Control Breaks

This chapter describes how the execution of a statement can be made dependent on a control break, and how control breaks can be used for the evaluation of Natural system functions.

The following topics are covered:

Use of Control Breaks

A control break occurs when the value of a control field changes.

The execution of statements can be made dependent on a control break.

A control break can also be used for the evaluation of Natural system functions.

System functions are discussed in *System Variables and System Functions*. For detailed descriptions of the system functions available, refer to the *System Functions* documentation.

AT BREAK Statement

With the statement `AT BREAK`, you specify the processing which is to be performed whenever a control break occurs, that is, whenever the value of a control field which you specify with the `AT BREAK` statement changes. As a control field, you can use a database field or a user-defined variable.

The following topics are covered below:

Control Break Based on a Database Field

The field specified as control field in an `AT BREAK` statement is usually a database field.

Example:

```
...
AT BREAK OF DEPT
  statements
END-BREAK
...
```

In this example, the control field is the database field `DEPT`; if the value of the field changes, for example, `FROM` `SALE01` to `SALE02`, the *statements* specified in the `AT BREAK` statement would be executed.

Instead of an entire field, you can also use only part of a field as a control field. With the slash-*n*-slash notation `/n/`, you can determine that only the first *n* positions of a field are to be checked for a change in value.

Example:

```
...
AT BREAK OF DEPT /4/
  statements
END-BREAK
...
```

In this example, the specified *statements* would only be executed if the value of the first 4 positions of the field `DEPT` changes, for example, FROM `SALE` to `TECH`; if, however, the field value changes from `SALE01` to `SALE02`, this would be ignored and no `AT BREAK` processing performed.

Example:

```
** Example 'ATBREX01': AT BREAK OF (with database field)
************************************************************************
DEFINE DATA LOCAL
1 MYVIEW VIEW OF EMPLOYEES
  2 NAME
  2 CITY
  2 COUNTRY
  2 JOB-TITLE
  2 SALARY (1:1)
END-DEFINE
*
READ (5) MYVIEW BY CITY WHERE COUNTRY = 'USA'
  DISPLAY CITY (AL=9) NAME 'POSITION' JOB-TITLE 'SALARY' SALARY(1)
  /*
  AT BREAK OF CITY
    WRITE /   OLD(CITY) (EM=X^X^X^X^X^X^X^X^X^X^X^)
          5X 'AVERAGE:' T*SALARY AVER(SALARY(1)) //
              COUNT(SALARY(1)) 'RECORDS FOUND' /
  END-BREAK
  /*
  AT END OF DATA
    WRITE 'TOTAL (ALL RECORDS):' T*SALARY(1) TOTAL(SALARY(1))
  END-ENDDATA
END-READ
END
```

In the above program, the first `WRITE` statement is executed whenever the value of the field `CITY` changes.

In the `AT BREAK` statement, the Natural system functions `OLD`, `AVER` and `COUNT` are evaluated (and output in the `WRITE` statement).

In the `AT END OF DATA` statement, the Natural system function `TOTAL` is evaluated.

Output of Program ATBREX01:

```
Page      1                                                04-12-14  14:07:26

  CITY            NAME                 POSITION            SALARY
--------- -------------------- ------------------------- ----------

AIKEN     SENKO                PROGRAMMER                     31500

A I K E N                  AVERAGE:                           31500

       1 RECORDS FOUND

ALBUQUERQ HAMMOND              SECRETARY                      22000
ALBUQUERQ ROLLING              MANAGER                        34000
ALBUQUERQ FREEMAN              MANAGER                        34000
ALBUQUERQ LINCOLN              ANALYST                        41000

A L B U Q U E R Q U E      AVERAGE:                           32750

       4 RECORDS FOUND

TOTAL (ALL RECORDS):                                         162500
```

Control Break Based on a User-Defined Variable

A user-defined variable can also be used as control field in an `AT BREAK` statement.

In the following program, the user-defined variable `#LOCATION` is used as control field.

```
** Example 'ATBREX02': AT BREAK OF  (with user-defined variable and
**                     in conjunction with BEFORE BREAK PROCESSING)
************************************************************************
DEFINE DATA LOCAL
1 MYVIEW VIEW OF EMPLOYEES
  2 CITY
  2 COUNTRY
  2 JOB-TITLE
  2 SALARY (1:1)
*
1 #LOCATION (A20)
END-DEFINE
*
READ (5) MYVIEW BY CITY WHERE COUNTRY = 'USA'
  BEFORE BREAK PROCESSING
    COMPRESS CITY 'USA' INTO #LOCATION
  END-BEFORE
  DISPLAY #LOCATION 'POSITION' JOB-TITLE 'SALARY' SALARY (1)
  /*
  AT BREAK OF #LOCATION
```

```
    SKIP 1
  END-BREAK
END-READ
END
```

Output of Program ATBREX02:

```
Page      1                                            04-12-14  14:08:36

     #LOCATION               POSITION            SALARY
-------------------- ------------------------- ----------

AIKEN USA            PROGRAMMER                     31500

ALBUQUERQUE USA      SECRETARY                      22000
ALBUQUERQUE USA      MANAGER                        34000
ALBUQUERQUE USA      MANAGER                        34000
ALBUQUERQUE USA      ANALYST                        41000
```

Multiple Control Break Levels

As explained above, the notation `/n/` allows some portion of a field to be checked for a control break. It is possible to combine several `AT BREAK` statements, using an entire field as control field for one break and part of the same field as control field for another break.

In such a case, the break at the lower level (entire field) must be specified before the break at the higher level (part of field); that is, in the first `AT BREAK` statement the entire field must be specified as control field, and in the second one part of the field.

The following example program illustrates this, using the field `DEPT` as well as the first 4 positions of that field (`DEPT /4/`).

```
** Example 'ATBREX03': AT BREAK OF (two statements in combination)
************************************************************************
DEFINE DATA LOCAL
1 MYVIEW VIEW OF EMPLOYEES
  2 NAME
  2 JOB-TITLE
  2 DEPT
  2 SALARY    (1:1)
  2 CURR-CODE (1:1)
END-DEFINE
*
READ MYVIEW BY DEPT STARTING FROM 'SALE40' ENDING AT 'TECH10'
     WHERE SALARY(1) GT 47000 AND CURR-CODE(1) = 'USD'
  /*
  AT BREAK OF DEPT
    WRITE '*** LOWEST BREAK LEVEL ***' /
  END-BREAK
  AT BREAK OF DEPT /4/
    WRITE '*** HIGHEST BREAK LEVEL ***'
  END-BREAK
  /*
  DISPLAY DEPT NAME 'POSITION' JOB-TITLE
END-READ
END
```

Output of Program ATBREX03:

```
Page      1                                                  04-12-14  14:09:20

DEPARTMENT         NAME                    POSITION
   CODE
---------- -------------------- -------------------------

TECH05     HERZOG               MANAGER
TECH05     LAWLER               MANAGER
TECH05     MEYER                MANAGER
*** LOWEST BREAK LEVEL ***

TECH10     DEKKER               DBA
*** LOWEST BREAK LEVEL ***

*** HIGHEST BREAK LEVEL ***
```

In the following program, one blank line is output whenever the value of the field `DEPT` changes; and whenever the value in the first 4 positions of `DEPT` changes, a record count is carried out by evaluating the system function `COUNT`.

```
** Example ’ATBREX04’: AT BREAK OF (two statements in combination)
************************************************************************
DEFINE DATA LOCAL
1 MYVIEW VIEW OF EMPLOYEES
  2 DEPT
  2 REDEFINE DEPT
    3 #GENDEP (A4)
  2 NAME
  2 SALARY    (1)
END-DEFINE
*
WRITE TITLE ’** PERSONS WITH SALARY > 30000, SORTED BY DEPARTMENT **’ /
LIMIT 9
READ MYVIEW BY DEPT FROM ’A’ WHERE SALARY(1) > 30000
  DISPLAY ’DEPT’ DEPT NAME ’SALARY’ SALARY(1)
  /*
  AT BREAK OF DEPT
    SKIP 1
  END-BREAK
  AT BREAK OF DEPT /4/
    WRITE COUNT(SALARY(1)) ’RECORDS FOUND IN:’ OLD(#GENDEP) /
  END-BREAK
END-READ
END
```

Output of Program ATBREX04:

```
            ** PERSONS WITH SALARY > 30000, SORTED BY DEPARTMENT **

 DEPT          NAME           SALARY
------ -------------------- ----------

ADMA01 JENSEN                   180000
ADMA01 PETERSEN                 105000
ADMA01 MORTENSEN                320000
ADMA01 MADSEN                   149000
ADMA01 BUHL                     642000

ADMA02 HERMANSEN                391500
```

```
ADMA02 PLOUG                    162900
ADMA02 HANSEN                   234000

       8 RECORDS FOUND IN: ADMA

COMP01 HEURTEBISE               168800

       1 RECORDS FOUND IN: COMP
```

Automatic Break Processing

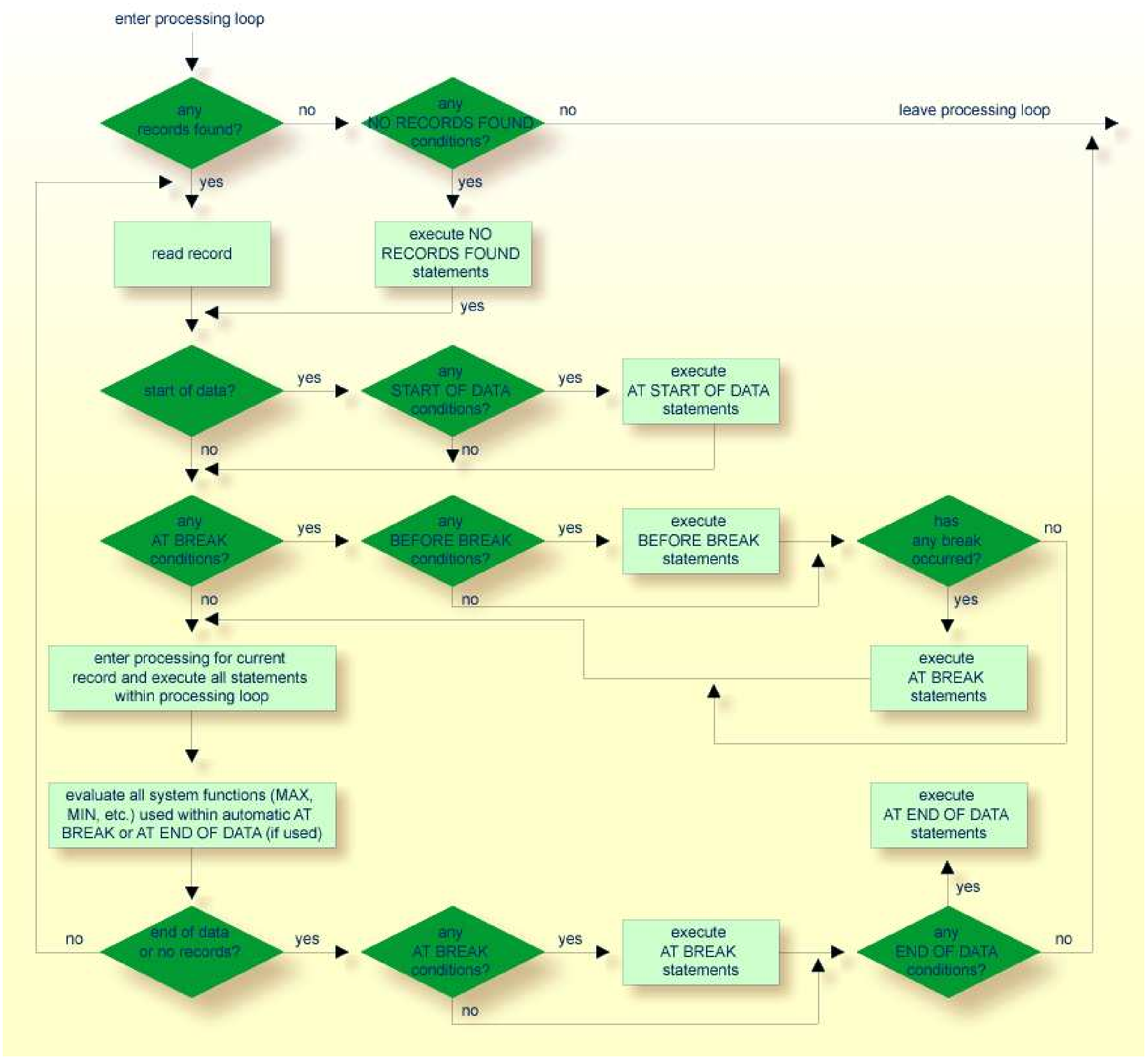
Automatic break processing is in effect for a processing loop which contains an `AT BREAK` statement. This applies to the following statements:

- `FIND`
- `READ`
- `HISTOGRAM`
- `SORT`
- `READ WORK FILE`

The value of the control field specified with the `AT BREAK` statement is checked only for records which satisfy the selection criteria of both the `WITH` clause and the `WHERE` clause.

Natural system functions (`AVER`, `MAX`, `MIN`, etc.) are evaluated for each record after all statements within the processing loop have been executed. System functions are not evaluated for any record which is rejected by `WHERE` criteria.

The figure below illustrates the flow logic of automatic break processing.


enter processing loop
any records found?
no
any NO RECORDS FOUND conditions?
no
leave processing loop
yes
yes
read record
execute NO RECORDS FOUND statements
yes
start of data?
yes
any START OF DATA conditions?
yes
execute AT START OF DATA statements
no
no
any AT BREAK conditions?
yes
any BEFORE BREAK conditions?
yes
execute BEFORE BREAK statements
has any break occurred?
no
no
no
yes
enter processing for current record and execute all statements within processing loop
execute AT BREAK statements
evaluate all system functions (MAX, MIN, etc.) used within automatic AT BREAK or AT END OF DATA (if used)
execute AT END OF DATA statements
yes
no
end of data or no records?
yes
any AT BREAK conditions?
yes
execute AT BREAK statements
any END OF DATA conditions?
no
no

Example of System Functions with AT BREAK Statement

The following example shows the use of the Natural system functions `OLD`, `MIN`, `AVER`, `MAX`, `SUM` and `COUNT` in an `AT BREAK` statement (and of the system function `TOTAL` in an `AT END OF DATA` statement).

```
** Example 'ATBREX05': AT BREAK OF (with system functions)
************************************************************************
DEFINE DATA LOCAL
1 MYVIEW VIEW OF EMPLOYEES
  2 NAME
  2 CITY
  2 SALARY    (1:1)
  2 CURR-CODE (1:1)
END-DEFINE
*
LIMIT 3
READ MYVIEW BY CITY = 'SALT LAKE CITY'
  DISPLAY NOTITLE CITY NAME 'SALARY' SALARY(1) 'CURRENCY' CURR-CODE(1)
  /*
  AT BREAK OF CITY
    WRITE /  OLD(CITY) (EM=X^X^X^X^X^X^X^X^X^X^X^X^X^X^X)
      31T ' - MINIMUM:' MIN(SALARY(1))  CURR-CODE(1) /
      31T ' - AVERAGE:' AVER(SALARY(1)) CURR-CODE(1) /
      31T ' - MAXIMUM:' MAX(SALARY(1))  CURR-CODE(1) /
      31T ' -     SUM:' SUM(SALARY(1))  CURR-CODE(1) /
      33T COUNT(SALARY(1)) 'RECORDS FOUND' /
  END-BREAK
  /*
  AT END OF DATA
    WRITE 22T 'TOTAL (ALL RECORDS):'
               T*SALARY TOTAL(SALARY(1)) CURR-CODE(1)
  END-ENDDATA
END-READ
END
```

Output of Program ATBREX05:

```
        CITY                 NAME           SALARY   CURRENCY
-------------------- -------------------- ---------- --------

SALT LAKE CITY       ANDERSON                  50000 USD
SALT LAKE CITY       SAMUELSON                 24000 USD

S A L T   L A K E   C I T Y    - MINIMUM:      24000 USD
                               - AVERAGE:      37000 USD
                               - MAXIMUM:      50000 USD
                               -     SUM:      74000 USD
                                       2 RECORDS FOUND

SAN DIEGO            GEE                       60000 USD

S A N   D I E G O              - MINIMUM:      60000 USD
                               - AVERAGE:      60000 USD
                               - MAXIMUM:      60000 USD
                               -     SUM:      60000 USD
                                       1 RECORDS FOUND

                     TOTAL (ALL RECORDS):     134000 USD
```

Further Example of AT BREAK Statement

See the following example program:

- *ATBREX06 - AT BREAK OF (comparing NMIN, NAVER, NCOUNT with MIN, AVER, COUNT)*

BEFORE BREAK PROCESSING Statement

With the `BEFORE BREAK PROCESSING` statement, you can specify statements that are to be executed immediately before a control break; that is, before the value of the control field is checked, before the statements specified in the `AT BREAK` block are executed, and before any Natural system functions are evaluated.

Example of BEFORE BREAK PROCESSING Statement

```
** Example 'BEFORX01': BEFORE BREAK PROCESSING
************************************************************************
DEFINE DATA LOCAL
1 MYVIEW VIEW OF EMPLOYEES
  2 NAME
  2 FIRST-NAME
  2 SALARY (1:1)
  2 BONUS  (1:1,1:1)
*
1 #INCOME  (P11)
END-DEFINE
*
LIMIT 5
READ MYVIEW BY NAME FROM 'B'
 BEFORE BREAK PROCESSING
    COMPUTE #INCOME = SALARY(1) + BONUS(1,1)
  END-BEFORE
  /*
  DISPLAY NOTITLE NAME FIRST-NAME (AL=10)
                 'ANNUAL/INCOME' #INCOME 'SALARY' SALARY(1) (LC==) /
                 '+ BONUS' BONUS(1,1) (IC=+)
  AT BREAK OF #INCOME
    WRITE T*#INCOME '-'(24)
  END-BREAK
END-READ
END
```

Output of Program BEFORX01:

```
        NAME         FIRST-NAME    ANNUAL      SALARY
                                   INCOME      + BONUS
-------------------- ---------- ------------ -----------

BACHMANN             HANS              56800 =     52800
                                                   +4000
                                ------------------------
BAECKER              JOHANNES          81000 =     74400
                                                   +6600
                                ------------------------
BAECKER              KARL              52650 =     48600
                                                   +4050
                                ------------------------
BAGAZJA              MARJAN           152700 =    129700
                                                  +23000
                                ------------------------
BAILLET              PATRICK          198500 =    188000
                                                  +10500
                                ------------------------
```

User-Initiated Break Processing - PERFORM BREAK PROCESSING Statement

With automatic break processing, the statements specified in an AT BREAK block are executed whenever the value of the specified control field changes - regardless of the position of the AT BREAK statement in the processing loop.

With a `PERFORM BREAK PROCESSING` statement, you can perform break processing at a specified position in a processing loop: the `PERFORM BREAK PROCESSING` statement is executed when it is encountered in the processing flow of the program.

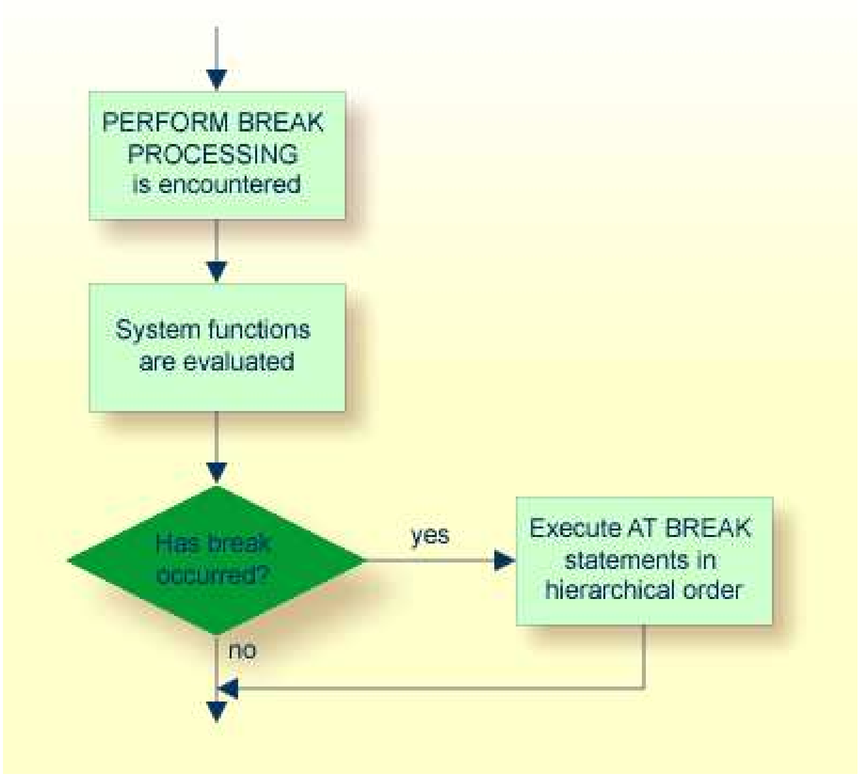
Immediately after the `PERFORM BREAK PROCESSING`, you specify one or more `AT BREAK` statement blocks:

```
...
PERFORM BREAK PROCESSING
  AT BREAK OF field1
    statements
  END-BREAK
  AT BREAK OF field2
    statements
  END-BREAK
...
```

When a `PERFORM BREAK PROCESSING` is executed, Natural checks if a break has occurred; that is, if the value of the specified control field has changed; and if it has, the specified statements are executed.

With `PERFORM BREAK PROCESSING`, system functions are evaluated *before* Natural checks if a break has occurred.

The following figure illustrates the flow logic of user-initiated break processing:


PERFORM BREAK PROCESSING is encountered
System functions are evaluated
Has break occurred?
yes
Execute AT BREAK statements in hierarchical order
no

Example of PERFORM BREAK PROCESSING Statement

```
** Example 'PERFBX01': PERFORM BREAK PROCESSING (with BREAK option
**                     in IF statement)
************************************************************************
DEFINE DATA LOCAL
1 MYVIEW VIEW OF EMPLOYEES
  2 NAME
  2 DEPT
  2 SALARY (1:1)
*
1 #CNTL    (N2)
END-DEFINE
*
LIMIT 7
READ MYVIEW BY DEPT
  AT BREAK OF DEPT              /* <- automatic break processing
    SKIP 1
    WRITE 'SUMMARY FOR ALL SALARIES         '
          'SUM:'   SUM(SALARY(1))
          'TOTAL:' TOTAL(SALARY(1))
    ADD 1 TO #CNTL
  END-BREAK
  /*
  IF SALARY (1) GREATER THAN 100000 OR BREAK #CNTL
    PERFORM BREAK PROCESSING    /* <- user-initiated break processing
    AT BREAK OF #CNTL
      WRITE 'SUMMARY FOR SALARY GREATER 100000'
            'SUM:'   SUM(SALARY(1))
            'TOTAL:' TOTAL(SALARY(1))
    END-BREAK
  END-IF
  /*
  IF SALARY (1) GREATER THAN 150000 OR BREAK #CNTL
    PERFORM BREAK PROCESSING    /* <- user-initiated break processing
    AT BREAK OF #CNTL
      WRITE 'SUMMARY FOR SALARY GREATER 150000'
            'SUM:'   SUM(SALARY(1))
            'TOTAL:' TOTAL(SALARY(1))
    END-BREAK
  END-IF
  DISPLAY NAME DEPT SALARY(1)
END-READ
END
```

Output of Program PERFBX01:

```
Page      1                                             04-12-14  14:13:35

        NAME         DEPARTMENT   ANNUAL
                        CODE      SALARY
-------------------- ---------- ----------

JENSEN               ADMA01         180000
PETERSEN             ADMA01         105000
MORTENSEN            ADMA01         320000
MADSEN               ADMA01         149000
BUHL                 ADMA01         642000

SUMMARY FOR ALL SALARIES          SUM:    1396000 TOTAL:    1396000
SUMMARY FOR SALARY GREATER 100000 SUM:    1396000 TOTAL:    1396000
SUMMARY FOR SALARY GREATER 150000 SUM:    1142000 TOTAL:    1142000
HERMANSEN           ADMA02          391500
PLOUG               ADMA02          162900

SUMMARY FOR ALL SALARIES          SUM:     554400 TOTAL:    1950400
SUMMARY FOR SALARY GREATER 100000 SUM:     554400 TOTAL:    1950400
SUMMARY FOR SALARY GREATER 150000 SUM:     554400 TOTAL:    1696400
```