards from the NP pocket in front of the asterisk card that follows the format-specifications section of the output deck (the cards from pocket 4).

    The punched output deck is a source program acceptable as input to the IBM 1401 and 1460 Report Program Generator (on Disk). Included in the output deck in their proper places are the five asterisk cards.

    The cards of the input deck are selected into pocket 1 of the IBM 1402.

Translation Listing

If the user specified a translation listing, the 1401 RPG Translator program prints it. The first line consists of the title RPG TRANSLATION 1401 TO 1401/1440 PAGE 001. The body of the listing usually consists of two lines for each report specification. The first line is the 1401 RPG specification (in the language and the form of the 1401 RPG). The second line is the translated specification (in the language and the form of the IBM 1401 and 1460 Report Program Generator (on Disk). The second line is offset to the right 20 print positions with respect to the first line.

Halts and Messages

The 1401 RPG Translator includes one programmed halt. It is the end-of-job halt. When it occurs, the I-address register contains 2695.

    If a translation listing is specified, and if the 1401 RPG specifications cards of the input deck are out of order, RPG Translator prints the following error message:

        ERROR—SPECIFICATIONS OUT OF ORDER.

The required action is to correct the input-deck card order and start the translator run again.

RPG EXAMPLE

Problem in Brief

A wholesale grocery chain maintains its current-accounts report on disk in random sequence. Mr. A wishes to prepare a report of the status of all

accounts. The report is to be both written on tape and printed. See Figure 10 for the RPG specifications and control cards necessary to produce these reports.

Description of the Disk Records

Each customer's account is represented by a master and up to four trailer records.

Master Records

The masters are unblocked and are one hundred characters in length. Each contains constant information about the customer, such as his name, address, sales area, and account number. The account number is used as the control data for the record.

Each delinquent account is identified by a T in position 6 of the record. All other accounts are identified by an S in this sixth position. See the input specifications in Figure 10.

If trailers are associated with a master, the address of the first trailer was prefixed to the master record by the IBM 1401 and 1460 Random Disk File Organization Routine.

The MAS control card contains the information relating to the master record.

Trailer Records

Weekly transactions between the customer and the grocery chain are recorded as trailer records on

```
                              1401/60  RPG   EDIT LISTING

        CD  PAGE
  SEQ   NO  LINE   CARD IMAGE                                                      DIAGNOSTIC

                     *

    1   1010  DAA   006 CS                              01
    2   1020  DBB   006 CT                              02

                     *

    3   2010  DCLIENT010             DAA  040        DBB  040
    4   2020  DDELINQ006             DBB  140
    5   2030  DAREA  010             DAA  050        DBB  050

                     *

    6   3010  ADND    01000                  CONTD ?        C
    7   3020  AQUOT   00700          DND   /  5000?         CREMAIN04
    8   3030  ACONV1  00600          20000&REMAIN?          C

                     *

    9   4010  LHAAX      01      1P
   10   4020  L                  OF
   11   4030  K                              080           @CURRENT ACCOUNTS REPORT@
   12   4040  LDAAX  T           01
   13   4050  L                  02
   14   4060  F                          CLIENT050
   15   4070  F                          DELINQ075 02
   16   4080  F                          AREA   030
   17   4090  K                              075 01        @OK@

                     *

          RPG CONTROL CARD    COL.    INFORMATION            PUNCHED

                             1-3    CTL. CARD IDENT.        RPG
                             4      MACH. SIZE GEN. PROG.   2
                             5      MACH. SIZE OBJ. PROG.   2
                             6      SENSE SWITCHES          -NO-
                             7      MULTIPLY-DIVIDE         -NO-
                             8      ADVANCED PROGRAMMING    -YES-
                             9      MODIFY ADD FEATURE      -YES-
                             10     DIRECT SEEK             -NO-
                             11     CONDENSED DECK          -YES-
                             14-17  INPUT MEDIA             DISK
                             18     PRINTER OUTPUT          132
                             19     PUNCH OUTPUT            -NO-
                             20     DISK OUTPUT             -NO-
                             76-80  IDENTIFICATION
```

Figure 10. Sample RPG Program (part 1 of 2)

```
TAPOUT CONTROL CARD COL. INFORMATION              PUNCHED

                     1-6    CTL. CARD IDENT.       TAPOUT
                     7      TAPE UNIT NUMBER        1
                     8-11   BLOCK LENGTH            0400
                     12-14  RECORD LENGTH           100
                     15-16  BLOCKING FACTOR         04
                     17     PADDING CHARACTER       -BLANK-
                     18     LABEL OPTION            -NONE--


         MAS CONTROL CARD    COL.    INFORMATION           PUNCHED

                     1-3    CTL. CARD IDENT.       MAS
                     4      CYLINDER OVERFLOW       -NO-
                     5-8    BLOCK LENGTH            0100
                     9-11   RECORD LENGTH           100
                     12-13  BLOCKING FACTOR         01
                     14     DIRECT ADDRESSING FILE  -YES-
                     30-31  CTL UNIT NO & ADDRESS   02
                     40     LABEL OPTION            -NONE-


         TRL CONTROL CARD    COL.    INFORMATION           PUNCHED

                     1-3    CTL. CARD IDENT.       TRL
                     4      CYLINDER OVERFLOW       -NO-
                     5-8    BLOCK LENGTH            0100
                     9-11   RECORD LENGTH           050
                     12     BLOCKING FACTOR         1
                     13-14  MAXINUM # TRAILERS      04
                     15-17  LOC HIGH ORDER CTL FLD  020
                     18-19  LEN HIGH ORDER CTL FLD  10
                     30-31  CTL UNIT NO & ADDRESS   02
                     40     LABEL OPTION            -NONE-


         POR CONTROL CARD    COL.    INFORMATION           PUNCHED

                     1-3    CTL. CARD IDENT.       POR
                     4      P. O. R. RECORD MEDIA   CARD
                     16     TYPE OF PROCESSING      -RANDOM-
                     17     POR FIELD C.D. OR D.A.  -C.D.-
                     18-19  LENGTH OF CONTROL DATA  10
                     20     CONVERSION NEEDED       -YES-
                     21     LENGTH OF DISK ADDRESS  6
                     22-24  LOC. 1ST POR FIELD      010
                     25-26  DISTANCE BETWEEN FIELD  12
                     27-28  MAX. NUM. FIELDS / RCD  03
                     29-34  NEXT RECORD FIELD       -NO-
```

Sample of POR File Card

```
         1               13              25            34
         0006252556      0090064325      0124006421
```

Figure 10. Sample RPG Program (part 2 of 2)

the disk. Each trailer is 50 characters long and is blocked by a factor of 2. When the pack was organized using the file-organization routine, the address of the next trailer (if any) was prefixed to the trailer. Information concerning the trailer records is given to the program through the TRL control card.

POR File

Because the data file to be processed is on the disk pack in random order, Mr. A must provide the program with a processing-order-records file (POR file) to organize the sequence of processing. His POR file is on cards in the spread format with three control data fields per card. Information concerning this file is punched in the POR control card. A card from the POR file for this program is shown in Figure 10.

Conversion Routine

The POR file contains control data; Mr. A must supply a conversion routine to calculate the disk address of the record to be processed. This routine is shown in Figure 10 in the calculation specifications.

Mr. A's customer files are on the disk from addresses 020,000 to 024,999 giving him a range of 5000. The control data, the account number, is divided by 5000. The remainder is added to 20,000 to obtain the address of the next record to be processed.

Output

Mr. A wishes his tape records to be blocked by four. He does not desire any label checking. The specifications for the tape are punched in the TAPOUT control card.

Running the RPG Program

To run this program, Mr. A needs the card-boot and the Autocoder control cards in addition to the items already specified. No RDLIN cards are needed.

Report Program Generator (on Disk) Operating Procedures
IBM 1401 and 1460,   C24-3334-0

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