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THE NIPR OPTICAL MARK READER SYSTEM

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## I. GENERAL GUIDE TO USERS

### 1. Introduction

An optical reader is being used by the NIPR to load data directly to the computer from original test or questionnaire forms for subsequent analysis. The purpose of this manual is to provide a comprehensive guide to the use of the optical reader programs written in the Computer Division.

The method used to provide the programs with information about the data, i.e. by means of "specification sheets", and the general range of facilities provided, were decided upon in consultation with the Psychometrics Division. The programs are thus specifically designed to meet current and projected test scoring needs at the NIPR.

The general plan of the manual is as follows. Section I contains some background information about the machine itself and the programming environment, as well as a description of the standard NIPR format for optical reader sheets. Section II describes the main loading program, NDC29, and forms the bulk of the manual. Section III describes an alternate loading system that may be useful in certain circumstances, but is not usually used.

### 2. The 1231-N1 optical reader

This device can read marks made by an ordinary lead pencil on paper documents. It can only detect the presence or absence of a mark in a particular position and so cannot read alphabetic or numeric characters as such.

The data sheets contain 1,000 mark positions arranged in fifty rows, each containing twenty positions. The maximum reading rate is 2,000 sheets per hour. Reading is done under control of a computer program, and if a document is found to be unacceptable by the program it can be selected to a special stacker.

Operator controls on the unit make provision for checking specified fields on the page for multiple or missing marks. However, since these facilities are not completely flexible and entail extra work for the operator in setting up the optical reader, these controls are always set to OFF and checking is done by the program.

Certain error conditions are detected by the unit and indicated by flags set in channel status bytes and the device sense byte. These fields may be printed by the program, and their meaning may be found from Table 1 and Table 2 in Section IV. Further details are given in section 13, "Error handling". For full details of the operation of the optical reader consult the IBM reference manual form A21-9031, "IBM 1231-N1 Component Description and Operating Procedures".

3. The NIPR Programming System

The simplest type of job involving the optical reader occurs when the only results required are test scores which are straightforward enough to be calculated by NDC29 (see Section 11 for details of the scoring capabilities of NDC29). In this case the only program required is NDC29, which reads in the sheets containing the test responses and prints out the scores. For jobs of this nature no knowledge of other NIPR programs or data conventions is needed.

If NDC29 cannot be used for scoring a test, or if the program is only being used to load data prior to some further analysis, such as tabulation or item analysis, then further programs in the NIPR system will be used. Details of the programs available and the system conventions regarding programs and data may be found in CSIR Special Report Pers. 99 'A Description of the NIPR System Programmes, Methods of Operation, and Intended Development' by R.S. Hall.

4. Data Sheet format

(i) Notation

The sheets each contain a thousand mark positions arranged in fifty rows, each row having twenty positions printed in four groups of five.

	0 1 2 3 4	5 6 7 8 9	0 1 2 3 4	5 6 7 8 9
1	= = = = =	= = = = =	= = = = =	= = = = =
2	= = IDENTIFICATION = =	= = = = =	= = = = =	= = = = =
3	= = = = =	= = = = =	= = = = CASE = = = = =	= = = = =
4	= = = = =	= = = = =	= = = = NO. = = = = =	= = = = =
5	= = = = SEQUENCE NO. = = = = =	= = = = =	= = = = =	= = = = =
6	= = = = = L			R
⋮				

fig. 1. Data sheet

The rows are numbered from 1 to 50 starting at the top of the sheet. The leftmost ten positions of a row form the "left word," denoted by L, and the remaining ten positions from the "right word," denoted by R. Thus, for example, the left ten positions of the third row are referred to as word 3L.

(ii) Coding numbers on the data sheet

An integer of between 1 and 9 digits may be coded on the sheet as a "numeric field". Each digit in a numeric field requires ten mark positions labelled 0 to 9 and the digit is coded by marking the appropriate position. For example the digit 7 may be marked as follows:

0	1	2	3	4	5	6	7	8	9
=	=	=	=	=	=	=	•	=	=

If the number contains more than one digit, the positions for marking succeeding digits must be directly below those for the first digit. For example, the following is a numeric field for coding a three digit integer. (160)

0	1	2	3	4	5	6	7	8	9
=	•	=	=	=	=	=	=	=	=
=	=	=	=	=	=	•	=	=	=
•	=	=	=	=	=	=	=	=	=

Digits corresponding to leading zeros can be left blank, but if the entire field is blank, it is treated as missing information.

(iii) Sheet identification

The top five rows of the sheet are reserved for identification and sequencing information as follows (fig. 1).

Words 1R - 5R must contain a case number of from one to five digits. If the data for a case extends over more than one sheet, the case number must appear on every sheet of the case.

Words 1L - 3L can contain a three digit identification number to distinguish sheets used in different jobs. This field may be left blank, but if it is used then all the sheets

to be read by the optical reader in one job must have the same identification number.

Words 4L and 5L can contain a two digit sequence number. This can be omitted if there is only one sheet per case. To clarify the meaning of the sequence number, if there were four sheets per case, each case would have sheets with sequence number 1, 2, 3 and 4.

(iv) Coding data:- Numeric and positional data fields

Data fields can be placed anywhere in rows 6 - 50 of the sheet. A data field may be "positional" or "numeric". A numeric data field can be an integer of from 1 to 9 digits and is coded as a numeric field as described above in the section "Coding numbers on the data sheet". When a large number is involved this is an efficient way of coding it. However, when a relatively small number of alternative answers are possible or when multiple responses to the same question are permissible, it is more efficient to display the alternatives and to require the applicable answers to be marked, as in the examples below.

A	B	C	D	E
=	=	=	=	..

YES	NO
..	=

Data fields of this type are called positional, in contrast to the numeric fields described above. For a positional field a mark in the first position is given a value of 1, a mark in the second position a value of 2, and so on. Thus the examples shown above have values of 5 and 2 respectively.

A positional data field which has not been marked can be treated as either zero or missing information. If more than one mark is made in the field the value of each position marked can be recorded in a response vector for that field. A positional field can start in one row and continue from the beginning of the next row for as many positions as desired, the only restriction on maximum length being imposed by the number of available positions on a page (900). The minimum length of a positional field is two positions.



5. Designing and printing data sheets

If any NIPR program is to be used to read data from the optical reader, then some restrictions are imposed on the layout of the data. These restrictions may be found in section four, "Format of data sheets". To give an idea of what can be done, some examples of sheets prepared for a variety of purposes have been included in Appendix A.

The method used for printing the sheets depends on the quality required and the number of sheets to be printed. Three methods have been used successfully and these are discussed below.

a) Specially printed sheets

Tolerances for paper and printing are very close and at the time of writing there is no South African printing works prepared to undertake this job. Printing has to be done overseas, in Germany or America, and this involves several months delay. A large printing order is also necessary to make this method economical. This is, however, the only way of getting really neat looking data sheets containing no unwanted mark positions.

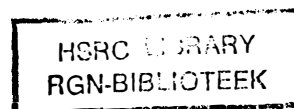
Sheets for printing must be drawn up on special forms available from IBM. The most commonly used one caters for five rows of mark positions per inch (fifty rows per sheet) and has reference number X20 - 8040. Sheets are also available for spacing rows three to the inch or four to the inch. Examples of specially printed sheets are given on pages A2 - A4 of Appendix A.

b) Overprinting by local printers

A more economical method of preparing sheets is to have the standard IBM 551, data sheets (page A1, Appendix A) overprinted with the desired additional information. This can be done by local printers and produces satisfactory results, although all one-thousand mark positions are present whether they are required or not. Some examples of locally overprinted sheets can be found in Appendix A on pages A5 and A6.

c) Overprinting by offset litho.

This may be done on an ordinary offset litho. duplicating machine using a paper master produced by the Xerox copier. The resulting sheets are not very attractive but are legible. If a large number of sheets



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is to be produced, an aluminium master can be made at small cost. It is usually impracticable to clean the machine and reload with a different colour ink, so the sheets are generally printed in black. This has the disadvantage that inaccurate duplication may produce unwanted marks in areas to be read by the optical reader. Thus, for sheets which are to be printed in this manner, printing close to the answer positions should be avoided. If a reflective ink such as red or green can be used, however, printing may appear anywhere on the sheet, even within the mark positions themselves. Examples of sheets overprinted by duplicating machine are given in Appendix A on pages A7 and A8.

## II. LOADING AND SCORING DATA WITH NDC29

### 6. Facilities and limitations of NDC29

NDC29 has two main functions:-

- (i) To load data from the optical reader to disk in standard NIPR format.
- (ii) Where the data are test responses, to read in sheets giving the correct responses and to use these to score the data.

The program is written to provide a good deal of flexibility in the layout of the data sheets and the scoring of responses. The general layout of data sheets is discussed in section 4. Information about the data is provided on specification sheets which are read before the data sheets. Details of these sheets are given in section 10.

The following points give an idea of the facilities provided by NDC29:-

- (i) The maximum number of response fields for each case is 1000.
- (ii) The response fields for each case may be spread over up to fifty pages, with the restriction that no field may be partly on one page and partly on another.
- (iii) Multiple responses can be handled.
- (iv) Up to 20 scores can be accumulated for a test. These may be totals for different parts of the test or alternative ways of

scoring the same test. Test scoring facilities are discussed in detail in section 11.

(v) Missing data.

Options are provided on the parameter card (see section 8 for details) for handling missing information. Fields with missing information may be set to the standard NIPR code for missing information ( $-.1E-49$ ) or to a specified whole number  $n$  ( $0 \leq n \leq 9999$ ). The options to be used for positional and numeric fields are specified separately, and may differ from each other.

7. Input and output options

Details of how to select the various options mentioned here are given in section 8, "cards required".

(i) Input data sets

The input to the program falls into two categories. These are:-

- (a) "Specification sheets", which describe the data and the scoring to be done.
- (b) The actual data sheets themselves.

(a) Specification Input

For some applications the specifications may occupy twenty or more sheets. Furthermore, information contained on the specification sheets is specific to a particular test or questionnaire rather than to the particular data cases being loaded, so the specifications for a particular test may remain constant over a number of runs with different data. For these reasons provision has been made for storing specification information on disk so that it can be read independently of the data.

(b) Data Input

The data may come from one of three different sources:-

- (1) Directly from the optical reader. (This is the normal mode of operation).
- (2) A standard NIPR data set on disk. (This is usually used for data previously loaded from the optical reader which

must be re-scored with a different set of keys, although any standard data set may be used even if was not loaded by NDC29).

- (3) Data-sheet images loaded to tape with NDC30. (This method is only used in special circumstances. See sections 15 and 16 on loading data with NDC30).

(ii) Output data sets

In addition to the printed output which is described in section 12, provision is made for three output data sets for storing on disk.

(a) Specification sheets may be stored on disk for later use, as described above.

(b) "Responses", i.e. the data on the sheets, can be loaded to disk in standard NIPR format. The number of variables in the response data set is  $M + \sum_j N_j$  where  $M$  is the number of numeric data elements and  $N_j$  is the number of responses permitted for the  $j$ th positional data element. If fewer marks are found in a positional field than the maximum permitted, the vector of responses is filled up with zeros, e.g. if the maximum permissible no. of marks for the field

1 2 3 4 5 6 is three, then three variables with values 1, 4 and 0 would be loaded.

(c) If scoring is to be done, the number of correct responses for each key used may be written to disk in standard format, one record for each case scored.

Responses and test scores may also be added onto an existing data set instead of being stored in a new data set.

## 8. Cards Required

(i) Job Control Cards

In order to run the program on the System/360, "job control language" cards are needed. Most of these cards are stored on disk in a "catalogued procedure" called NDC29P.

Instructions on how to prepare a deck to run NDC29 using this procedure are contained in a "program layout form" for NDC29.

For the sake of completeness the "data definition cards" used in the procedure are listed below together with a description of their function.

<u>DDNAME</u>	<u>PURPOSE</u>
FT11FOOL	- disk specification input
FT12FOOL	- disk response input
FT13FOOL	- sheet-image input from NDC 30
FT21FOOL	- disk specification output
FT22FOOL	- disk response output
FT23FOOL	- disk test scores output
OPTICALR	- optical reader input

(ii) Title card

This is always required and is a full card of descriptive comment which is printed with the output.

(iii) Parameter card

This is always required and specifies which program options are to be used.

COLS	1 - 4	not used
	5 - 8	0 = read specifications from OMPR 1 = read specifications from disk
	9 - 12	0 = specifications not written to disk 1 = specifications written to disk (must be 0 if previous parameter is 1)
	13 - 16	0 = read responses from OMPR 1 = read responses from disk 2 = read sheet images loaded by NDC30
	17 - 20	0 = responses not written to disk 1 = responses written to disk 2 = responses added to existing data set (must be 0 if previous parameter is 1)
	21 - 24	No. of cases expected (only required if previous or next parameter is 1)
	25 - 28	0 = test scores not written to disk 1 = test scores written to disk 2 = test scores added to existing data set

COLS 29 - 32      0 = some positional fields may be blank  
                     1 = all positional fields must contain marks

33 - 36      n(>0) = missing data for positional fields to be  
                     coded as n  
                     -1 = missing data given standard NIPR code  
                     (1E-49)

37 - 40      n(>0) = missing data for numeric fields coded  
                     as n  
                     -1 = missing data for numeric fields given  
                     standard NIPR code (1E-49).

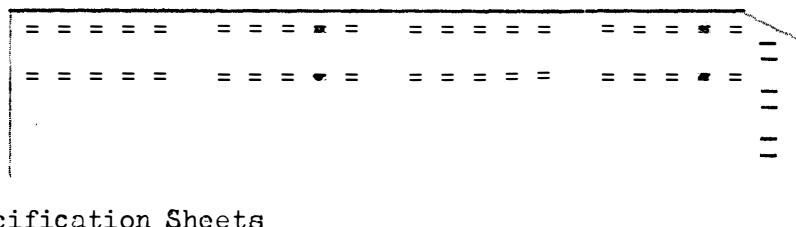
9. The program control sheet

This sheet controls the data transfer from the optical reader and must always be the first sheet in any batch to be processed by the computer. It can be used to specify which words on the data sheets are to be read. In order to standardize operating procedures, however, this facility is not used by the NIPR and the entire data sheet is always read. A standard program control sheet is thus used for all types of data sheet and any selection of fields from the sheets is done by the computer program itself.

The program control sheet must be filled in by marking position nine of every word on the sheet.

0 1 2 3 4    5 6 7 8 9  
 = = = = =    = = = = =

The marked sheet will thus consist of two columns of marks, with fifty marks in each column.



10. Specification Sheets

These sheets contain information about the layout of the data sheets and, if scoring is to be done, provide the keys giving the correct responses. The sheets either precede the data sheets or are loaded from a data set on the disk. The purpose, use and layout of the four types of specification sheet are described in the following

paragraphs. The notation used to describe positions of fields on the sheets is explained in section 4.

(i) Parameter sheet

This sheet is always required and supplies general information about the data and the scoring keys to be used, if any. The following fields are used.

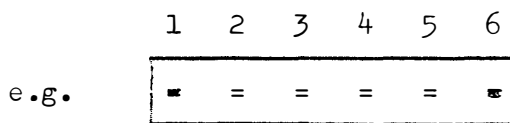
<u>Position of Field</u>	<u>Contents of field</u>
1L - 3L	3 digit test identification (This may be blank, but if used it must appear on every sheet)
1R - 4R	No. of data elements i.e. number of numeric and positional fields on sheets for one case.
5R	= 1 if (i) multiple responses are allowed for any positional data elements or (ii) any numeric elements are used = 0 otherwise.
6R - 7R	No. of data sheets for each case (default 1)
8R - 9R	No. of scoring keys to be used (may be 0)
10R - 11R	No. of sheets for key 1 )
⋮	⋮ ) (default 1)
48R - 49R	No. of sheets for key 20)

(ii) Format sheets

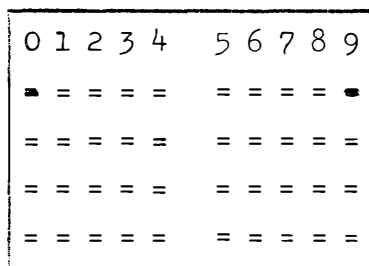
These describe the layout of the individual data sheets. As many format sheets are required as there are data sheets in a case. The format sheets are set out as follows.

<u>Position of field.</u>	<u>Contents of field</u>
1L - 3L	3 digit test identification
1R	Marks in the first three positions, to identify this sheet as a specification sheet.
4R - 5R	Sequence no. of format sheet.
lines 6 to 50	Identification of data element.

Each positional data element is identified by marking the first and last positions of the field containing it.



Each numeric data element is identified by marking the extreme positions for the first digit of the number



(The number of digits in a numeric element is specified on the multiresponse sheet.)

(iii) Multiresponse sheets

These are required if multiple responses are allowed for any positional data elements or if any numeric data elements are present. For positional data elements they specify the maximum number of responses allowed, and for numeric elements they specify the number of digits in the fields. As many multiresponse sheets are required as there are data sheets in a case. The sheets are set out as follows.

<u>Position of field:</u>	<u>Contents of field</u>
1L - 3L	3 digit test identification.
1R	Marks in first three positions, to identify this as a specification sheet.
2R - 3R	Must be 99.
4R - 5R	Sequence no. of multiresponse sheet.
lines 6 - 50	Multiresponse information as explained below.

Positional elements

For each positional field on the data sheets, a maximum number of permissible responses may be specified. This is done by marking the multiresponse sheet, in the position corresponding to the



response field for that element, as follows. If not more than N marks may be made in the field at the same time, then position N of the field must be marked e.g. if, in a six-position positional field, it could happen that all six positions could be marked at the same time, the corresponding field on the multiresponse sheet would be marked in position six as shown.

1	2	3	4	5	6
=	=	=	=	=	■

If at most one response is allowed the field may be left blank.

Numeric elements

For each numeric element, the multiresponse sheet entry is used to identify the element as numeric and to specify how many digits it contains. This is done by marking the field corresponding to the first digit of the number in the following way. Position 10 of the field (i.e. the position corresponding to the digit 9) must be marked to indicate a numeric field. In addition, for an N-digit number ( $1 \leq N \leq 9$ ), position N in the field must be marked.

The example shows the multiresponse sheet field for a two-digit numeric element.

0	1	2	3	4	5	6	7	8	9
=	■	=	=	=	=	=	=	=	■
=	=	=	=	=	=	=	=	=	=

(iv) Key sheets

If scoring of tests is to be done by NDC29 a set of key sheets is required for each total that is being accumulated. These sheets define which data elements are to be used in getting the test score and also give the correct responses. If a page of the test is not used in accumulating a particular test score the key sheet corresponding to that page may be left out of the set of key-sheets for that test score. See section 11 for details of test-scoring facilities.

The key sheets are set out as follows.

<u>Position of field</u>	<u>Contents of field</u>
1L - 3L	3 digit test identification.
1R	Marks in first three positions to identify this as specification sheet.
2R - 3R	Number of test-score for which this set of key-sheets provides correct responses.
4R - 5R	Sequence no. of key sheet (within its own set of key sheets, ignoring omitted sheets).
4L - 5L	Sequence no. of the format sheet to which this key sheet corresponds.
lines 6 - 50	Correct responses for this test-score must be marked on the sheet. If a data element is not included when accumulating this test-score the corresponding field should be left blank.

#### 11. Test-scoring facilities

As the data cases are loaded they may be scored according to scoring keys provided on sets of key sheets (see section 10 (iv)). Since the data may consist of several sub-tests which should be scored separately, provision has been made for up to twenty scoring keys. Each set of key sheets specifies the correct responses for one sub-test, those fields which are not used for this particular sub-test being left blank on the key. The program counts the correct responses for each sub-test and the output for each case consists of totals of correct responses for each sub-test. If multiple responses are permissible for a positional field all the responses are checked, and if one of them is correct the total is increased by one.

The following points about the method of scoring should be noted.

- (i) The same response field may appear in several sub-tests, with different "correct" responses on the corresponding key sheets.
- (ii) Unequal weights cannot be allocated to response fields. The scoring is always simply "one" for correct and "zero" for incorrect.
- (iii) It is not possible to specify two different "correct"

responses for the same field on the same subtest and to score "one" if either of the two responses is given.

If scoring beyond the scope of what is described here is desired, then NDC29 may be used just to load the data, and a special scoring subroutine may be written for use with the loaded data.

## 12. Description of printout

- (i) The program identification, date and time are printed, followed by the title card and the parameters from the parameter card.
- (ii) When the parameter sheet has been decoded the parameters on the sheet are printed.
- (iii) When all the other specification sheets have been read in the information contained on them is printed out. This may be used to check that the sheets have been filled out and read in correctly.

### a) Format sheet

For each of the data sheets, starting with the left-most field in the row nearest the top of the first sheet and ~~wor~~king from left to right down successive sheets, three numbers are printed.

- (1) No. of page on which the field appears.
- (2) The mark-position on page at which field begins.  
The mark-positions are numbered from 1 to 1000 starting at the top left hand corner and going from left to right along successive rows.
- (3) No. of positions in field.

### b) Multiresponse sheets

For each field, taken in the same order as above, a numeric code is printed. For a positional field this code is the maximum number of marks which may appear in the field at the same time, and for numeric fields the code is 100n where n is the number of digits in the field.

- (iv) Messages are printed for each data set that is used, giving the data set number and the file parameters.
- (v) If scoring is being done the case number and the test scores are printed for each case.

- (vi) Various error messages may be printed. See section 13 "Error handling", for details.

### 13. Error handling

The error messages produced during program execution may be divided into two main groups, those printed by the operating system (OS) and those printed by NDC29 itself. These two groups are discussed separately below, with information on how to recognise the different kinds of messages, some possible causes of the errors, and where further details may be found.

#### (i) OS Error messages

An OS error message may take the form of either a numbered error message or a hexadecimal system completion code.

For a FORTRAN program such as NDC29, numbered error messages are usually produced by the FORTRAN error detecting routines. These messages start with the identification code IHC and may be produced for errors such as a missing parameter card or an invalid character in an input record.

The system completion codes are issued by the supervisor program for errors such as missing data sets, insufficient core storage specification, or a branch beyond the limits of the program storage.

Both the numbered error messages and the completion codes are listed with explanations in the IBM manual "IBM System/360 Operating System, Messages and Codes", reference number C28-6631.

#### (ii) NDC29 Error messages

These error messages may be subdivided into three groups:

- (a) Non-terminal error messages, which are printed when an error is detected but execution can nevertheless continue.
- (b) Terminal error messages, which are printed for errors which force the program to stop immediately.
- (c) Optical reader input errors, which may be either terminal or non-terminal, depending on where the error occurs.

#### (a) Non-terminal error messages

These occur when the data sheets for a particular case are in

error after the specifications have been correctly read in. The wrong case is then ignored and normal processing can be resumed with the next case. An error message is printed and the sheets for the case containing the error are selected to the alternate stacker.

Some examples of errors of this type are, wrong sequence number on a sheet, different case numbers on two sheets of the same case, or too many marks in an answer field. If there are errors in more than one answer field in the same case, a message is printed for each error.

(b) Terminal error messages

These messages are produced for serious errors such as incorrect specification information or an error in writing the output to disk, and cause the program to terminate. They are known as UNCLE messages, because the program is actually terminated by a standard NIPR error subroutine called UNCLE. An UNCLE message can be recognised by the following printout.

```
*****  
$ N.I.P.R. ERROR MESSAGE.  UNCLE NUMBER XX.YY $  
*****
```

The code number XX.YY indicates the source of the error message as follows.

If XX.YY is replaced by 0.0 then the error occurred in the main program and the UNCLE printout will be preceded by an error message printed by NDC29. This message should be self-explanatory, but in addition all such messages are listed in alphabetical order in Appendix B, together with a more detailed explanation where this might be helpful in finding the cause of the error.

If XX.YY is not 0.0 but some such number as 32.06, this indicates that the program terminated in an NIPR system subroutine. This might be caused by an uncorrectable input error when reading the specifications or responses from disk in which case XX.YY would, in fact, be 32.06. If any other number occurs, a programmer from the computer division should be consulted.

(c) Optical reader input error

This error terminates the program if it occurs while reading the

specification sheets, otherwise execution continues.

The following message is printed.

INPUT ERROR WHILE READING FROM OMPR - 41CCCCSS RETURNED.

The return code consists of eight hexadecimal digits representing four bytes of status information and may be used to determine the cause of the input error. The first byte will always be 41, indicating an unsuccessful read.

The characters CCCC represent the status bytes of the channel status word. If these hexadecimal digits are converted to binary (see table 3) and the resulting binary digits are numbered from 1 to 16, then the meaning of a "1" in any position may be found from table 1.

If the error occurs on the first sheet read, it is quite likely that the program control sheet (see section 9) has been incorrectly loaded. If this is the case then bit 10, "incorrect length" will be "1", and the program control sheet should be rewritten.

Other bit combinations probably indicate a machine malfunction and the job should be resubmitted. If bit 7, "unit check", is "1", then the sense byte SS will give more details. This byte should then be converted to binary and the meaning of its bits are given in table 2.

More detailed information on the meaning of the status bytes is given in the IBM manual, form A24-9031, "IBM 1231-N1 Component Description and Operating Procedures."

### III. PRELOADING DATA WITH NDC30 AND NDC31

#### 14. General Remarks

Before being scored or loaded to disk in standard NIPR format, data sheets may be spooled onto tape with the program NDC30. Since the output from this program is not in standard format, further processing may be done only with one of the programs NDC31 or NDC29, as follows.

1. NDC29 may be used to read the sheet images on tape and load them to disk in standard NIPR format and, if desired to score the data.

2. If some error in the data sheets is detected during loading or scoring with NDC29, then the file of sheet-images on tape may be updated with NDC31.

The programs NDC30 and NDC31 were written primarily for a computing environment where costs are proportional to the real time taken by a job. Since NDC30 does very little computation it can operate at the maximum speed of the optical reader, namely, 2000 sheets per hour. If any considerable amount of processing is done during reading, however, as is the case with NDC29, the clutch on the reader disengages between reading sheets, which reduces the rate of reading to about 700 sheets per hour. Since the introduction of a multiprogramming system at the computer centre, however, there is little point in using NDC30.

#### 15. Use of NDC30

This program reads sheets from the optical reader and loads images of the sheets to a data set, usually on tape. The sheets are not checked as they are read in, but any errors in the physical transfer of data from the optical reader are reported. Reading is done at the full speed of the reader (2000 sheets per hour) using an assembler subroutine ROMP which is a buffered version of the subroutine of the same name supplied by the computing centre. The program does not use any subroutines from the NIPR subroutine package and no title or parameter card is required.

##### Data definition cards required

FT06FO01        - printer output  
FT21FO01        - tape output  
OPTICALR        - UNIT = 017 (optical reader input)

Note: If NDC31 will be used to update the file produced by NDC30 then the sheets should be loaded in ascending order of case number.

#### 16. Use of NDC31

This program produces an updated version of a file loaded by NDC30. Sheet images may be added, replaced or removed. If sheets are not in ascending order of case number an error will be reported

and the program will stop. The program does not use any subroutines from the NIPR subroutine package. No title card is required and the parameter card differs slightly from standard, as described below.

Input to the program

There are three sources of input. These are the tape to be corrected, new sheets to be loaded on the optical reader and a parameter card specifying the position in the file of sheet images to be deleted. If there exists in the file a sheet-image with the same case number and page number as a sheet read in from the optical reader, this sheet-image is replaced by the new sheet. If no such corresponding sheet exists in the file the new sheet is added in its correct place in the file.

Deleting existing sheet images

If any sheets are out of position in the tape file or have invalid case or sequence numbers, they must be deleted or the update will not function correctly. The positions of sheets to be deleted are specified on a parameter card, as follows.

Parameter card

All parameters must be punched as integers and right adjusted within their fields.

<u>Columns</u>	<u>Contents of field</u>
1 - 4	No. of data sheets in each case
5 - 8	No. of sheets to be deleted
9 - 12	Position in file. of first sheet to be deleted
13 - 16	Position in file of second sheet to be deleted
,	
,	
,	
,	
69 - 72	Position in file of sixteenth sheet to be deleted.

Data definition cards required

- FT05FO01 - card input
- FT06FO01 - printer output
- FT13FO01 - tape-input
- FT23FO01 - tape-output
- OPTICALR DD UNIT = 017 (optical reader input)



Note that data set numbers 13 and 23 rather than 11 and 21 have been used, in order to tie in with conventions for program NDC29.

A P P E N D I X A

Specimen data sheets

The image displays a large grid of red dashed lines on a white background. The grid is organized into 25 columns and 40 rows. The lines are evenly spaced and create a consistent pattern of small rectangular cells across the entire page. There is no text or other content within the grid cells.

# BIOGRAFIESE INLIGTING

A2

Vorm	Gevalnummer
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9

Van  Voorletters

Beroep ----- Graad / Diploma -----

Geslag - Man. .... Vrou. .... Huistaal - Af. .... Eng. ....

Opvoedkundige vlak	
(a) Standaard geslaag -	6 7 8 9 10
(b) NTS behaal -	1 2 3 4 5
(c) Universiteit, jare suksesvol voltooi	1 2 3 4 5

Ouderdom - Jare																			
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49																		

Geboortedatum																			
Dag - 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31																			
Maand - Jan. Feb. Mrt. Apr. Mei Jun. Jul. Aug. Sep. Okt. Nov. Des.																			
Jaar - 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967																			

Vandag se datum																			
Dag - 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31																			
Maand - Jan. Feb. Mrt. Apr. Mei Jun. Jul. Aug. Sep. Okt. Nov. Des.																			
Jaar - 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986																			

Toetser -----																			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9																		
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9																		
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9																		
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9																		

Sentrum -----																			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9																		
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9																		
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9																		
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9																		

Opmerkings -----

MEGANIESE

A3

INSIGTOETS

Number Nommer	--0-- --1-- --2-- --3-- --4-- --5-- --6-- --7-- --8-- --9--
	--0-- --1-- --2-- --3-- --4-- --5-- --6-- --7-- --8-- --9--
	--0-- --1-- --2-- --3-- --4-- --5-- --6-- --7-- --8-- --9--
	--0-- --1-- --2-- --3-- --4-- --5-- --6-- --7-- --8-- --9--
	--0-- --1-- --2-- --3-- --4-- --5-- --6-- --7-- --8-- --9--

Name of tester / Naam van toetsafnemer \_\_\_\_\_ Place of testing / Toetsentrum \_\_\_\_\_ Today's date / Vandag se datum \_\_\_\_ / \_\_\_\_ / 19 \_\_\_\_

Your surname / U van \_\_\_\_\_ Initials / Voorletters \_\_\_\_\_

Occupation / Beroep \_\_\_\_\_ Home town / Tuisdorp \_\_\_\_\_

Home language / Huistaal English / Afrikaans Sex / Geslag male / manlik female / vroulik

Age / Ouderdom  tens / tiene  units / ene years / jare  tens / tiene  units / ene months / maande

Educational standard / Opvoedkundige standaard --6-- --7-- --8-- --9-- --10-- Other qualifications / Ander kwalifikasies \_\_\_\_\_

- |                            |                            |                            |                            |
|----------------------------|----------------------------|----------------------------|----------------------------|
| <b>Example Voorbeeld 1</b> | <b>Example Voorbeeld 2</b> | <b>Example Voorbeeld 3</b> | <b>Example Voorbeeld 4</b> |
| 1 --A-- --B-- --C--        | 21 --A-- --B-- --C--       | 41 --A-- --B-- --C--       | 61 --A-- --B-- --C--       |
| 2 --A-- --B-- --C--        | 22 --A-- --B-- --C--       | 42 --A-- --B-- --C--       | 62 --A-- --B-- --C--       |
| 3 --A-- --B-- --C--        | 23 --A-- --B-- --C--       | 43 --A-- --B-- --C--       | 63 --A-- --B-- --C--       |
| 4 --A-- --B-- --C--        | 24 --A-- --B-- --C--       | 44 --A-- --B-- --C--       | 64 --A-- --B-- --C--       |
| 5 --A-- --B-- --C--        | 25 --A-- --B-- --C--       | 45 --A-- --B-- --C--       | 65 --A-- --B-- --C--       |
| 6 --A-- --B-- --C--        | 26 --A-- --B-- --C--       | 46 --A-- --B-- --C--       | 66 --A-- --B-- --C--       |
| 7 --A-- --B-- --C--        | 27 --A-- --B-- --C--       | 47 --A-- --B-- --C--       | 67 --A-- --B-- --C--       |
| 8 --A-- --B-- --C--        | 28 --A-- --B-- --C--       | 48 --A-- --B-- --C--       | 68 --A-- --B-- --C--       |
| 9 --A-- --B-- --C--        | 29 --A-- --B-- --C--       | 49 --A-- --B-- --C--       | 69 --A-- --B-- --C--       |
| 10 --A-- --B-- --C--       | 30 --A-- --B-- --C--       | 50 --A-- --B-- --C--       | 70 --A-- --B-- --C--       |
| 11 --A-- --B-- --C--       | 31 --A-- --B-- --C--       | 51 --A-- --B-- --C--       | 71 --A-- --B-- --C--       |
| 12 --A-- --B-- --C--       | 32 --A-- --B-- --C--       | 52 --A-- --B-- --C--       | 72 --A-- --B-- --C--       |
| 13 --A-- --B-- --C--       | 33 --A-- --B-- --C--       | 53 --A-- --B-- --C--       | 73 --A-- --B-- --C--       |
| 14 --A-- --B-- --C--       | 34 --A-- --B-- --C--       | 54 --A-- --B-- --C--       | 74 --A-- --B-- --C--       |
| 15 --A-- --B-- --C--       | 35 --A-- --B-- --C--       | 55 --A-- --B-- --C--       | 75 --A-- --B-- --C--       |
| 16 --A-- --B-- --C--       | 36 --A-- --B-- --C--       | 56 --A-- --B-- --C--       | 76 --A-- --B-- --C--       |
| 17 --A-- --B-- --C--       | 37 --A-- --B-- --C--       | 57 --A-- --B-- --C--       | 77 --A-- --B-- --C--       |
| 18 --A-- --B-- --C--       | 38 --A-- --B-- --C--       | 58 --A-- --B-- --C--       | 78 --A-- --B-- --C--       |
| 19 --A-- --B-- --C--       | 39 --A-- --B-- --C--       | 59 --A-- --B-- --C--       | 79 --A-- --B-- --C--       |
| 20 --A-- --B-- --C--       | 40 --A-- --B-- --C--       | 60 --A-- --B-- --C--       | 80 --A-- --B-- --C--       |

Score Telling 

--	--	--	--	--	--



Van Sur name

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Voorletters Initials

--	--	--	--	--	--	--	--	--	--	--	--	--

A4

Geval - / Case nr. / No.

Vorm / Form	0	1	2	3	4	5	6	7	8	9

0	1	2	3	4	5	6	7	8	9

1	46	91	136
2	47	92	137
3	48	93	138
4	49	94	139
5	50	95	140
6	51	96	141
7	52	97	142
8	53	98	143
9	54	99	144
10	55	100	145
11	56	101	146
12	57	102	147
13	58	103	148
14	59	104	149
15	60	105	150
16	61	106	151
17	62	107	152
18	63	108	153
19	64	109	154
20	65	110	155
21	66	111	156
22	67	112	157
23	68	113	158
24	69	114	159
25	70	115	160
26	71	116	161
27	72	117	162
28	73	118	163
29	74	119	164
30	75	120	165
31	76	121	166
32	77	122	167
33	78	123	168
34	79	124	169
35	80	125	170
36	81	126	171
37	82	127	172
38	83	128	173
39	84	129	174
40	85	130	175
41	86	131	176
42	87	132	177
43	88	133	178
44	89	134	179
45	90	135	180

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

PAGE/BLADSY

2

TEST TOETS 4

TEST TOETS 5

1 A B C D E
2 A B C D E
3 A B C D E
4 A B C D E
6 A B C D E
6 A B C D E
7 A B C D E
8 A B C D E
9 A B C D E
10 A B C D E
11 A B C D E
12 A B C D E
13 A B C D E
14 A B C D E
15 A B C D E
16 A B C D E
17 A B C D E
18 A B C D E
19 A B C D E
20 A B C D E

1 A B C D E
2 A B C D E
3 A B C D E
4 A B C D E
5 A B C D E
6 A B C D E
7 A B C D E
8 A B C D E
9 A B C D E
10 A B C D E
11 A B C D E
12 A B C D E
13 A B C D E
14 A B C D E
15 A B C D E
16 A B C D E
17 A B C D E
18 A B C D E
19 A B C D E
20 A B C D E

42 A B C D E
43 A B C D E
44 A B C D E
45 A B C D E
46 A B C D E
47 A B C D E
48 A B C D E
49 A B C D E
50 A B C D E
51 A B C D E
52 A B C D E
53 A B C D E
54 A B C D E
55 A B C D E
56 A B C D E
57 A B C D E
58 A B C D E
59 A B C D E
60 A B C D E
61 A B C D E

83 A B C D E
84 A B C D E
85 A B C D E
96 A B C D E
87 A B C D E
88 A B C D E
89 A B C D E
90 A B C D E
91 A B C D E
92 A B C D E
93 A B C D E
94 A B C D E
95 A B C D E
96 A B C D E
97 A B C D E
98 A B C D E
99 A B C D E
100 A B C D E
101 A B C D E
102 A B C D E

Black out the chosen

letter thoroughly

Rub out all other

pencil marks

Maak die gekose

letter deeglik swart

Vee alle ander pot

loodmerke uit

21 A B C D E
22 A B C D E
23 A B C D E
24 A B C D E
25 A B C D E
26 A B C D E
27 A B C D E
28 A B C D E
29 A B C D E
30 A B C D E
31 A B C D E
32 A B C D E
33 A B C D E
34 A B C D E
35 A B C D E
36 A B C D E
37 A B C D E
38 A B C D E
39 A B C D E
40 A B C D E
41 A B C D E

21 A B C D E
22 A B C D E
23 A B C D E
24 A B C D E
25 A B C D E
26 A B C D E
27 A B C D E
28 A B C D E
29 A B C D E
30 A B C D E
31 A B C D E
32 A B C D E
33 A B C D E
34 A B C D E
35 A B C D E
36 A B C D E
37 A B C D E
38 A B C D E
39 A B C D E
40 A B C D E
41 A B C D E

62 A B C D E
63 A B C D E
64 A B C D E
65 A B C D E
66 A B C D E
67 A B C D E
68 A B C D E
69 A B C D E
70 A B C D E
71 A B C D E
72 A B C D E
73 A B C D E
74 A B C D E
75 A B C D E
76 A B C D E
77 A B C D E
78 A B C D E
79 A B C D E
80 A B C D E
81 A B C D E
82 A B C D E

103 A B C D E
104 A B C D E
105 A B C D E
106 A B C D E
107 A B C D E
108 A B C D E
109 A B C D E
110 A B C D E
111 A B C D E
112 A B C D E
113 A B C D E
114 A B C D E
115 A B C D E
116 A B C D E
117 A B C D E
118 A B C D E
119 A B C D E
120 A B C D E
121 A B C D E
122 A B C D E
123 A B C D E

**ATTITUDE SURVEY - ROAD SAFETY PROJECT 7041/9200**

A6

**SURVEY  
QUESTIONS**

	1	2	3	4	5
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					

**SEX**

M	F
---	---

**MARITAL STATUS**

S	M	D	SEP	W
---	---	---	-----	---

**AGE**

0	1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---	---

**NO. OF CHILDREN**

0	1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---	---

**RACE**

E.	CO.	AFR.	AS.
----	-----	------	-----

**OCCUPATION**

UNSK.	SEMI-S.	SK.	CLER.	ADM.	MAN	PROF.	EXEC.	0
-------	---------	-----	-------	------	-----	-------	-------	---

**No. Years Driving**

0	1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---	---

**VEHICLE DRIVEN**

CAR	TRU.	TAXI	BUS
-----	------	------	-----

**WHERE DRIVEN**

T	C	B
---	---	---

**MILES DRIVEN**

0	1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---	---

**PER YEAR**

**NO. OF ACCIDENTS**

0	1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---	---

**INVOLVED IN**

**LANGUAGE**

A	E	O
---	---	---



1. I would rather be a senator than a philosopher.
2. I would rather be an efficiency expert than a musician.
3. I would rather be a research engineer than an industrial engineer.
4. In writing a report or paper, I find the searching for ideas the most distasteful process.
5. I rarely come up with novel ideas.
6. I would rather be a business promoter than a psychologist.
7. I would rather be an engineer than an artist.
8. I am occasionally taken in by new books and ideas.
9. I often daydream about unsolved problems.
0. I enjoy daydreaming about future projects, activities, or problems.
1. I would rather be a research scientist than a scientific administrator.
2. I get my best ideas by daydreaming rather than relying on books, well-established authorities, or other people.
3. If I had the talent, I would enjoy being a composer.
4. I would rather edit than write a book.
5. I would rather be a leader than an inventor.
6. I often try to be alone so I can think things through.
7. I am regarded as a person of many ideas.
8. I would prefer living a life like that of Edison rather than that of Freud.
9. Daydreaming is a poor way to solve problems.
0. I am interested in psychology and psychiatry.
1. I would rather be an influential public figure than a creative artist.
2. I am quiet rather than an expressive person.
3. I prefer teachers who give well-organized courses and clear assignments to those who require independent reports and papers.
4. I have to learn things in my own way rather than accepting ideas or relationships suggested in textbooks, etc.
5. The way to solve difficult problems is by thorough planning and good organization of your time.
6. I often make judgments by my first impressions and feelings rather than by a careful thinking through of the situation.
7. I would like to be an inventor.
8. I solve intellectual problems by careful, logical thinking.
9. I would rather be an experimental than a clinical psychologist.
0. If I had the necessary talent, I would enjoy being a sculptor.
1. I enjoy problems for which you can obtain precise answers.
2. I would rather be a writer than a banker.
3. I think I am a practical rather than an imaginative person.
4. My friends think of me as an objective rather than an emotional or expressive person.
5. I begin projects by daydreaming about how they might be done.
6. My friends regard me as somewhat absent-minded.
7. I am more of a realist than an idealist.
8. I often act without thinking.



APPENDIX BError messages for NDC29

The following is an alphabetical list of the error messages which may be produced by NDC29. Most of them are self-explanatory, but an explanation has been included where this may clarify the message. The letters i and j represent integer values which appear in the messages.

CASE i HAS INVALID NUMBER FOR QUESTION j

Response j was a numeric data field that contained an invalid number.

CASE i HAS NO RESPONSE TO QUESTION j

This message applies to positional data fields when the option to check all such fields for marks has been used.

CASE i HAS TOO MANY RESPONSES TO QUESTION j

A positional data element has more marks in the field than specified on the multiresponse sheet.

CASE i HAS WRONG TEST ID

END OF FILE ON OMPR - SPECIFICATIONS INCOMPLETE

The specifications were still incomplete after the last sheet had been read by the optical reader.

ERROR IN FILLING OUT FORMAT SHEET i

An unpaired mark occurred in the body of the format sheet.

FORMAT SHEETS CONTAIN MORE THAN i FIELDS

i is the number of fields specified on the parameter sheet.

FORMAT SHEETS DEFINE ONLY i FIELDS

The number of fields specified on the parameter sheet exceeded the number i found on the format sheets.

FORMAT SHEET i HAS INVALID FIRST LINE

FORMAT SHEET i HAS INVALID MARKS IN LINES 2 OR 3

FORMAT SHEET i HAS WRONG SEQUENCE NO.

FORMAT SHEET HAS WRONG TEST ID

INPUT ERROR WHILE READING FROM OMPR - 41CCCCSS RETURNED  
The meaning of the return code is explained in section 13  
and can be looked up in tables 1 and 2.CCCC are the bits of  
the status bytes of the CSW, and SS is the 1231-N1 sense byte.

KEY SHEET HAS WRONG TEST ID

KEY SHEET i OF SUBTEST j HAS AN INVALID RESPONSE  
For a positional field, more than one correct response has  
been specified. For a numeric field, an invalid number has  
been specified.

KEY SHEET i OF SUBTEST j HAS INVALID FIRST LINE

KEY SHEET i OF SUBTEST j HAS WRONG SEQUENCE NO.

LAST CASE INCOMPLETE

MULTIRESPONSE SHEET i DOES NOT HAVE 99 IN LINES 2 & 3

MULTIRESPONSE SHEET i HAS INVALID FIELD  
A positional field has more than one mark on the multiresponse  
sheet, or a numeric element either does not have the required  
mark in position ten or has more than one additional mark.

MULTIRESPONSE SHEET i HAS INVALID FIRST LINE

MULTIRESPONSE SHEET i HAS WRONG SEQUENCE NO.

MULTIRESPONSE SHEET i HAS WRONG TEST ID

NO. OF FORMAT SHEETS .NE. NO. OF PAGES IN TEST

PARAMETER SHEET CONTAINS INVALID NUMBER

SHEET HAS INVALID CASE NUMBER

The first sheet of a case has an invalid case number.

SHEET i OF CASE j HAS WRONG CASE NUMBER

Sheet 2 or a subsequent sheet of the case does not have the same case number as the first sheet.

SHEET i OF CASE j HAS WRONG SEQUENCE NUMBER

TABLE 1: STATUS BITS OF CHANNEL STATUS WORD

<u>Bit No.</u>	<u>Meaning</u>
1	Attention
2	Status modifier
3	Control unit end
4	Busy
5	Channel end
6	Device end
7	Unit check
8	Unit exception
9	Program-controlled interuption
10	Incorrect length
11	Program check
12	Protection check
13	Channel data check
14	Channel control check
15	Interface check
16	Chaining check

TABLE 2: 1231 & N1 SENSE BYTE

<u>Bit No.</u>	<u>Meaning</u>
1	Command reject
2	Intervention required
3	Bus out check
4	Equipment check
5	Data check
6	Over-run
7	Timing mark check
8	Master Mark Sheet

TABLE 3: HEXADECIMAL TO BINARY CONVERSION TABLE

<u>Hexadecimal</u>	<u>Binary</u>
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111



