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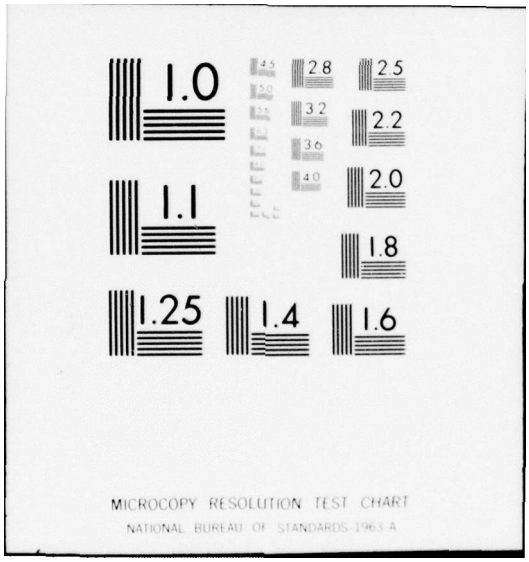
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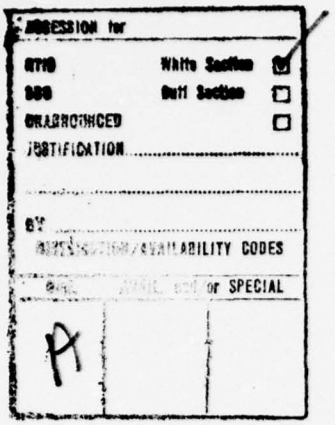

A SYSTEM ANALYSIS OF WATER QUALITY SURVEY DESIGN

Data Handling System User's Manual

APPENDIX VII

Author: Thomas L. Drake

August 1975

Supported by

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Washington, D.C. 20314

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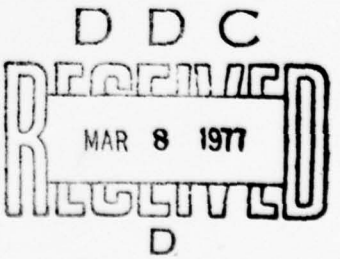

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is the final report of a three year project titled, "A Systems Analysis of Water Quality Survey Design."

In this project a study was made of water quality surveys conducted by the United States Army Environmental Hygiene Agency (AEHA). Mainly data and reports from studies of Army Ammunition Plants (AAP) were used.

The focus of this project was the development of computer aided procedures which would assure efficient use of manpower and equipment and assure that the measurements taken give a reasonalbe representation of the system. Planning the

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survey, conducting the survey and reporting on the survey were included in the study.

The site modeling program models the manufacturing processes which contribute pollutants to the system, models the sewer system, and models the treatment system including acid or caustic neutralization, settling ponds, and domestic treatment. The inputs to the model are the production levels of the manufacturing processes and the outputs are the predicted pollutant measurement values at each possible measure point in the system.

The resource matching program accepts data defining proposed measurements and matches these against the available time, manpower, and equipment. The output lists the pollutant to be measured at each measure point, the total commitment of time for each analyst and for each piece of equipment. Note is made of any overcommitment of manpower or equipment.

The model refinement or updating program accepts measurements taken during a preliminary survey or during a regular survey and computes suggested new parameters for the process models.

The indicator model program evaluates the performance of sanitary treatment facilities.

The program uses design data, data from the operating log and/or data generated during the survey and computes key operational characteristics. Comparing these with desirable values as cited in design books and manuals will give the survey planner insight into the operation of the system and suggest the need for more survey measurements or the need for changes in operation.

A system was developed for automatic instrumentation of pH, conductivity, and other parameters which use strip charp recordings. Interface hardware was selected and purchased and interface software was developed for direct connection to a digital computer.

A data handling system was developed for use during and after the survey. A PDP8-OS/8 and peripheral equipment was purchased. Software was developed to perform data handling functions and to direct the user in application of the software. The program accepts raw data from the analytical chemist and performs data conversions, transcriptions, and data logging functions. Output is available in several forms as may be needed for various reports during and at the end of the survey.

Recommendations are: the survey planner should obtain sufficient data in a proliminary survey to model and analyze the site; measurements should be automated to the maximum extent possible; data handling should be delegated to the computer when the operations are well defined and repetitive. The programs, software and hardware included here will assist the survey planner in following these recommendations and design a more effective survey.

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INTRODUCTION

Introduction:

A Data Handling System is described which handles on-site water quality survey data measured by the Army. Data and commands are entered into the system on-line via either the Teletype, Hewlett-Packard optical mark reader, Talos graphic digitizer, DEC manual data entry station, Yellow Springs S-C-T meter, or Fisher pH/ion meter. The digitizer, manual data entry station, specific conductivity instrumentation, and pH instrumentation are interfaced to the system via the DEC PDP-70 programmable data mover. The Data Handling System may be at a fixed location with a telephone data link and/or may be found on-site.

The Data Handling System may be viewed as a collection of programs which operate within the supervision of the OS/8 executive on a DEC PDP-8/E. Each of these programs operate in conjunction with data files found on the mass storage devices. An important feature of the OS/8 software permits the user of the system to develop programs written in BASIC which can utilize the same data base generated by the data handling software.

The OS/8 is a software system which is supported by a large variety of hardware configurations with a DEC PDP-8/E CPU. This system is a comprehensive library of system programs operating under the supervision of an integrated executive. A brief description of the OS/8 executive is found in the OS/8 System Section.

Data Formats:

All measurements accepted by the system must have a format consisting of 6 primary ID tags, 5 secondary ID tags, and a measurement value. The format of a measurement is as follows:

ID1 ID2 ID3 ID4 ID5 ID6 ID7 ID8 ID9 ID10 ID11 Value

where the primary ID tags are:

ID1 = Day ID

ID2 = Point ID

ID3 = Period ID

ID4 = Parameter ID

ID5 = Discrete ID

ID6 = Comment ID

Each primary ID is a character string from 0 to 6 characters in length. However, only the Discrete and Comment ID are permitted to be null (0 characters). A maximum of 63 IDs are permissible in each primary ID group.

The secondary ID tags with the usual assigned Quality and Accuracy ID tags are:

ID7 = Quality ID

Turbid (T)
Clear (CL)
Light Color (LC)
Intense Color (IC)
Hot (H)
Cold (C)
Greasy (G)
Nonhomogeneous (NH)
Imperfect Preservation (IP)
Questional Stability (QS)

ID8 = Accuracy ID

Accurate Result (AR)
10% (10%)
Order of Magnitude (OM)
Inaccurate Results (IR)

ID9 = Chemist ID

ID10 = Method ID

ID11 = Unused

More than one Quality ID tag may be used to describe each measurement with each Quality ID tag being a character string from 0 to 6 characters. Up to 12 Quality ID tags can be handled with a comma separating multiple Quality ID tags. The Chemist, Accuracy, and Method ID tags are character strings from 0 to 6 characters in length with a maximum of 63 IDs permissible in each of these groups.

Examples of measurements are as follows:

```
1  C1 2  COND 2   T,LC,H  AR  DRAKE  M1  700
10 S1 3  PH       DRAKE   7.4
2  IS 1  TOC 25   BROWN   200
```

Overview of Data Handling Operation:

A brief summary of the various data handling operations follows:

1. Data Input - Data and commands are entered into the data handling system via either the Teletype, optical mark reader, digitizer, manual data entry station, or interfaced automated instrumentation. The system will accept one or more raw measurement values for each measurement on input and then perform the appropriate data reduction to arrive at a final measurement value. This data when received is extensively checked by this system. Valid data is transferred to a data file. Error messages are generated for invalid data. A new data file is created each time the system enters the data input mode. The name of this data file is determined by the system while the filename extension is specified by the operator.

2. Merge - Each of the files created during data input must be merged into a master data file with either the program PIP or MERGE by the system supervisor. The program MERGE lists the name of each data file which has not been merged and receives a response from the supervisor on the particular action to be taken. Measurements may also be either deleted or changed within the master data file with MERGE.

3. Report - Reports and Print-Plots of selected data in a variety of formats can be requested by the operator.

4. Sort - Selected information is retrieved from a specified data file and sorted. A data file is created for this sorted data.

5. File Management - File management operations such as the transfer of files between devices, merge and delete files, and list, zero, and compress directories are provided by the OS/8 system programs FOTP, PIP, and DIRECT.

6. Analysis Functions - The analysis programs provide the capability of computing parameters such as range, maximum, minimum, mean, and standard deviation for selected measurements.

7. System Generation - Several system tables are used by the system to define the particular survey to the system. The extensive use of tables permits the system to be readily adapted to each survey.

8. Data Reduction - Data reduction programs can be readily implemented as OS/8 supports BASIC, FORTRAN II, and FORTRAN IV.

Operator Requirements:

Operation of the system may require knowledge of the following OS/8 system operating concepts:

1. Permanent Device Names

2. File Names and Extensions
3. Keyboard Monitor Commands
4. Command Decoder Command Strings
5. PIP Program Operation
6. FOTP Program Operation
7. DIRECT Program Operation
8. BATCH Program Operation
9. OS/8 BASIC Operation
10. Concise Command Language Commands

Each of these concepts are documented in the DEC OS/8 Handbook.

The present system supports two on-line DECtape units. Each DECtape unit can store up to 240 files having a combined total length of approximately 700 blocks. A block when used for data storage can hold 28 measurements. The data handling software automatically defines a consistent set of file names to the various files created during data entry. The programs PIP, FOTP, and DIRECT are useful in managing the files on these devices.

OS/8 SYSTEM OPERATION

Introduction:

The OS/8 Operating System is a powerful programming system designed for the PDP-8 family of computers. This system permits use of a wide range of peripherals and all available core up to 32K. OS/8 offers a versatile Keyboard Monitor which allows the user to control the flow of programs. In addition to the Keyboard Monitor, OS/8 offers extensive I/O facilities at the Monitor level which are documented in the OS/8 Software Support Manual (DEC-S8-OSSMB-A-D).

Besides the Monitor facilities, OS/8 includes a library of powerful system programs which allows the user to do program development using BASIC, FORTRAN II, FORTRAN IV, or assembly language. A detailed description of each of these system programs is found in the OS/8 Handbook (DEC-S8-OSHBA-A-D). OS/8 BATCH provides the user of the system with a batch processing monitor that is integrated into the OS/8 Monitor structure.

Starting the OS/8:

The data handling system has a TD8E ROM Bootstrap. The following steps should be followed when starting the system.

1. Set the switch register on the PDP-8/E console to 7470 (octal), i.e., set switches 0, 1, 2, 3, 6, 7, and 8 in the up position and set switches 4, 5, 9, 10, and 11 in the down position.

2. Raise the SING STEP switch. Lower and raise the HALT switch.

3. Mount an OS/8 system tape on DECtape unit 0 and set to WRITE ENABLE and REMOTE. A second DECtape may be mounted on DECtape unit 1.

4. Press the EXTD ADDR LOAD, ADDR LOAD, CLEAR, and CONT switches. The tape bootstrap will be executed and the OS/8 Keyboard Monitor will

print a dot (.) to indicate that it is active.

File Names and Extensions:

Files are referenced by a name of up to six alphanumeric characters followed, optionally, by a period and an extension of two alphanumeric characters. The extension to a file name is generally used as an aid for remembering the format of a file. Some system programs utilize default extensions when an extension is not specified. For example, the extension .SV indicates a core image file while .BA indicates a BASIC source file.

Permanent Device Names:

Each device in the OS/8 system is referenced by means of a standard permanent device name. These names are as follows:

Permanent Name	I/O Device
SYS	System device (DECtape 0)
DTA0	DECtape unit 0
DTA1	DECtape unit 1
DSK	Default device (DECtape 1)
TTY	Teletype keyboard and printer
PTP	Paper tape punch on Teletype
PTR	Paper tape reader on Teletype
MTA0	Magnetic tape unit 0
MTA1	Magnetic tape unit 1
CDR	Card Reader

Using the Keyboard Monitor:

Each command to the Keyboard Monitor is typed at the Teletype keyboard. A command line is terminated with a RETURN or an ALTMODE. Correcting mistakes is accomplished by typing the RUBOUT key which deletes the last

character and causes a backslash (\) to be printed followed by the character which was deleted. Successive RUBOUTS each cause one more character to be printed and deleted. The first non-RUBOUT causes a backslash (\) to be printed thus enclosing the deleted characters with backslashes. For example:

```
User types:     RUN DSK:(RO)(RO)(RO)(RO)SYS:ABC
Printer shows:  RUN DSK:\:KSD\SYS:ABC
Monitor sees:   RUN SYS:ABC
```

A command line may be deleted completely by typing a CTRL/U. Control can be returned to the Keyboard Monitor while running any of the system programs by typing a CTRL/C.

Keyboard Monitor Commands:

The user has a choice of nine commands which he may type in response to the dot (.) printed by the Keyboard Monitor. These are: ASSIGN, DEASSIGN, GET, SAVE, ODT, RUN, R, START, and DATE. Commands may be abbreviated by typing only the first two characters. The Keyboard Monitor will also accept CCL commands.

The ASSIGN command is of the form:

```
.ASSIGN dev udev
        or
.AS dev udev
```

This command causes a new user-defined device name (udev) to be considered equivalent to the permanent device name (dev). For example:

```
.AS DTA1 IN
```

cause all future references to In to refer to DECtape unit 1.

The DEASSIGN command is of the form:

.DEASSIGN

or

.DE

and causes all permanent device names to be restored, discarding all previous user-defined device names.

The R command is of the form:

.R file.ex

or

.R file

This command handles only core image files from the system device. The file is loaded and started. If the file name extension is not specified, the extension. SV is automatically added.

The RUN command is of the form:

.RUN dev:file.ex

This command handles only core image files. The file on the specified device is loaded and started.

The GET, SAVE, ODT, and START commands will not be discussed as they would not normally be used by the operator.

The DATE command is of the form:

.DATE mm/dd/yy

or

.DA mm/dd/yy

The DATE command sets up the date in the system for purposes of dating directory entries and listings, printing on program output, etc.

Concise Command Language (CCL):

The CCL provides the OS/8 user with an extended set of Keyboard Monitor Commands. Many CCL commands allow the user to call a system program indirectly, perform an operation, and return to the Keyboard Monitor. The CCL commands are entered at the terminal in the same manner as Keyboard Monitor commands, in response to the dot (.) printed.

Certain CCL commands that run the FOTP or DIRECT programs may use a wild card construction. The wild card construction means that the file name or the extension in the CCL command may be totally replaced with an asterisk (*) or partially with a question mark (?) to designate certain file names or extensions.

Example of the asterisk are as follows:

DATA.*	All files with name DATA and any extension
*.AA	All files with the extension AA
.	All files

Examples of the question mark construction are as follows:

DATA.A?	All files with name DATA and any extension beginning with A
DATA??.??	All files with any extension and the file name begins with DATA
???.*	All files with file names 3 characters or less

Some CCL commands of interest will be discussed in the following paragraphs. Only a small subset of commands will be presented. The OS/8 Handbook provides a complete description of all the CCL commands.

The COPY command transfers files from one I/O device to another. The COPY command has the form:

```
.COPY DEV:FILE.EX<DEV:FILE.EX
```

The wild card construction may be used and each file copied is listed on the terminal.

The DIR command produces listings of OS/8 device directories. The DIR command has the form:

```
.DIR DEV:
```

The SUBMIT command

```
SUBMIT DEV:FILE.EX
```

runs the BATCH program with the commands given in the specified file.

Command Decoder:

Many programs make use of the Command Decoder by permitting the user to enter a list of I/O files and devices. The Command Decoder prints an asterisk (*) at the left margin to indicate it is ready to accept a command string. The command string has the general form:

```
Output files<Input files/Options
```

where the left angle bracket (<) is the divider character between output and input files. There may be 0-3 output files and 0-9 input files specified in a command string.

Each file in the command string is specified by a device name, filename, and a filename extension. The filename is separated from the device name and extension respectively by a colon (:) and a period (.). A comma separates multiple files in the string. The device DSK: is used whenever the device is not specified.

Various options can also be indicated within a command line. Options are either numbers or alphanumeric option characters. Numbers used as options are generally contained in the command line with equal sign (=) or square brackets ([]) construction. The alphanumeric option characters

are set off from the I/O specifications by the slash (/) character for single character options, and parentheses for a string of single characters.

Some examples of command strings are as follows:

```
DTA1:DATA.AA<DTA0:DATA.AB,SYS:ABC.SV/I/A
```

where one output file with device and two input files with input devices are specified. The A and I options were specified.

DATA FILE NAMING CONVENTIONS

Data Files:

The data handling software by default has selected a consistent set of data file names. The file name is changed by the data handling software whenever the measurement data within the file has been used to update a master data file. This file name thus reflects the status of the file with respect to a master data file.

A new data file is created each time the system enters the data entry step. The data entry program INPUT creates files with the following file names:

D1XXYY.ZZ	Add data file
D2XXYY.ZZ	Change data file
D3XXYY.ZZ	Delection data file

where

XX = First 2 characters in chemist name

YY = Internal Parameter ID

ZZ = Extension specified by chemist.

Hence, each data file is uniquely defined in terms of the chemist, parameter, and its usage within the system. The initial file should be given an extension of

Initial Extension = 01

and incremented each time a new data file is entered into the system with the same file name.

The master data file may reside on any mass storage device and has the file name of

MASTER.ZZ

The first master data file would be given the extension of 01 and incremented each time a new master file is created.

The first letter of a file name is changed to the letter A whenever this file has been used to update the master data file. These data files become

A1XXYY.ZZ

A2XXYY.ZZ

A3XXYY.ZZ

AASTER.XX

after they have been used to update a master data file.

Temporary Data Files:

The following file names are used by the system for temporary data storage and should never be used for permanent data storage.

DATA.*	Created by Sort
DATADD.*	Created by Sort

FILE MANAGEMENT

The OS/8 system programs PIP, FOTP, and DIRECT provide the user with several file management operations. These file management operations include the transfer of files between devices, merging and deleting files, and list, zero, and compress directories. The OS/8 Handbook gives a complete description of these system programs.

PIP:

PIP is an OS/8 system program which is used to transfer files between devices, merge and delete files, and list, zero, and compress directories.

PIP is called by the command

```
.R PIP
```

in response to a dot printed by the Keyboard Monitor. PIP uses the Command Decoder to receive all I/O file specifications and options from the user. the /I option must be used with all file transfers. Four examples showing PIP operations are now shown.

PIP Example 1 (Merge)

```
.R PIP
*SYS:DATA.23<INPUT.48,INPUT.49,INPUT.50/I
```

This command instructs PIP to merge the files INPUT.48, INPUT.49 and INPUT.50 on DSK into one file DATA.23 on SYS. The /I option must be used for this operation.

PIP Example 2 (File Deletion)

```
*DATA.AB</D
*DATA:DATA.AC</D
```

The files DATA.AB and DATA.AC are deleted respectively from DSK and DATA.

PIP Example 3 (Copy a Tape)

```
*DSK:<(YZ)
*DSK:<SYS:/S
ARE YOU SURE?Y
```

The first PIP command places a new system area on DSK and zeroes the directory of this device. The second command copies all the files on SYS onto the device DSK. At the completion, DSK will contain only those files on SYS. However, all embedded empty files will have been eliminated.

PIP Example 4 (File Transfer)

```
*DSK:ABC.AA<SYS:INPUT.AC/I
```

The data file INPUT.AC on SYS is transferred to DSK and given the name ABC.AA. The /I option must be used with this transfer.

FOTP:

FOTP is an OS/8 system program which is used to transfer files between devices, deleted files, and rename files. FOTP is faster than PIP for certain functions and can perform certain functions not available to PIP. One advantage of FOTP is that it permits a wild card construction in the command string. The wild card construction allows several files to be transferred, deleted, or renamed with a single command. The same PIP function might require several commands to arrive at the same result.

Examples of FOTP use after being loaded by

```
.R FOTP
```

are

*DSK:DATA.??/D	Deleted all file on DSK: with the name of DATA
DTA1:<DTA0:DATA.	Transfer all files on DTA0: to DTA1: with name of DATA

DIRECT:

DIRECT is an OS/8 system program that produces listings of OS/8 directories. DIRECT producrs several varieties of listings and supports the wild card construction in the command line. PIP also produces directory listings.

Examples of DIRECT use after being loaded by

```
.R DIRECT
```

are

DSK:D1????.	List all files beginning with D1 on the Teletype
*SYS:A2????.03	List all files beginning with A2 with an extension of 03 on the Teletype

DATA ENTRY

Data is entered into the system via either the Hewlett-Packard HP-7260A Optical Mark Reader or the Teletype. The program INPUT is used for this purpose and is loaded as follows:

```
.AS DSK DATA
.R INPUT
```

The device DATA must have been defined to OS/8 prior to loading INPUT.

Each command line received by INPUT must have the following format:

```
CMD ID1 ID2 ID3 ID4 ID10 ID5 ID7 ID8 ID6 V1 V2 . . . Vn
```

where

CMD = Command Code
ID1 = Day ID
ID2 = Point ID
ID3 = Period ID
ID4 = Parameter ID
ID10 = Method ID
ID5 = Discrete ID
ID7 = Quality ID
ID8 = Accuracy ID
ID6 = Comment ID
V1 = First measurement value
V2 = Second measurement value
Vn = Nth measurement value

Each command line is classified as a command or a measurement to the system by the command code with a null command code specifying a measurement.

The following notation is used to simplify the command line examples which follow.

ID = Valid set of IDs

PAR = Valid Parameter and Method ID only

VAL = N measurement values V1, V2, . . ., Vn

J = One or two digit positive integer in numeric field

K = One or two digit positive integer in numeric field

Data File Specification:

The data file created by the data entry step must be specified before this program will accept measurements. These data files are normally given one of the following names:

DATA:D1XXYY.ZZ	Add Data File
DATA:D2XXYY.ZZ	Change Data File
DATA:D3XXYY.ZZ	Deletion Data File

where

XX = First 2 characters of chemists name

YY = Internal Parameter ID

ZZ = Extension specified by chemist.

Five commands are provided for file name specification which are as follows:

FNAM	PAR J K	Add Data File
DFILE	PAR J K	Deletion Data File

CFILE	PAR J K	Change Data File
CMDCR		Call Command Decoder
RFNAM	PAR J K	Resubmit Data File

where

J = Integer gives internal Chemist ID

K = Integer give file extension.

Prior to opening this file, the software checks to see whether a file with this name is already present. If a file is present, an error message is printed thus permitting the user to change file names. The RFNAM command permits the current file with this name to be replaced with the data which follows.

The software also checks to see whether a file with this name, but with the first letter being A instead of D, is already present. If a file is present, an error message is printed thus permitting the user to change file names. The check of file names prohibits the user from accidently deleting a valid data file.

Chemist Specification:

The name of the chemist must be specified before any measurement data is accepted by the system. The commands relating to the chemist specification are as follows:

NACHEM	K	Name the chemist
PRCHEM		Print the name of current chemist

The integer K appears in the numeric field and is the internal Chemist ID for this chemist.

End of Data Entry:

The command

END

tells INPUT that the end of all input has been received.

Measurement Value Format:

The format of the measurements in the numeric field can be specified to detect the presence of excessive digits or the absence of missing digits. These format commands are as follows:

FORM VAL	Enable format checking, sample measurements are given in numeric field
OFFORM	Disable format checking
ONFORM	Enable format checking

Two measurements have the same format if they have exactly the same number of digits before and after the decimal points. Formats are checked only on measurements.

Default ID Generation:

The default IF option, when enabled, replaces a missing ID with a default ID. This option is operable only with measurements and not command. The default ID commands are as follows:

GDFID ID	Enable system to use the default ID set given in this command
ONDID	Enable system to use default IDs
OFFDID	Disable system from using default IDs
LSDID	Use IDs from last measurement as the default IDs and enable system for default ID usage

Data Input Options:

Several options are available to the user to use during data entry. These options are as follows:

CONDAT	Accept only continuous data
DISCAT	Accept only discrete data
CONERR	Continue reading cards on an error
TRAN	Use translation table (Card reader is usually input device)
NTRAN	Do not translate (Teletype usually is the input device)
MXVAL PAR VI	Place maximum limit of VI on measurement value for parameter given
MNVAL PAR VI	Place lower limit of VI on the measurement value for the parameter given
ON	Enable system to do data conversions
OF	Disable system from performing data conversions

Whenever the value of the measurement for the specified parameter exceeds the specified limits, the value of the measurement becomes the limit and the comment ID is changed to note that a limit has been exceeded. The program INPUT has been initiated to accept both continuous and discrete data, stop when an error is encountered while reading cards, use translation tables, disable from doing data conversions, and have no limits specified.

Function Specification:

The various data reduction algorithms use calibration curves to convert from a raw measurement value to a final measurement value. For example, a concentration can be computed via a calibration curve from an absorbance. The program approximates these calibration curves with either a piecewise linear functions or long-linear functions. Given the

coordinate pairs, (X_1,Y_1), (X_2,Y_2), ..., (X_n,Y_n), the system defines the linear function F(x) as follows:

$$F(X) = Y_i + M_i\ (X - X_i) \qquad X \leq X_2 \quad X_i \leq X \leq X_{i+1} \quad X \geq X_{n-1}$$

$$M_i = (Y_{i+1} - Y_i)/(X_{i+1} - x_i)$$

The following command sequence is used to enter these coordinate pairs:

```
CNI          PAR

DA           X1 Y1          Input (x1, y1)
DA           X2 Y2               .
DA           X3 Y3               .
 .             .                 .
DA           XN YN          Input (xn,yn)
EDA                         End-of-table
```

The coordinates which define any function can be listed by the following command:

```
LSFNC        PAR
```

The value of the function can be determined for any value of X by the following command:

```
CHKFN        PAR      X
```

The capability to define upper and lower limits for this function computations are provided by the commands as follows:

MN	PAR	V1	V1 is lower limit of function for given parameter
MX	PAR	V1	V1 is upper limit of function for the given parameter

Whenever the limits of the function are exceeded, the comment ID is changed to note that the limit has been exceeded.

Calibration Curve Computations:

The system program INPUT has the capability of accepting a sequence of coordinates (X_i, Y_i) and provide a least square fit to this coordinate sequence to find the coefficients for one of the following equations:

$$Y = M \cdot X$$

$$Y = B + M \cdot X$$

$$Y = B + M \cdot \mathrm{Log}(X)$$

The coefficient for the first equation is computed by the command sequence:

```
LOFNC   PAR
DA      X1  Y1
 .      .   .
 .      .   .
DA      Xn  Yn
EDA
```

The system will then automatically print out the original coordinate sequence along with the computed value of Y.

```
N
X1   Y1    **  F(X1)
.    .          .
.    .          .
Xn   Yn    **  F(Xn)
```

The coefficients, B and M, for the second linear equation are computed by the command sequence:

```
LIFNC   PAR
DA      X1  Y1
.       .   .
.       .   .
DA      Xn  Yn
EDA
```

with the program automatically printing out the original sequence of points with the corresponding computed value of Y_i.

The coefficients for the log-linear function are determined by using the command

LGFNC PAR

followed by the sequence of coordinate pairs.

The tabulation of the original coordinate sequence along with the computed value of the function can be disabled with the command

DPRFNC

and enabled by

DPRFNC

The system is initialized to print this function.

The computed coefficients are automatically placed in the function tables allocated to these parameters. The command

LSFNC PAR

permits a listing of these tables. If the function tables for this parameter were input by one of these commands, the following would be printed in response to this command.

$$\begin{matrix} 2 & \\ X_1 & Y_1 \\ X_2 & Y_2 \end{matrix}$$

For the log-linear case, the coefficients are

$$Y_1 = B$$
$$Y_2 = M$$

with the values of X_1 and X_2 having no meaning.

Data Conversion Constants:

The data reduction algorithms in some cases require one or more constants to fully define these algorithms. These constants are entered into this program by the command

CN PAR VAL

where the number of values entered is dependent on the algorithm for the specified parameter.

Duplicate Data:

Under certain circumstances, a given measurment is performed several times with the final measurement being the average of all these measurements. The program provides the capability to accept multiple measurements and perform this average. These duplicate measurement must be entered in consecutive order with the command sequence

```
 ID        VAL
DU   PAR   VAL
DU   PAR   VAL
 ID        VAL
```

The command DU instructs this program that this command line is duplicate data for the previous measurement. When the program encountera a measurement for a new sample, the number of measurements received and the average of these measurements are printed.

Data Continuation:

The program provides the capability of using more than one card to enter the numeric field information. The command

ADATA

enables the continuation of the numeric field to additional cards while

NOADA

requires all information to be found on one card. The program is initialized to require a command line to be one card.

When data continuation is used, the following command

CMD ID V1 V2 V3 .... VN

can be entered by

```
CMD   ID   V1
DA         V2
.          .
DA         VN
```

Whenever an insufficient number of values are found in the numeric field, the program with data continuation enabled expects to find the next card to have the command DA with more values.

Skip ID Option:

Each command line requires the specification of 6 primary ID tags and 3 secondary ID tags. When the Teletype is used as the input device, this specification requires excessive typing. This command allows measurement command lines to skip selected ID tags and use the default ID option for the specification of these skipped ID tags.

The command

SKPID ID

instructs the system to skip those ID tags on input for measurement lines for those non-null ID tags found in this ID specification. If an ID tag is null in this command, the user must supply this ID via the Teletype keyboard for each measurement line. Command lines with a non-null command code always require the entering of all information.

List Output Buffer:

Valid measurements are placed in an output buffer. This output buffer has space for 28 measurements. When this buffer becomes full, this buffer is emptied by transferring these measurements to the output device. The command

LBUF

permits the information in the current output buffer to be listed on the Teletype.

Teletype Input:

On teletype input, the NTRAN option should be used to disable translation. The program INPUT prints a (#) to request either a measurement or a command line from the operator while in this mode. For command lines, INPUT automatically skips those ID tags which are not required to specify the command. For measurement lines, the SKPID and DEFID data input options should be used to simplify input. The Automated Instrument User's Manual gives example and additional information on receiving input from the Teletype.

PDM-7Ø Programming:

The program INPUT has the capability of remotely programming an interfaced PDM-7Ø. The command PROG I sends program number I to the PDM-7Ø. Programs 1, 2, and 3 respectively program the PDM-7Ø to operate the Fisher Scientific pH meter, Talos digitizer, and the Yellow Springs S-C-T meter. The Automated Instrument User's Manual provided additional details of this function.

Change Column Translate Table:

The command CHTRAN I J replaces the column I table with the column J table at execution time. This command was primarily added to permit column 0-39 tables for a 40 column card to be replaced with tables defined for columns 40, 41, 42, . . .

Translation Tables:

When the mark cards are used as the input media, it is necessary to convert these marks to meaningful input through the use of translation tables. Each character from the card reader when received is translated via a translation table to a character string which may be null. A unique translation table is provided for each card column.

The translated card image is a character string which is divided into several character strings, called fields, by the occurrence of a space. The character string which defines each field is translated into a new character string by a unique translation table provided for each field. This final resulting character string is the character string printed on the Teletype and is interpreted by the system as the command line. Each field in this final command line is either a command code, an ID tag, or a value in the numeric field. The character string for each field is checked for validity. The ID tags are compared to the lists provided by the file DSK:SYSDEF.AR.

Operation of Program:

The progran INPUT is loaded by

.R INPUT

with the default options being

1. Input data from the card reader
2. Accept continuous and discrete data
3. Numeric formats are not checked
4. Card reader stops on error. Ready required to restart.
5. Default ID option disabled
6. Data continuation disabled

All output printed on the Teletype during data entry is a copy of the actual measurement information received by the INPUT program. This printout should be reviewed by the chemist to validate that the system received the correct information. The program MERGE can be used to correct any errors which are noted within this file.

If the command decoder is used to receive the output file name, the options which may be used are shown in the Data Input Option Table.

The panel controls for the HP-7260A are found in tables showing both Front Panel and Back Panel Operator Controls.

Back Panel Operator Controls

Control	Position
Data Rate Selector	110 Baud
Card Selector	Clock After Data

Data Input Option Table

Option	Function
/T	Input Data from the Teletype
/C	Accept Continuous Data only
/C	Accept Discrete Data only
/E	Continue on Error Condition
/F	Check Numeric Field Formats (Requires Format Table)

Front Panel Operator Controls

Control	Position	Function
Line on PB	In	Turns Power On and Off
Terminal Mute PB	In	Mutes Transmission from Connected Terminal
Line/Local PB	In	Connects Reader for On-Line Operation
Full/Half PB	In	Full or Half Duplex Operation
Ready PB		Signals CRB that Cards can be read
Stop PB		Stops Reading of Cards
Single-Pick PB		Not used by CRB
Continuous-Pick PB		Should not be used

Several messages may be printed on the Teletype regarding the status of the Card Reader. These messages and their functions are shown in the following table.

Card Reader Status Messages

Messages	Function
RDY	Card Reader is ready, READY PB was pressed
NOT RDY	Reader stopped, STOP PB was pressed
HOPPERS?	Input/Output Hopper is Empty/Full
PICK FAIL	Card Jam
COL CNT	Excessive number of columns found on a card.
CONFUSED	Illegal character sequence detected.

The system reports to the operator errors in the command lines which have been located. The error message consists of a character denoting the type of error followed by a 2 digit number indicating the approximate column where the error was detected. These error codes are as follows:

Error Messages

Code	Reason
Bnn	No room in tables
Dnn	Dispatch error, no EDA command found
Enn	Error encountered, usually given

Code	Reason
Fnn	Format error in numeric field
Gnn	Function error, no information on function
Hnn	Duplicate data error
Inn	ID error, illegal or missing ID
Jnn	Incorrect number of values in numeric field
Knn	Illegal Chemist given
Lnn	More IDs received than expected
Mnn	Expected 1 or 2 digit integer
Nnn	File present with same name or illegal file
Pnn	Device DATA: not found, fatal error
Qnn	No table for this parameter
Rnn	System cannot receive coordinates
Snn	Not enough coordinates given
Tnn	Translate error
Vnn	Cannot perform conversion
Znn	Command line is too short

On Teletype input, the system prints a # to request a measurement from the operator. The following rules must be followed while typing the measurement.

1. One space between each ID
2. One space between comment ID and numeric field
3. Numeric field must be terminated with a RETURN.
4. One space between command field and Day ID.

INPUT COMMAND SUMMARY

Card Code	Command	Function
DA	DA	Data Card
EN	EDA	End of data
A1	GDFID ID	Enter default ID, enable default ID option
A2	ONDID	Enable default ID option
A3	OFFDID	Disable default ID option
A4	LSDID	Get default ID from last measurement
A5	SKPID ID	Skip the IDs given
A10	FORM VAL	Enable numeric field format checking, the numeric field must have same format as VAL
A11	ONFORM	Enable numeric field format checking
A12	OFFORM	Disable numeric field format checking
B1	CONDAT	Accept continuous data only
B2	DISDAT	Accept discrete data only
B3	CONERR	Continue on error option
B4	ADATA	Permit numeric field to be continued in the next command lines
B5	NOADA	Disable numeric field continuation
B6	NTRAN	Do not translate, Teletype is input device
B7	TRAN	Translate, card reader is input device
CA1	LOFNC PAR	Using least squares, pass equation Y=MX through following data
CA2	LIFNC PAR	Using least squares, pass equation Y=B+MX through the following data
CA3	LGFNC PAR	Using least squares, pass the equation Y=B+M·LOG(X) through the following data
CA10	EPRFNC	Evaluate equation found by least squares for each X and print Y

Card Code	Command	Function
CA11	DPRFNC	Disable system from evaluating equation after least square fit
CN	CN PAR VAL	Enter constants for data conversion algorithm
CN1	CN1 PAR	Enable system to accept the following function defining coordinates
CN2	LSFNC PAR	List the function defining coordinates
CN3	LBUF	List current output buffer
CN4	CHCAL PAR VAL	Check data conversion algorithm
CN5	CHKFN PAR VAL	Evaluate function
CN10	MN PAR VAL	Accept function lower limit
CN11	MX PAR VAL	Accept function upper limit
CN20	MXVAL PAR VAL	Limit maximum final measurement value
CN21	MNVAL PAR VAL	Limit minimum final measurement value
D	FNAM PAR I J	Specify data addition file name
D11	RFNAM PAR I J	Name the replacement data file
D1	CFILE PAR I J	Name the change data file
D2	DFILE PAR I J	Name the deletion data file
D20	CMDCR	Call the command Decoder
CH	NACHEM I	Name the chemist
CH1	PRCHEM	Print the name of chemist
OF	OF	Disable system to do data conversions
ON	ON	Enable system to do data conversions
DU	DU PAR VAL	Enter duplicate data
EN1	END	End of data entry
B8	CHTRAN I J	Replace column I table with column J table
B9	PROG I	Send program I to PDM-70

Data Entry Examples:

Several examples of data entry using the program INPUT are shown to illustrate these data entry commands with a wide variation of parameters and conditions. These examples utilized the data conversion algorithms shown in the following tables.

Parameter	Conversion Algorithm
SO4	10
PH	14
COND	15
ACID	12
TALK	1
G&O	9
TURB	8
TS	13
SS	9
MBAS	6
NH3-N	7
TOC	2
NO-N	4
TDS	13
CCL4	3
C2HCL3	3
CHCL3	4
PO4	4
PHENOL	4
CR	0

DATA REDUCTION ALGORITHMS

Function Number	Algorithm
0	$Y = M_1$
1	$Y = 50000 * C_1 * (M_1/M_2)$
2	$Y = F_1(M_1) * M_2 + F_2(M_3) * M_4$
3	$Y = F(M_1)$
4	$Y = F(M_1) * M_2$
5	$Y = C_1 * Exp(C_2*M_1)$
6	$Y = F(M_1)/M_2$
7	$Y = Exp((M_1 - Y_1)/Y_2)$
8	$Y = M_1 * M_2$
9	$Y = 100 * (M_2 - M_3)/M_1$
10	$Y = F(M_1*M_2 - C_1)$
11	$Y = M_1 * F(M_2) * M_3$
12	$Y = (M_1 - M_2) * C_1 * 50000/M_3$
13	$Y = (M_1 - M_2) * 100/C_1$
14	$Y = MI/1000$
15	$Y = F_1(M_2) * F_2(M_4)$

```
FNAM     TURB        3 1
NACHEM             3 WOLLA
ON
 12 S1 1 TURB        2 1 *      +2.00
 12 I6 1 TURB       66 1 *     +66.00
 12 I7 1 TURB       12 1 *     +12.00
 12 I10 1 TURB      26 1 *     +26.00
 12 I13 1 TURB       5 1 *      +5.00
 12 S1 2 TURB       8 1 *      +8.00
 12 I5 1 TURB       6 1 *      +6.00
 12 I6 2 TURB      72 4 *    +288.00
 12 I7 2 TURB       4 1 *      +4.00
 12 I8 2 TURB       2 1 *      +2.00
 12 I10 2 TURB     15 1 *     +15.00
 12 I11 2 TURB      1 1 *      +1.00
 12 I12 2 TURB     31 1 *     +31.00
 12 I13 2 TURB     15 1 *     +15.00
END
```

Figure 1 Sample Input and Computation for Turbidity

```
FNAM     P04       Ø2 Ø2
MNVAL     P04       .Ø5
LIFNC     P04
DA            Ø -.ØØ162685
DA            1 .Ø2Ø
EDA

      +2.ØØ
      +Ø.ØØ      -Ø.ØØ  **      -Ø.ØØ
      +1.ØØ      +Ø.Ø2  **      +Ø.Ø2
ON
NACHEM            Ø2 BROWN
 6 I9 1 P04        16 25 *      +8.61

 7 S2 1 P04        5.5 1 *      +Ø.12

 7 S4 1 P04        26 1 *      +Ø.56

 7 I9 1 P04        47.5 1 *      +1.Ø3

 7 I7 1 P04        18.5 5 *      +1.99

 7 I5 1 P04        Ø 25 *<      +Ø.Ø5

 7 I8 1 P04        14 625 *    +188.22

 7 S2 2 P04        Ø 5 *<      +Ø.Ø5

 7 S4 2 P04        68.2 1 *      +1.47

 7 I7 2 P04        24.5 5 *      +2.64

 7 I5 2 P04        8.8 25 *      +4.72

 7 I8 2 P04        85 25 *     +45.92

END
•
```

Figure 2 Sample Input and Computation for Phosphates

```
FNAM     TALK       5 2
NACHEM              5 SMITH
CN     TALK         .0307
ON
 13 S2 1 TALK    T, AR  4.5 100 *     +69.07
 13 S4 1 TALK    CL,C, AR  4.6 100 *     +70.61
 13 I5 1 TALK    LC,C, AR  20.4 100 *    +313.14
 13 S2 1 TALK    IC,C, 10  4.2 100 *     +64.47
 13 I6 2 TALK    LC,C,NH, 10  10.5 50 *    +322.35
 13 I9 2 TALK    CL,C, AR  1.5 50 *      +46.05
 13 I7 2 TALK    CL,C,    2.5 50 *      +76.75
 13 I5 2 TALK    CL,C, AR  12.7 100 *    +194.94
 13 S4 2 TALK    CL,C, AR  3.6 100 *     +55.26
 13 S2 2 TALK    CL,C, AR  4.0 100 *     +61.40
 13 S1 2 TALK    LC,C, AR  3.7 100 *     +56.79
 13 I11 2 TALK    CL,C, AR  2.7 50 *     +82.89
 13 I10 2 TALK    CL,C, AR  7.2 10 *   +1105.20
 13 I8 2 TALK    LC,H,    1.0 50 *      +30.70
END
```

Figure 3 Sample Input and Computation for Total Alkalinity

```
FNAM     SS        02 02
NACHEM             02 BROWN
ON
  4 S4 1 SS        200 188670 186661 *   +1004.50
  4 I11 2 SS       200 169986 169971 *      +7.50
  4 S4 2 SS        200 187560 187551 *      +4.50
  4 I11 1 SS       100 164339 164325 *     +14.00
  4 I8 2 SS        200 148813 148805 *      +4.00
  4 I7 2 SS        200 187450 187445 *      +2.50
  4 I6 2 SS        200 184990 184976 *      +7.00
  4 S1 2 SS        200 189737 189724 *      +6.50
  4 I6 1 SS        250 187251 187230 *      +8.40
  4 S2 1 SS        400 174478 174471 *      +1.75
  4 I8 1 SS        200 157505 157482 *     +11.50
  4 I10 2 SS       100 188884 188871 *     +13.00
  4 I10 1 SS       100 234882 234881 *      +1.00
  4 I7 1 SS        150 237393 237388 *      +3.33
  4 I13 1 SS       100 227523 227510 *     +13.00
  4 I12 1 SS        75 237640 237597 *     +57.33
  4 S1 1 SS        200 227952 227950 *      +1.00
  4 I13 2 SS       100 241239 241230 *      +9.00
  4 S2 2 SS        400 238269 238263 *      +1.50
  4 I12 2 SS       100 238199 238160 *     +39.00
```

```
LBUF

4 S4 1 SS          +1004.50
4 I11 2 SS             +7.50
4 S4 2 SS              +4.50
4 I11 1 SS             +14.00
4 I8 2 SS              +4.00
4 I7 2 SS              +2.50
4 I6 2 SS              +7.00
4 S1 2 SS              +6.50
4 I6 1 SS              +8.40
4 S2 1 SS              +1.75
4 I8 1 SS             +11.50
4 I10 2 SS             +13.00
4 I10 1 SS              +1.00
4 I7 1 SS              +3.33
4 I13 1 SS             +13.00
4 I12 1 SS             +57.33
4 S1 1 SS              +1.00
4 I13 2 SS              +9.00
4 S2 2 SS              +1.50

END
```

Figure 4 Sample Input and Computation for Suspended Solids

```
FNAM     NO-N        01 01
CN1     NO-N
DA             0 -.020
DA             1 .0014763
EDA
NACHEM             01 DRAKE
PRCHEM              DRAKE
LSFNC     NO-N
      +2.00
      +0.00        -0.02
      +1.00        +0.00

ON
CONDAT
 8 I8 1 NO-N        24 5 *       +2.48

 8 I8 2 NO-N        28.3 25 *     +14.69

END
```

Figure 5 Sample Input and Computation for Nitrite-Nitrate

```
FNAM     PH          1 01
NACHEM               02 BROWN
 13 I11 2 PH          6.7
 13 I9 2 PH           7.1
 13 I10 2 PH          11.2
 13 I8 2 PH           6.1
 13 I7 2 PH           7.0
 13 I5 2 PH           7.7
 13 S4 2 PH           7.1
 13 S2 2 PH           7.2
 13 S1 2 PH           6.9
 13 I11 1 PH          9.0
 13 I10 1 PH          11.9
 13 I9 1 PH           9.0
 13 I8 1 PH           6.9
 13 I6 1 PH           9.4
 13 I7 1 PH           7.1
 13 I5 1 PH           8.8
 13 S4 1 PH           7.4
 13 S2 1 PH           9.4
 13 S1 1 PH           9.1
END
```

Figure 6 Sample Input and Computation for PH

```
FNAM     SO4          03 03
NACHEM                03 WOLLA
CN     SO4          0
LIFNC     SO4
DA              0 -.424465
DA              1 -.140411
EDA

      +2.00
      +0.00       -0.42  **       -0.42
      +1.00       -0.14  **       -0.14
ON
LSFNC     SO4
      +2.00
      +0.00        -0.42
      +1.00        -0.14

PRCHEM               WOLLA
 12 I13 2 SO4          50 50 *    +709.71

 12 I12 2 SO4          43 25 *    +304.93

 12 I13 1 SO4          25 100 *    +709.71

END
```

Figure 7 Sample Input and Computation for Sulfates

```
FNAM     C2HCL3       Ø1 Ø1
NACHEM           Ø1 DRAKE
L1FNC    C2HCL3
DA           Ø Ø
DA            1 .0475907
EDA

     +2.ØØ
     +Ø.ØØ      +Ø.ØØ  **      +Ø.ØØ
     +1.ØØ      +Ø.Ø5  **      +Ø.Ø5
ON
MNVAL     C2HCL3       .Ø5
 6 I5 1 C2HCL3       Ø *<      +Ø.Ø5

 6 I6 1 C2HCL3       14.4 *      +Ø.69

 6 S4 1 C2HCL3       Ø *<      +Ø.Ø5

 6 I1Ø 1 C2HCL3       Ø *<      +Ø.Ø5

 6 S2 1 C2HCL3       Ø *<      +Ø.Ø5

 6 I8 1 C2HCL3       Ø *<      +Ø.Ø5

 7 I8 1 C2HCL3       4.6 *      +Ø.22

 7 I6 1 C2HCL3       61 *      +2.9Ø

 7 I1Ø 1 C2HCL3       Ø *<      +Ø.Ø5

 7 S4 1 C2HCL3       Ø *<      +Ø.Ø5

 7 S2 1 C2HCL3       Ø *<      +Ø.Ø5

 7 I13 1 C2HCL3       2 *      +Ø.1Ø

 7 I9 1 C2HCL3       6.1 *      +Ø.29

END
```

Figure 8 Sample Input and Computation for C_2HCL_3

```
FNAM     CHCL3       Ø1 Ø1
CN1     CHCL3
DA            Ø Ø
DA            1 .Ø38Ø789
EDA
ON
NACHEM            Ø1 DRAKE
PRCHEM             DRAKE
 6 I5 1 CHCL3       7.8 *      +Ø.3Ø

 6 I6 1 CHCL3       8.2 *      +Ø.31

 6 S4 1 CHCL3       6.9 *      +Ø.26

 6 I1Ø 1 CHCL3       5.2 *      +Ø.2Ø

 6 S2 1 CHCL3       5 *      +Ø.19

 6 I8 1 CHCL3       8.3 *      +Ø.32

 7 I8 1 CHCL3       11.3 *      +Ø.43

 7 I6 1 CHCL3       1Ø.3 *      +Ø.39

 7 I1Ø 1 CHCL3       11.5 *      +Ø.44

 7 S4 1 CHCL3       11.8 *      +Ø.45

 7 S2 1 CHCL3       11.8 *      +Ø.45

 7 I13 1 CHCL3       12.4 *      +Ø.47

 7 I9 1 CHCL3       12.7 *      +Ø.48

END
```

Figure 9 Sample Input and Computation for $CHCL_3$

```
FNAM     COND       Ø1 Ø1
NACHEM              Ø2 BROWN
ON
 13 I6 2 COND        521 22 1. *    +552.26
 13 I11 2 COND        181 20 1. *    +199.10
 13 I9 2 COND        134 21 1. *    +144.72
 13 I10 2 COND        1840 22 1. *   +1950.40
 13 I8 2 COND        143 20 1. *    +157.30
 13 I7 2 COND        277 20 1. *    +304.70
 13 I5 2 COND        668 19 1. *    +764.19
 13 S4 2 COND        136 16 1. *    +173.54
 13 S2 2 COND        158 17 1. *    +194.66
 13 S1 2 COND        149 18 1. *    +177.01
 13 I11 1 COND        140 6 1. *    +215.60
 13 I10 1 COND        5030 16 1. *   +6418.27
 13 I10 1 COND        182 18 1. *    +216.22
 13 I9 1 COND        128 16 1. *    +163.33
 13 I8 1 COND        394 15 1. *    +520.08
 13 I6 1 COND        211 5 1. *     +333.38
 13 I7 1 CON         617 16 1. *    +787.29
 13 I5 1 COND        146 18 1. *    +173.45
 13 S4 1 COND        144 4 1. *     +233.28
 13 S1 1 COND        101 3 1. *     +167.66
END
```

Figure 10 Sample Input and Computation for Specific Conductivity

```
FNAM     TS        3 1
NACHEM             3 WOLLA
ON
CN     TS       100
 4 I12 2 TS       942455 942160 *    +295.00
 4 S2 2 TS        849191 849084 *    +107.00
 4 I13 2 TS       856571 855216 *   +1355.00
 4 S1 1 TS        869571 869465 *    +106.00
 4 I12 1 TS       923690 931557 *   -7867.00
 4 I13 1 TS       974954 973508 *   +1446.00
 4 I7 1 TS        935940 935767 *    +173.00
 4 I10 1 TS       879857 877791 *   +2066.00
 4 I10 1 TS       946870 946808 *     +62.00
 4 I8 2 TS       1386171 1386046 *    +125.00
 4 S2 1 TS        899233 899124 *    +109.00
 4 I6 1 TS        979061 978969 *     +92.00
 4 S1 2 TS        709432 709340 *     +92.00
 4 I6 2 TS        722398 722276 *    +122.00
 4 I7 2 TS        705900 705766 *    +134.00
 4 I8 2 TS        715717 715581 *    +136.00
 4 I11 1 TS       716358 716150 *    +208.00
 4 S4 2 TS        878040 877931 *    +109.00
 4 I11 2 TS      1298719 1298405 *    +314.00
 4 S4 1 TS        906106 905947 *    +159.00
END
```

Figure 11 Sample Input and Computation for Total Solids

```
FNAM     G&O       Ø1 Ø1
NACHEM             Ø1 DRAKE
ON
 8 S1 1 G&O       900 809378 809091 *     +31.89
 8 S2 1 G&O       920 568842 568724 *     +12.83
 8 S4 1 G&O       880 827114 827008 *     +12.05
 8 I8 1 G&O       940 831119 831008 *     +11.81
 8 I9 1 G&O       830 788667 788463 *     +24.58
 8 I6 1 G&O       955 562866 561850 *    +106.39
 8 I7 1 G&O       920 573240 572965 *     +29.89
 8 I5 1 G&O       940 564310 563339 *    +103.30
 8 I10 1 G&O       945 590100 588039 *    +218.10
 8 I13 1 G&O       935 563303 562814 *     +52.30
 9 I8 1 G&O       940 562316 562061 *     +27.13
 9 S2 1 G&O       900 588550 588310 *     +26.67
 9 I9 1 G&O       900 809357 809087 *     +30.00
 9 S4 1 G&O       900 569090 568828 *     +29.11
 9 I13 1 G&O       900 532547 532158 *     +43.22
 9 I7 1 G&O       920 578150 577703 *     +48.59
 9 I5 1 G&O       915 820150 819062 *    +118.91
 9 I10 1 G&O       915 836401 828763 *    +834.75
 9 I6 1 G&O       945 793018 791995 *    +108.25
END
```

Figure 12 Sample Input and Computation for Greases and Oils

```
FNAM     MBAS        2 01
CNI     MBAS
DA             0 1.08536
DA             1 196.251
EDA
NACHEM             02 BROWN
ON
MNVAL     MBAS         1.
MXVAL     MBAS         40
CONDAT
CHCAL     MBAS         .4128 2 *>      +40.00

LSFNC     MBAS
      +2.00
      +0.00         +1.09
      +1.00       +196.25

PRCHEM              BROWN
LSFNC     COND
      +6.00
      +5.00         +1.58
     +10.00         +1.38
     +15.00         +1.32
     +20.00         +1.10
     +25.00         +1.00
     +30.00         +0.90

 8 I5 1 MBAS        .4128 2 *>      +40.00

 8 I5 2 MBAS        .5475 2 *>      +40.00

 8 I6 1 MBAS        .5998 5 *      +23.63

 8 I6 2 MBAS        .6520 5 *      +25.67

 8 I7 1 MBAS        1.1380 20 *     +11.16

 8 I7 2 MBAS        1.2250 20 *     +12.01

 8 I8 1 MBAS        .0578 100 *<      +1.00

 8 I8 1 MBAS        .0154 50 *<       +1.00

 8 I9 2 MBAS        .5190 20 *       +5.12

 8 I10 1 MBAS        .3355 20 *       +3.33
```

```
 8 I10 2 MBAS        .1468 30 *<       +1.00

 8 I11 1 MBAS        .0381 30 *<       +1.00

 8 I11 1 MBAS        .0557 30 *<       +1.00

 8 I12 2 MBAS        .9698 20 *        +9.52

 8 I13 1 MBAS        .5330 20 *        +5.26

 8 I13 2 MBAS        .3611 20 *        +3.58

 8 S1 1 MBAS        .0252 100 *<       +1.00

 8 S1 2 MBAS        .0089 100 *<       +1.00

 8 S2 1 MBAS        .0109 100 *<       +1.00

 8 S2 2 MBAS        .0216 100 *<       +1.00

 8 S4 1 MBAS        .0260 100 *<       +1.00

 8 S4 2 MBAS        .0222 100 *<       +1.00

EPRFNC
LIFNC     MBAS
DA              2 4
DA              1 2
DA              3 6
DA              4 8
DA              10 20
EDA

      +5.00
      +2.00        +4.00   **        +4.00
      +1.00        +2.00   **        +2.00
      +3.00        +6.00   **        +6.00
      +4.00        +8.00   **        +8.00
     +10.00       +20.00   **       +20.00
LSFNC     MBAS
      +2.00
      +0.00         +0.00
      +1.00         +2.00

END
```

Figure 13 Sample Input and Computation for MBAS

```
CN NH3-N 3.45293 -.0408985
ON
8 S1 1 NH3-N    165.7 1  **      +0.00
8 S2 1 NH3-N    150.2 1  **      +0.01
8 S4 1 NH3-N    146.3 1  **      +0.01
8 I5 1 NH3-N    57.4 1   **      +0.33
8 I6 1 NH3-N    119.0 1  **      +0.03
8 I7 1 NH3-N    111.5 1  **      +0.04
8 I8 1 NH3-N    45.7 1   **      +0.53
8 I9 1 NH3-N    59.4 1   **      +0.30
8 I10 1 NH3-N   61.9 1   **      +0.27
8 I11 1 NH3-N   68.7 1   **      +0.21
8 I12 1 NH3-N   62.6 1   **      +0.27
8 I13 1 NH3-N   106.3 1  **      +0.04
8 S1 2 NH3-N    88.8 1   **      +0.09
8 S2 2 NH3-N    106.5 1  **      +0.04
8 S4 2 NH3-N    116.9 1  **      +0.03
8 I5 2 NH3-N    47.2 1   **      +0.50
8 I6 2 NH3-N    93.6 1   **      +0.08
8 I7 2 NH3-N    108.7 1  **      +0.04
8 I10 2 NH3-N   -2.4 1   **      +3.81
8 I11 2 NH3-N   57.9 1   **      +0.32
8 I13 2 NH3-N   98.9 1   **      +0.06
```

Figure 14 Sample Input and Computation for Ammonia

LIST

The Data Handling System provides the capability of listing data files, information files, and the ID tags on the Teletype. This listing software is loaded by the commands:

```
.R DAHDLR
```

When loaded, the system will respond with

```
DATA HANDLER
FUNCTION?
```

where the operator must enter the appropriate listing command. Any user device name such as device DATA and device INFO must have been defined to the OS/8 monitor with the ASSIGN command prior to calling this program. Any attempt to list a nonexistent file or a file in the wrong format will result in an error with the system returning to the Key Board Monitor.

Data Files:

Data files can be listed on the Teletype with either the command LIST or the command LISTPRI. The command LISTPRI ignores the secondary ID tags. Two examples are shown to illustrate this data file listing concept. The user of the system must supply the file name to the system.

Information Files:

Information files can be listed on the Teletype with either the command LINFO or LISTINF. The command LINFO lists the temporary information file INFO:INFO.IN which is created during report and print-plot generation. The command LISTINF permits the operator to list an information file with an arbitrary name.

The example shown lists the file INFO:INFO.IN which contains 2 records.

Short ID Tags:

The short ID tags belonging to any ID class may be listed on the Teletype by entering the command LISTSD. This listing shows both the internal ID tag and the short external ID tag. The ID tags are handled internally by the Data Handling System as positive integers between 1 and 63 where the external representation is a character string. The listing of the Chemist ID class provides a correspondence between external and internal ID tags required by the file naming command step during data entry. Examples are shown to illustrate the listing of each ID class.

```
FUNCTION?LIST

INPUT FILE?DISM05.02
13 S2 1 TALK     69.0749 T, SMITH AR
13 S4 1 TALK     70.6099 CL,C, SMITH AR
13 I5 1 TALK     313.14 LC,C, SMITH AR
13 S2 1 TALK     64.4699 IC,C, SMITH 10
13 I6 2 TALK     322.35 LC,C,NH, SMITH 10
13 I9 2 TALK     46.05 CL,C, SMITH AR
13 I7 2 TALK     76.7499 CL,C, SMITH
13 I5 2 TALK     194.945 CL,C, SMITH AR
13 S4 2 TALK     55.26 CL,C, SMITH AR
13 S2 2 TALK     61.4 CL,C, SMITH AR
13 S1 2 TALK     56.795 LC,C, SMITH AR
13 I11 2 TALK     82.8899 CL,C, SMITH AR
13 I10 2 TALK     1105.2 CL,C, SMITH AR
13 I8 2 TALK     30.7 LC,H, SMITH
INPUT FILE DISM05.02 HAS  14 POINTS
```

Figure 15 Sample Listing of Data File

```
FUNCTION?LISTPRI

INPUT FILE?DIBR27.01
8 I5 1 MBAS  >  40
8 I5 2 MBAS  >  40
8 I6 1 MBAS     23.6291
8 I6 2 MBAS     25.6667
8 I7 1 MBAS     11.1592
8 I7 2 MBAS     12.0082
8 I8 1 MBAS  <  1
8 I8 1 MBAS  <  1
8 I9 2 MBAS     5.11881
8 I10 1 MBAS     3.32817
8 I10 2 MBAS  <  1
8 I11 1 MBAS  <  1
8 I11 1 MBAS  <  1
8 I12 2 MBAS     9.51784
8 I13 1 MBAS     5.25543
8 I13 2 MBAS     3.57798
8 S1 1 MBAS  <  1
8 S1 2 MBAS  <  1
8 S2 1 MBAS  <  1
8 S2 2 MBAS  <  1
8 S4 1 MBAS  <  1
8 S4 2 MBAS  <  1
INPUT FILE DIBR27.01 HAS  22 POINTS
```

Figure 16 Sample Listing of Data File with Primary ID Tags

```
FUNCTION?LINFO

INFO RECORD =  1
 1  3  2  4  0  0
DAY
 1 1
PNT
 1 S1
 2 S2
 3 S4
 4 I5
 5 I6
 6 I7
 7 I8
 8 I10
 9 I13
PEP
 1 2
PAR
 1 PH
 2 COND
 3 TALK
 4 TURB
 5 TOC
 6 TS
 7 VS
 8 TDS
 9 NH3-N
 10 NO-N
 11 PO4
 12 SO4
 13 MBAS
 14 PHENOL
 15 G&O
 16 BOD
DIS
SEGMENT =  5
OPTION = REPORT
```

```
INFO RECORD =  2
 1  3  2  4  Ø  Ø
DAY
 1 2
PNT
 1 S1
 2 S2
 3 S4
 4 I5
 5 I6
 6 I7
 7 I8
 8 I1Ø
 9 I13
PER
 1 1
 2 2
PAR
 1 PH
 2 COND
 3 TALK
 4 TURB
 5 TOC
 6 TS
 7 VS
 8 TDS
 9 NH3-N
 1Ø NO-N
 11 PO4
 12 SO4
 13 MBAS
 14 PHENOL
 15 G&O
 16 BOD
DIS
SEGMENT =  5
OPTION = REPORT
```

Figure 17 Sample Listing of Information File

```
FUNCTION?LISTSD

ID?DAY

 1 1
 2 2
 3 3
 4 4
 5 5
 6 6
 7 7
 8 8
 9 9
 10 10
 11 11
 12 12
 13 13
 14 14
 15 15
 16 16
 17 17
 18 MAX
 19 MIN
 20 AVE
 21 NPTS
 22 RANGE
 23 STD
```

Figure 18 Sample Listing of Day ID

```
FUNCTION?LISTSD

ID?PNT

 1 S1
 2 S2
 3 S3
 4 S4
 5 I5
 6 I6
 7 I7
 8 I8
 9 I9
 10 I10
 11 I11
 12 I12
 13 I13
 14 P51
```

Figure 19 Sample Listing of Point ID

```
FUNCTION?LISTSD

ID?PAR

 1 TEMP
 2 PH
 3 COND
 4 ACID
 5 TALK
 6 G&O
 7 TURB
 8 TS
 9 SS
 10 DS
 11 VS
 12 TOC
 13 COD
 14 BOD
 15 TKN
 16 AL
 17 ZN
 18 PO4
 19 PHENOL
 20 CR
 21 PB
 22 FE
 23 CL
 24 SO4
 25 FLOW
 26 HARD
 27 MBAS
 28 NH3-N
 29 NO-N
 30 NCEL
 31 CA
 32 TDS
 33 VSS
 34 CCL4
 35 BENZ
 36 C2HCL3
 37 CHCL3
 38 TC
 39 TIC
```

Figure 20 Sample Listing of Parameter ID Tags

```
FUNCTION?LISTSD

ID?PER

 1  1
 2  2
 3  3
 4  1A
 5  1B
 6  1C
 7  2A
 8  2B
 9  2C
```

Figure 21 Sample Listing of Period ID Tags

```
FUNCTION?LISTSD

ID?DIS

 1  1
 2  2
 3  3
 4  4
 5  5
 6  6
 7  7
 8  8
 9  9
 10  10
 11  11
 12  12
 13  13
 14  14
 15  15
 16  16
 17  17
 18  18
 19  19
 20  20
 21  21
 22  22
 23  23
 24  24
 25  25
 26  26
 27  27
 28  28
```

Figure 22 Sample Listing of Discrete ID Tags

```
FUNCTION?LISTSD

ID? COM

 1 <
 2 >
 3 *
 4 #
```

Figure 23 Sample Listing of Comment ID Tags

```
FUNCTION?LISTSD

ID? CHEM

 1 DRAKE
 2 BROWN
 3 WOLLA
 4 ROZAK
 5 SMITH
```

Figure 24 Sample Listing of Chemist ID Tags

```
FUNCTION?LISTSD

ID? QUAL

 1 T
 2 CL
 3 LC
 4 IC
 5 H
 6 C
 7 G
 8 NH
 9 IP
 10 QS
```

Figure 25 Sample Listing of Quality ID Tags

```
FUNCTION?LISTSD

ID? ACC

 1 AR
 2 10
 3 OM
 4 IR
```

Figure 26 Sample Listing of Accuracy ID Tags

MERGE

Each of the files created during the data entry step can be merged into a master data file using the program MERGE.SV. The program MERGE lists the name of each data file which has not yet been merged and receives a response from the supervisor on the particular action to be taken. The program MERGE also provides the capability to either delete measurements or change measurements within the master file.

The merge operation is normally requested by the command

```
.SUBMIT MERGE
```

which submits the BATCH input file MERGE.BI to the OS/8 program BATCH. This command has the data handling system perform the following steps:

1. Create the files SYS:SYSDIR.AR and DSK:DSKDIR.AR with the system program DIRECT. These files contain the names of all files whose names begin with D1, D2, D3, and MASTER.
2. Run the program MERGE.SV to create a new master data file by updating the current master data file.
3. Change the first letter in the name of each file, used to update the master file, to the letter A with the system program FOTP.

The MERGE program accepts as input one master file to be updated and up to 25 data files which are merged into a new master file by this program. In addition, one change data file and one deletion data file may be optionally accepted as input. All measurements within the data deletion and data change files are first read into a data array. Each measurement from the master file is then compared to the measurements in this data array. Whenever the Day, Point, Period, Parameter, and Discrete

ID simultaneiosly agree, the measurement in the master input file is either deleted or changed. The measurements within the data addition files are merged directly into the new master file and are not compared to the measurements in these data arrays of change and deletion measurements.

The file DSK:UPDATE.ER is created with a message to the supervisor whenever a match from the master input file is not found for all entries in this data array. This file contains those measurements for which a match cannot be found. The file UPDATE.ER can be listed with the list option found within the program DAHDLR.

When loaded, the MERGE program provides a brief summary of the merge commands which are shown as follows:

```
COMMANDS ARE AS FOLLOWS;
     AD, ADD DATA IN THIS FILE TO MASTER FILE
     CH, CHANGE DATA FILE
     DEL, DELETION DATA FILE
     NULL RESPONSE, NO ACTION
```

The program then lists the names of the files on the device DSK:, one file name at a time, for which the supervisor must respond with either a AD, DEL, CH, or null ine. This procedure is then repeated for the files on the device SYS:. An example of this print-out is as follows:

```
DSK:FILES

DATE 19-OCT-75

DSK:D1W007.01?AD
DSK:D1BR09.02?AD
DSK:D1DR02.01?AD
DSK:D1BR18.02?AD
DSK:D1DR06.01?AD

SYS:FILES

DATE 19-OCT-75

OTHER FILES?
LAST MASTER DSK:MASTER.01
OUTPUT FILE? SYS:MASTER.02
MASTER INPUT FILE?MASTER.01
```

The program gives the supervisor the option of specifying one or more data addition files whose names differ from the file naming convention. The message

OTHER FILE?

is listed on the Teletype. A null response to this message terminates this section of the program. Otherwise, this question is repeated until a null response is received.

The program searches the files DSKDIR.AR and SYSDIR.AR for those files with a name of MASTER. The master file which has the largest extension is selected by the porgram as the last master file with the message such as

LAST MASTER DSK:MASTER.09

being printed. The program then requests from the supervisor the name of the next master file with the message

OUTPUT FILE?

It is recommended that the supervisor use the name of MASTER with an extention derived by incrementing the extension on the last master file.

The program then requests from the supervisor the name of the master input file with the message

MASTER INPUT FILE?

The supervisor would normally respond by typing in the name of the last master file. A null response to this question is permitted. However, this question is asked twoce whenever the first response is null.

The program prints the name of each file when the program is using this file to update the master file. The name of each file used to update the master file has its name changed to provide the data handling system with an accounting technique.

REPORT GENERATION

The Data Handling System is capable of generating reports and print-plots of selected data using a wide variety of report and print-plot formats. The general report formats are determined by the sorting order and are shown for continuous and discrete data in the following figures.

Continuous Data Report Format

Continuous

First Order	Second Order				
Third Order	Fourth Order				
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

Discrete Data Report Format

First Order

Second Order	Third Order				
Fourth Order	Fifth Order				
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

Report generation is accomplished by the system in four distinct steps which are:

1. Master File Determination
2. INFO:INFO.IN File Generation
3. SORT
4. REPORT

The file INFO.IN contains one record for each report requested. Each record contains information such as:

1. Order of Sort (Report Format)
2. Options (Report/Plot)
3. Segment Size (Number of Columns)
4. ID lists

During the SORT step, the information necessary for the report is retrieved from a specified data file and sorted. A temporary data file is created on device data for each record in the INFO.IN file. The REPORT step then formats and prints the information in each of these temporary files. The REPORT places all output in the file OUT:REPORT.RP. By defining OUT with the ASSIGN command as TTY, the reports and print-plots will be printed on the teletype.

The report generation step is normally requested by the command

```
.SUBMIT REPORT
```

which submits the BATCH input file REPORT.BI to the OS/8 program BATCH. The devices DATA, INFO, and OUT must be defined to OS/8 prior to starting the report generation step. This command has the Data Handling System perform the following steps:

1. Create the files SYS:SYSDIR.AR and DSK:DSKDIR.AR with the system program DIRECT. These files are created to provide the program DAHDLR with the names of all files with the name of MASTER.

2. Run the program DAHDLR.SV to create the file INFO:INFO.IN.

3. Run the program SORT.SV with the master file and information files specified in step 2 to create the temporary data files for the REPORT step.

4. Run the program REPORT.SV to generate the reports and print-plots specified in the previous steps. The output is placed in the file OUT:REPORT.RP.

The program DAHDLR when loaded produces the following messages

```
DATA HANDLER
FUNCTION?REPORT
#
```

for which the operator must respond with the command REPORT to specify the report option. The pound sign (#) is used to prompt the user that a report generation command is expected. The file INFO:INFO.IN contains one record for each report or print-plot specified.

Before the report generation commands are discussed, several listings of records from the file INFO:IN with the corresponding report or print-plot are shown to demonstrate the result to be achieved from these commands. Please note that each record of the file INFO.IN contains the following information:

1. Order of Sort (Report Format)
2. Options (Report/Plot)
3. Segment Size (Number of Columns in Report)
4. Primary ID Lists (Comment ID not used)

The order in which the IDs are placed within the ID list determine the order the IDs will appear in a report.

A given ID tag should appear in a list only once as the SORT step will only use the first occurrence of the ID. The identification of rows in a report requires 25 columns while each column of data requires 9 columns. A Teletype with 72 print positions allows a maximum segment size of 5.

```
INFO RECORD =  2
 1  3  2  4  Ø  Ø
DAY
 1 1
PNT
 1 S1
 2 S2
 3 S3
 4 S4
 5 I5
 6 I6
 7 I7
 8 I8
 9 I9
 10 I10
 11 I11
 12 I12
 13 I13
PER
 1 2
PAR
 1 PH
 2 COND
 3 TALK
 4 TURB
 5 TOC
 6 TS
 7 VS
 8 TDS
 9 NH3-N
 10 NO-N
 11 PO4
 12 SO4
 13 MBAS
 14 PHENOL
 15 G&O
 16 BOD
DIS
SEGMENT =  5
OPTION = REPORT
```

Figure 27 Information File for Sample Report

TITLE OF REPORT
THIS IS A SAMPLE HEADER
CLEMSON UNIVERSITY, CLEMSON SOUTH CAROLINA

CONTINUOUS DATA

DAY 1 PERIOD 2

SAMPLE POINT	PH	COND.	T. ALK	TURB.	TOC
SAMPLE POINT S-1	7.6	176.0	152	8	3
SAMPLE POINT S-2	7.7	159.9	69	5	8
SAMPLE POINT S-4	7.8	144.7	57	4	20
SAMPLE POINT I-5	7.6	835.7	208	92	772
SAMPLE POINT I-6	12.0	2204.8	3300	400	1416
SAMPLE POINT I-7	9.1	209.3	79	32	25
SAMPLE POINT I-8	7.1	106.0	66	1	4
SAMPLE POINT I-10	12.7	2860.0	13500	650	1835
SAMPLE POINT I-13	8.6	1647.8	327	42	50

	T. SOL	VOL. S	TDS	NH3-N	NO-N
SAMPLE POINT S-1	87	*******	68	.10	*******
SAMPLE POINT S-2	82	*******	79	.10	*******
SAMPLE POINT S-4	70	*******	69	.07	*******
SAMPLE POINT I-5	1597	*******	1532	.05	*******
SAMPLE POINT I-6	875	*******	500	.09	*******
SAMPLE POINT I-7	156	*******	110	.09	*******
SAMPLE POINT I-8	28	*******	25	.07	1.02
SAMPLE POINT I-10	11783	*******	11517	.57	*******
SAMPLE POINT I-13	1198	*******	1175	.09	*******

	T. PO4	SO4	MBAS	PHENOL	G&O
SAMPLE POINT S-1	*******	*******	0	*******	*******
SAMPLE POINT S-2	1.15	*******	0	*******	7
SAMPLE POINT S-4	.26	*******	0	*******	6
SAMPLE POINT I-5	14.19	*******	121	*******	*******
SAMPLE POINT I-6	*******	*******	54	13.78	*******
SAMPLE POINT I-7	1.30	*******	0	*******	*******
SAMPLE POINT I-10	*******	*******	3	*******	*******
SAMPLE POINT I-13	*******	1079.0	4	*******	*******

	BOC
SAMPLE POINT I-13	145

Figure 28 Sample Report

```
INFO RECORD =  5
 1  3  2  4  Ø  Ø
DAY
 1 1
 2 2
 3 3
 4 4
 5 5
 6 6
 7 7
 8 8
 9 9
 1Ø 1Ø
 11 11
 12 12
 13 13
 14 14
 15 15
PNT
 1 S1
 2 S2
 3 S4
 4 I5
 5 I6
PER
 1 1
 2 2
PAR
 1 PH
 2 COND
 3 TALK
 4 PH
 5 TALK
DIS
SEGMENT =  5
OPTION = PLOT
```

Figure 29 Information File for Sample Plot

```
PLOT 1 :PH AT S1
MAXIMUN =  9.1
MINIMUN =  6.8
AVERAGE =  7.60768
NUMBER OF POINTS =  26

UPPER LIMIT =  9.1
LOWER LIMIT =  1


PLOT 2 :COND AT S2
MAXIMUN =  233.28
MINIMUN =  149.606
AVERAGE =  179.781
NUMBER OF POINTS =  27

UPPER LIMIT =  2800
LOWER LIMIT =  100


PLOT 3 :TALK AT S4
MAXIMUN =  307
MINIMUN =  50.655
AVERAGE =  75.1476
NUMBER OF POINTS =  27

UPPER LIMIT =  307
LOWER LIMIT =  0


PLOT 4 :PH AT I5
MAXIMUN =  12.1
MINIMUN =  7.3
AVERAGE =  8.25454
NUMBER OF POINTS =  22

UPPER LIMIT =  12.1
LOWER LIMIT =  1


PLOT 5 :TALK AT I6
MAXIMUN =  3300
MINIMUN =  44.515
AVERAGE =  586.567
NUMBER OF POINTS =  24

UPPER LIMIT =  3300
LOWER LIMIT =  0
```

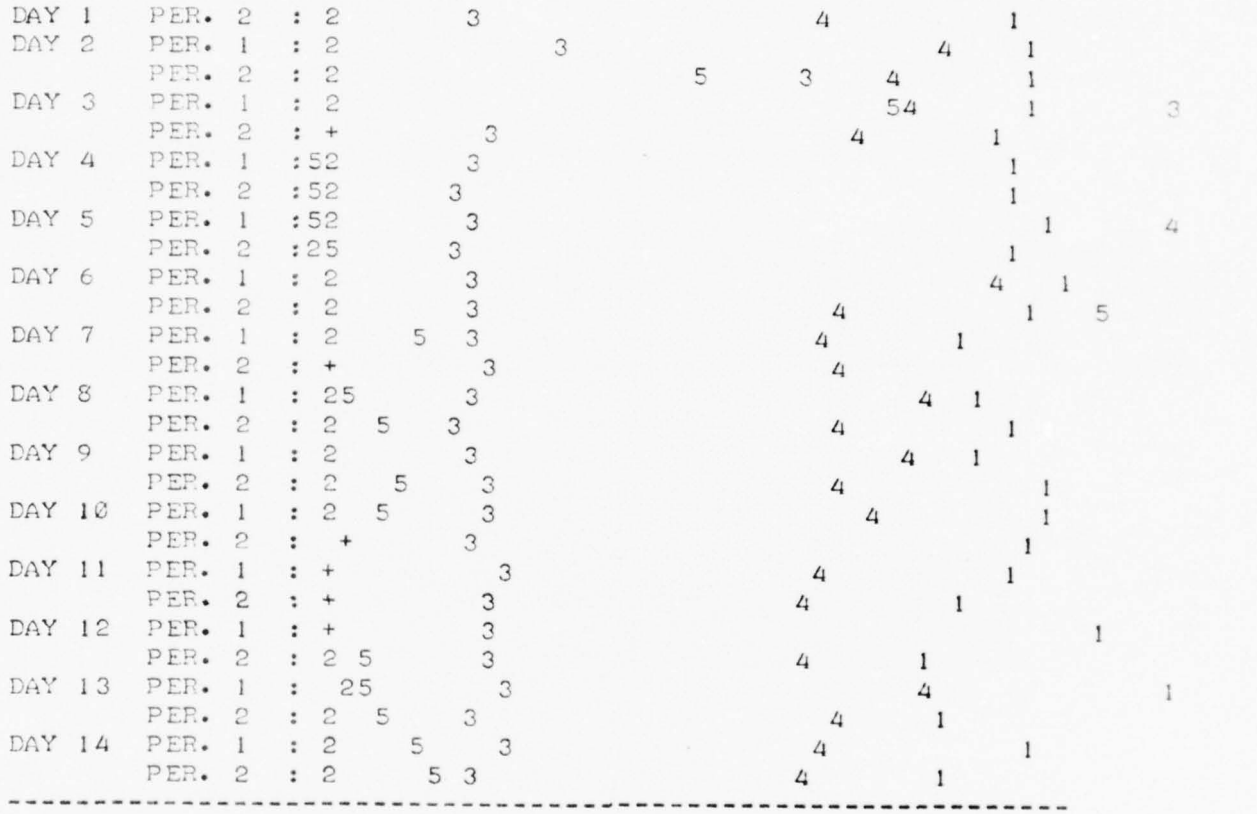


Figure 30 Sample Plot

List Editing Commands:

The Day, Point, Period, Parameter, and Discrete ID lists can be created, modified, and listed with the following list editing commands.

LIST EDITING COMMANDS

Command	
NEW IDLIST	Delete all entries in IDLIST
A IDLIST ID1 ID2 . . . IDN	Add ID1 . . . IDN to IDLIST
A ID1 ID2 . . .IDN	Add ID1 . . . IDN to previously named IDLIST
D IDLIST ID1 ID2 . . . IDN	Delete ID1 . . . IDN from IDLIST
D ID1 ID2 . . . IDN	Delete ID1 . . . IDN from previously names IDLIST
C IDLIST OLDID NEWID	Change first occurrence of OLDID to NEWID in IDLIST
C OLDID NEWID	Change first occurrence of OLDID to NEWID in previously named IDLIST
I IDLIST OLDID ID1 ID2 . . . IDN	Insert ID1 . . . IDN before OLDID in IDLIST
I OLDID ID1 ID2 . . . IDN	Insert ID1 . . . IDN before OLDID in previously named IDLIST
L IDLIST	List entries in IDLIST
L	List previously named IDLIST
AP PNT PAR	Add plot for continuous data
AP DAY PNT PER PAR	Add plot for discrete data
LP	List plot lists

Two command modes are provided for entering these List Editing Commands. For the non-string input mode (NSTR), each symbolic name in the command must be terminated by a carriage return (RETURN) with a null line delimiting a command string.

An example of a command in the non-string input mode is

```
#?A
?IDLIST
?ID1
?ID2
?ID3
 .
 .
?IDN
?
```

where the pound sign (#) and question mark (?) are printed by the Data Handling System to prompt the operator. The non-string input mode is recommended over the string input mode because it is significantly faster in execution time.

The string input mode has the system accept the list editing command as a single command line which is terminated with a carriage return. A single space separates each symbolic name in the command. The execution time for this input mode may be slow as a result of overlays.

Report Generation Commands:

Additional report generation commands are shown in the following tables.

REPORT GENERATION COMMANDS

Command	Operation
DISC	Select discrete data option
CONT	Select continuous data option
DO	Create one information record by outputting the current ID list, option, segment size, and sort order.
SEG	Enter new segment size
LSEG	List current segment size
END	End of information file generation. Close this information file
RPT	Set option of current record to report option
PLT	Set option of current record to plot option
NIDS	Initialize all ID lists with zero entries
NSTR	Disable string input mode
STR	Enable string input mode
ORD	Specify order of sort
LORD	List current sorting order
LTAB	List current status of ID lists, sort order, option, and segment size.
STD	Initialize current status of ID list, sort order, option, and segment size with a record from the file INFO:STD.IN.

Standard Report:

The program DAHDLR provides the capability of generating the information file INFOLSTD.IN with several records. The command

STD

gives the user the capability of initializing the ID lists, sort order, option, and segment size with any record within this file.

Master File Selection:

The file INFO:INFO.IN has been created with the END command is given. The program then prints the message

FUNCTION?

and the command

DOREPORT

instructs the program to search the files DSK:DSKDIR.AR and SYS:SYSDIR.AR for files with the name MASTER. These names of these files are typed on the Teletype as follows:

DSK: FILES

MASTER.10

MASTER.11

SYS. FILES

MASTER.12

MASTER FILE INPUT?

The operator must supply the name of the master input file for this report.

Report Generation with Parameter Computations:

Report generation has the capability to permit each report to include parameters such as range, maximum, minimum, average, number of points, and standard deviation for selected measurements. When a report includes these parameters, report generation is accomplished by the system in 7 steps instead of 4 steps which are as follows:

1. Master File Determination
2. INFO:INFO.IN File Generation
3. INFO:MXINFO.IN File Generation
4. SORT
5. MAXMIN Computations
6. SORT
7. REPORT

Steps 3, 4, and 5 are entered only when these parameters are computed. Steps 3 and 4 create the sorted data files DATA:DATA.AA, DATA:DATA.AB, ..., etc. which are processed by step 5 to yield the file DATA:MAXMIN.01 containing these parameters.

The user should read the MAXMIN chapter before attempting to use these parameters. The program MAXMIN.BA places requirements on the System Definition File SYSDEF.AR and the input data files to arrive at meaningful parameter computations.

Examples:

Some examples are shown which illustrate these report generation commands.

```
DATA HANDLER

FUNCTION?PLOT

CONT, DISC?CONT
#?A
?DAY
?1
?2
?3
?4
?5
?6
?7
?8
?9
?10
?11
?12
?13
?14
?15
?
#?A
?PER
?1
?2
?
#?AP
?S1
?PH
?
#?DO
#?AP
?S2
?COND
?
#?DO
#?AP
?S4
?TALK
?
#?DO
#?AP
?I5
?PH
?
#?DO
```

```
#?AP
?I6
?TALK
?
#?DO
#?AP
?I8
?MBAS
?
#?DO
#?END
```

Figure 31 Example of Information File Generation

```
FUNCTION?LINFO


INFO RECORD =  1
 1  3  2  4  0  0
DAY
 1 1
 2 2
 3 3
 4 4
 5 5
 6 6
 7 7
 8 8
 9 9
 10 10
 11 11
 12 12
 13 13
 14 14
 15 15
PNT
 1 S1
PER
 1 1
 2 2
PAR
 1 PH
DIS
SEGMENT =  5
OPTION = PLOT
```

```
INFO RECORD =  6
 1  3  2  4  Ø  Ø
DAY
 1 1
 2 2
 3 3
 4 4
 5 5
 6 6
 7 7
 8 8
 9 9
 10 10
 11 11
 12 12
 13 13
 14 14
 15 15
PNT
 1 S1
 2 S2
 3 S4
 4 I5
 5 I6
 6 I8
PER
 1 1
 2 2
PAR
 1 PH
 2 COND
 3 TALK
 4 PH
 5 TALK
 6 MEAS
DIS
SEGMENT =  5
OPTION = PLOT
```

Figure 32 Example of Information File Listing

```
DATA HANDLER

FUNCTION?REPORT

RPT,PLT?RPT
CONT,DISC?CONT
#?LSEG
SEG SIZE =  5
#?LORD
 Ø  Ø  Ø  Ø  Ø  Ø
#?OPD
DAY?1
PNT?3
PER?2
PAR?4
#?A
?DAY
?1
?
#?A
?PNT
?S1
?S2
?S3
?S4
?I5
?I6
?I7
?I8
?I9
?I1Ø
?I11
?I12
?I13
?
#?A
?PER
?
#?A
?PAR
?PH
?COND
?TALK
?TURB
?TOC
?
```

```
 #?A
 ?TS
 ?VS
 ?TD
 ?
 ILL PAR TD
 #?A
 ?TS
 ?VS
 ?TDS
 ?NH3-N
 ?NO-N
 ?
 #?L
 ?
  1 PH
  2 COND
  3 TALK
  4 TURB
  5 TOC
  6 TS
  7 VS
  8 TDS
  9 NH3-N
  10 NO-N
#?A
?PO4
?SO4
?MBAS
?PHENOL
?G&O
?
#?A
?BOD
?
```

```
#?LTAB
INFO RECORD =  1
 1  3  2  4  0  0
DAY
 1 1
PNT
 1 S1
 2 S2
 3 S3
 4 S4
 5 I5
 6 I6
 7 I7
 8 I8
 9 I9
 10 I10
 11 I11
 12 I12
 13 I13
PER
PAR
 1 PH
 2 COND
 3 TALK
 4 TURB
 5 TOC
 6 TS
 7 VS
 8 TDS
 9 NH3-N
 10 NO-N
 11 PO4
 12 SO4
 13 MBAS
 14 PHENOL
 15 G&O
 16 BOD
DIS
SEGMENT =  5
OPTION = REPORT
#?L
?PER
?
#?A
?PER
?2
?
```

```
#?DO
#?C
?DAY
?1
?2
?
#?LTAB
INFO RECORD =  2
 1  3  2  4  0  0
DAY
 1 2
PNT
 1 S1
 2 S2
 3 S3
 4 S4
 5 I5
 6 I6
 7 I7
 8 I8
 9 I9
 10 I10
 11 I11
 12 I12
 13 I13
PER
 1 2
PAR
 1 PH
 2 COND
 3 TALK
 4 TURB
 5 TOC
 6 TS
 7 VS
 8 TDS
 9 NH3-N
 10 NO-N
 11 PO4
 12 SO4
 13 MBAS
 14 PHENOL
 15 G&O
 16 BOD
DIS
SEGMENT =  5
OPTION = REPORT
#?SEG
?4
SEG SIZE =  4
#?DO
```

Figure 33 Example of Information File Generation

DAHDLR

The program DAHDLR performs several functions which include the listing of files in a variety of formats and information file generation. The program DAHDLR is loaded by

```
.R DAHDLR
```

and responds with the messages

```
DATA HANDLER
FUNCTION?
```

The operator of the system must respond by typing one of the following commands:

DAHDLR COMMANDS

Command	Function
REPORT	Generate the information file INFO:INFO.IN
PLOT	Generate the information file INFO:INFO.IN
PRESTD	Generate the information file INFO:STD.IN
PREINF	Generate an information file with an operator specified file name
LINFO	List the information file INFO:INFO.IN
LISTINF	List the information file with an operator specified file name
LISTSD	List the entries in a selected ID class
LIST	List a specified data file
LISTPRI	List a specified data file but ignore the secondary ID tags
STR	Use string input mode
NSTR	Do not use string input mode
DOREPORT	Generate a report specified by INFO:INFO.IN with an operator specifid master file

MAXMIN	Generate the information file INFO:MXINFO.IN and enable report generation to compute and use these parameters
MXMN	Generate the information file INFO:MXINFO.IN from INFO:INFO.IN and enable report generation to compute and use these parameters

The operation of each option specified by these commands are specified in other chapters of this manual. The devices DATA, INFO, and OUT should be assigned prior to running DAHDLR.

SORT

The program SORT retrieves selected data from a specified data file, sorts this data and then places the sorted data in an output file. Instructions for this sorting operation are received from an information file. Each record of this information file contains:

1. Sorting order
2. ID lists
3. Segment size
4. Sorting options

Each record of the information file defines a new sorting function which results in a new output file.

The SORT program may be loaded by

```
.R SORT
*(Output File) < (Info File), (Data File 1), (Data File 2)
```

When loaded, the operator must supply to the Command Interpreter

1. Initial Output file name
2. Information file name
3. First data file name
4. Second data file name (optional)

The extension of the initial output file is incremented to determine the name of successive output files. The last two characters of the output file name should not be "D" as the system uses this to denote a duplicate data file. Usually, the SORT option is one step in a BATCH command input file.

An END message will be printed at the completion of each sorting operation. When all the records of the information file are processed, control is returned to the OS/8 Monitor.

Normally, the software names the information file INFO:INFO.IN while the output files are named DATA:DATA.AA, DATA:DATA.AB, etc. The extension of the first output file is .AA but is incremented with each addition output file.

The SORT program checks to see if there is 2 or more points with identical Day, Point, Period, Parameter, and Discrete IDs present in the data file. The first measurement encountered with this ID will be used in the sorting operation. All remaining measurements with this ID are placed in a duplicate data file with a DUP.DATA message generated in place of the END message. If duplicate data were encountered while generating DATA:DATA.AF, duplicate data would be placed within the file DATA:DATADD.AF.

When the report sorting option is selected, the Day, Point, Period, Parameter, and Discrete (Discrete data only) IDs of this measurement be present in the ID lists provided by the information file to be selected for this sorting step. The plot sorting option additionally requires that either the Point and Parameter ID for continuous data of the Day, Point, Period, and Parameter ID for discrete data be found in the same relative location within the respective lists.

SYSTEM TABLES

Several system tables are used by the system software to define a particular data handling application to the system. The system definition file (SYSDEF.AR) provides information which includes lists of valid ID tags, upper and lower limits for measurement values, data formats, and various heading and column information used during report generation. The translation table file (TRNTBL.AR) contains the translation tables for the mark sense cards. The method file (METHOD.AR) specifies for each parameter the particular data conversion algorithm within the function file (FNCTN.AR) to use on input.

System Definition File Format:

The system definition file, DSK:SYSDEF.AR, is required to define the application to the data handling system. This file is an OS/8 ASCII file containing several character strings. A Null character string segments this file into several lists. These lists, in the order of appearance, are

Day ID Lists

Point ID Lists

Period ID Lists

Parameter ID Lists

Discrete ID Lists

Comment ID Lists

Header

Chemists ID Lists

Quality ID Lists

Accuracy ID Lists

The Parameter ID list contains 6 character strings per list entry while the remaining primary ID lists, contain 3 character strings per list entry. The first 3 character strings per primary ID list entry provide alternate ways of externally representing this ID tag. The name, length, and usage of each of these representations are shown as follows:

Order	Name	Length	Usage
First	Short ID	1-6 char.	Normally used
Second	Long ID	1-24 char.	Header of Reports
Third	Column ID	1-6 char.	Column header in Reports

The 1st three character strings for each list entry in the Parameter ID list defines a minimum, maximum, and format for each parameter. The format is an integer and specifies the number of places to the right of the decimal point to be used during report generation. The minimum and maximum defines the lower and upper limits during a print-plot.

The header must be 3 lines in length even though one or more of these lines are null. Each line must contain less than 72 characters. This header labels each page of the report and print-plot during report generation.

The Accuracy and Quality ID lists contain 2 character strings per list entry. The first string is a 1 to 6 characters in length and is normally used. The second string is 1 to 24 characters in length and provides an alternate way of representing the same ID information.

The Chemist ID list identifies the name of the chemist and contains 2 character strings per list entry. The first string is 1 to 6 characters in length and provides an abbreviated name. The second string permits the chemist to be identified with a name which is 1 to 24 characters in length.

SYSTEM DEFINITION FILE EDITOR

The System Definition File (DSK:SYSDEF.AR) provides the data handling system with information such as lists of valid ID tags, upper and lower limits for measurement values, data formats, and various heading and column information used during report generation. This file is required to define the application to the data handling system and is an OS/8 ASCII file containing several character strings. This file can be edited either with the OS/8 EDIT program or the BASIC program EDITS.BA.

The BASIC program EDITS.BA is an editor written especially to list, modify, or create the System Definition File DSK:SYSDEF.AR. When loaded, the program responds with the message

DEFAULT FILES?

A response of YES to this question will cause the program to select the default input/output files of

DSK:SYSDEF.AR

For an answer of NO, the system will explicitly ask the user for the names of the input and the output files.

The program now requests the following information

ID TO BE EDITED?

The user must respond with one of the following responses:

DAY	Day ID List
PNT	Point ID List
PER	Period ID List
PAR	Parameter ID List
DIS	Discrete ID List

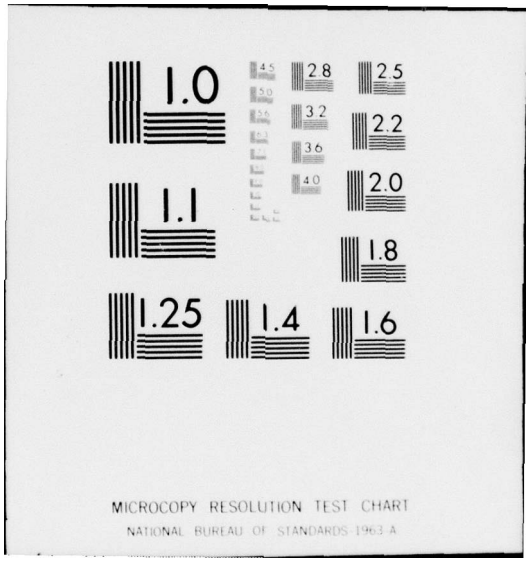
AD-A036 529 CLEMSON UNIV S C COLL OF ENGINEERING F/G 13/2
A SYSTEMS ANALYSIS OF WATER QUALITY SURVEY DESIGN. APPENDIX VII--ETC(U)
AUG 75 T L DRAKE DADA17-72-C-2152

UNCLASSIFIED NL

2 OF 2
ADA036529

END

DATE
FILMED
3-77


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

COM	Comment ID List
HDR	Report Header
QLT	Quality ID List
ACC	Accuracy ID List
NAM	Chemist ID List
END	End Edit Operations

it is recommended that the user edit the ID lists in the order shown as this minimizes the number of file transfers.

The program now provides the message

CREATE OR EDIT?

for which the user must respond with the following commands:

CREATE	Create a New ID List
EDIT	Edit Existing ID List
Null Response	Finished, get next ID

The CREATE option allows the user to create a new ID list. The user is prompted with one or more of the following messages:

SHORT?

LONG?

COLUMNS?

FORMAT?

MAXIMUM?

MINIMUM?

The selection of the EDIT option will cause the program to respond with the message

ADD, CHANGE, OR LIST?

for which the valid responses by the operator are as follows:

ADD	Append a New ID to the List
CHANGE	Change an ID in the List

LIST	List Selected Entries
Null Response	Return to Edit or Create Step

The ADD option will append a new ID list entry to the end of the selected ID list. The CHANGE option permits a current ID list entry to be modified. Both the ADD and CHANGE operation will prompt the user with the same questions as were used with the CREATE option.

The LIST and CHANGE commands prompt the user with the following message

SHORT ID?

The user enters the particular ID in the selected list to be changed or listed. However, a response of ALL for the LIST command causes the entire list to be listed. Otherwise, the program for the LIST command will request the number of lines to be printed starting at the named short ID.

The program checks the syntax of each input received. The appropriate error message is printed in response to an incorrect input.

The program EDITS.BA has one file open for input and another file open for output. The output file contains the edited results. Whenever the ID lists are not edited in the same order as they appear within the System Definition File, then the program may be required to close both files and then make the output file the input file. When this happens, a new output file is opened with the same name as the original input file and the original input file is usually lost. When this happens, the program asks the user whether to alter the input file or not. The user must respond with either a YES or NO answer.

When the default file names are used, both the input and the output files have the same names. Whenever the output file is closed, the input file is list.

PROGRAM INPUT GENERATION

The program INPUT contains several tables which are highly dependent on the contents of the files SYSDEF.AR, METHOD.AR, TRNTBL.AR, and FNCTN.AR. Therefore, this program must be generated whenever any of these files is altered. The Batch file GENCRH.BI contains a list of commands which automate this procedure. This Batch file GENCRH.BI, however, assumes that the following files are present on DSK: and SYS:

DSK: Files

SYSDEF.AR	System Definition File
METHOD.AR	Methods File
TRNTBL.AR	Translation Tables
FNCTN.AR	Functions
GETPUT.PA	Source of Get-Put Subroutines
CRH.PA	Source of INPUT
IDGEN.BA	Creates Temporary Files

SYS: Files

PAL8.SV	Assembler
ABSLDR.SV	Absolute Loader
BCOMP.SV	BASIC Compiler
BRTS.SV	BASIC Run Time System
BLOAD.SV	BASIC Loader
BASIC.UF	BASIC User Functions
BASIC.SF	BASIC String Functions
BASIC.AF	BASIC Arithmetic Functions
BASIC.FF	BASIC File Handling Functions
NONEAE.BN	Floating Point Package

BATCH.SV Batch System

PIP.SV PIP Program

A listing of the file GENCRH.BI is as follows;

```
$JOB GENCRH
.R BCOMP
*DSK:IDGEN.BA
.R PAL8
*SYS:GETPUT.BN<SYS:PARCRH.AR,DSK:GETPUT.PA/F
.R PAL8
*SYS:TABLE.BN<DSK:SYSDEF.PA/F
.R PAL8
*SYS:CVRTBL.BN<SYS:PARCRH.AR,DSK:FNCTN.AR,SYS:CVRTBL.AR/F
.R PAL8
*SYS:CRH.BN<SYS:PARCRH.AR,DSK:CRH.PA/F
.R ABSLDR
*SYS:NONEAE.BN,CRH,CVRTBL,TABLE,GETPUTS
.SA DSK:INPUT.SV 0-7577,10000-17577,20000-26000;200
.R PIP
*SYS:TABLE.BN</D
*DSK:SYSDEF.PA</D
*SYS:CVRTBL.AR</D
*SYS:PARCRH.AR</D
*SYS:GETPUT.BN</D
*SYS:TABLE.BN</D
*SYS:CRH.BN</D
*SYS:CVRTBL.BN</D
$END
```

The program IDGEN.BA accepts as input the files

DSK.TRNTBL.AR

DSK:SYSDEF.AR

DSK:METHOD.AR

and produces the temporary files

DSK:SYSDEF.PA

SYS:PARCRH.AR

SYS:CVRTBL.AR

Additional temporary files are created with the PAL8 assembler. These temporary files are then loaded and then saved to form the program INPUT.SV. All temporary files are then deleted.

TDS

The Data Handling System is capable of computing the Total Dissolved Solids (TDS) measurement at a sample point from the Total Solids (TS) and Suspended Solids (SS) measurements at this point. If both the TS and SS measurements are present and the TDS measurement is not present, then the TDS measurement is computed and placed in a user specified output file.

The TDS computation is normally requested by the command

```
.SUBMIT  TDS
```

which submits the BATCH input file TDS.BI to the OS/8 program BATCH. This command has the data handling system perform the following steps:

1. Create the files SYS:SYSDIR.AR and DSK:DSKDIR.AR with the system program DIRECT. These files contain the names of all files whose names begin with MASTER.
2. Run the program TDSFNA.SV to receive the name of the master input file and the output file from the operator.
3. Run the program TDSINF.SV to create an information file INFO:TDSINF.IN.
4. Run the program SORT.SV to create two sorted data files containing TS, SS, and TDS.
5. Run the program TDS.SV to create an output file which contains computed TDS measurements.

This program when loaded prints the names of all master files on the devices DSK: and SYS:. An example of this print out is as follows:

```
DSK:MASTER FILES
DATA  19-OCT-75
DSK:MASTER.11
```

SYS:MASTER FILES

DATE 19-OCT-75

SYS:MASTER.12

This program then requests the operator to supply the name of a master file which contains the most recent TS, SS, and TDS measurements as follows:

MASTER INPUT FILE?

The operator would normally respond by typing the last master file which was just listed.

The program now asks the name of the output file from the operator as follows:

OUTPUT FILE?

To have a file name consistant with MERGE, this file name should have the D1 as the first two letters. By selecting a file name such as DITDS with two character numeric extension would provide a unique file name to the system.

MAXMIN

Report generation has been modified to permit these reports to include parameters such as range, maximum, minimum, average, number of points, and standard deviation for selected measurements. When a report includes these parameters, report generation is accomplished by the system in 7 steps instead of 4 steps which are

1. Master File Determination
2. INFO:INFO.IN File Generation
3. INFO:MXINFO.IN File Generation
4. SORT
5. MAXMIN Computations
6. SORT
7. REPORT

Steps 3, 4, and 5 are entered only when these parameters are computed. Steps 3 and 4 create the sorted data files DATA:DATA.AA, DATA:DATA.AB, ... etc. which are processed by the OS/8 BASIC Program MAXMIN.BA in step 5 to yield the file DATA:MAXMIN.01 containing these parameters.

The OS/8 BASIC program MAXMIN.BA receives as input the sorted data files DATA:DATA.AA, DATA:DATA.AB, ... and creates the data file DATA:MAXMIN.01. This program expects the System Definition File SYSDEF.AR to include one or more of the Day ID tags MAX, MIN, AVE, RANGE, STD, and NPTS.

This program segments each input file into groups of measurements which have the identical Point, Period, Parameter, and Discrete ID tags. The maximum, minimum, average, range, standard deviation, and number of points within a group is then computed for each group.

These computed parameters from all input files are then placed within a single output file DATA:MAXMIN.01. Any given measurement should be found in only one input file. If a measurement is found in two or more input files, the output data file will contain duplicate data. Only one output file is created.

The input data files, DATA.AA, DATA.AB, etc., are created by the program SORT according to the information file INFO:MXINFO.IN prior to running this program. The SORT program retrives selected data from a specified master file with the information file providing the instructions for this sorting operation. Step 6 creates new data files, DATA.AA, DATA.AB, etc., as input to REPORT.

The report generation step is normally requested by the command

```
.SUBMIT REPORT
```

which submits the BATCH input file REPORT.BI to the OS/8 program BATCH. The devices DATA, INFO, and OUT must be defined to OS/8 prior to starting the report generation step.

The program DAHDLR when loaded produces the following message

```
DATA HANDLER
FUNCTION? REPORT
```

for which the operator must respond with the command REPORT to specify the report option. The file INFO:INFO.IN is generated with the function. The Day ID tag list may contain the ID tags MAX, MIN, AVE, NPTS, STD, and RANGE if these parameters are desired in the report.

The operator must specify either the MAXMIN function or the MXMN function to generate the file INFO:MXINFO.IN. The MAXMIN function

```
FUNCTION? MAXMIN
```

has the same commands as the REPORT function. The CONT data option

with the Day ID order being 4 is automatically selected with a segment size of 1000 by this function. The Day, Point, and Parameter ID lists should be selected to specify the data base to be processed by the program MAXMIN.BA.

The operator must specify the DOREPORT function in order to specify the master file and to automatically execute steps 4, 5, 6, and 7 without operator intervention.

The REPORT and MAXMIN functions within the program DAHDLR are independent of each other. The REPORT function specifies the Report Format, Report Options, Number of Columns, and ID lists for the final report. The MAXMIN function specifies the ID lists to be used for the MAXMIN computations. If more than one record is generated by the MAXMIN function, the measurements found in each record must be different than all other records. The measurements used by the REPORT function must agree with the measurements used by the MAXMIN function to yield meaningful reports.

The MXMN function automatically creates the information file INFO:MXINFO.IN directly from the information file INFO:INFO.IN.

This function requires the measurements printed for each report be different than the measurements found in all other reports. A report is created with the MXMN function by

```
FUNCTION? REPORT
```

The operator then creates the file INFO.IN as before. The operator then responds with MXMN function before requesting DOREPORT function.

```
FUNCTION? MXMN
FUNCTION? DOREPORT
```

AUTOMATED INSTRUMENTATION

A Fisher Scientific Accument Model 520 Digital pH/Ion meter, a Yellow Springs Model 33 S-C-T meter, a Talos 514B graphic tablet, and a Digital Equipment Corporation RT02-BA data entry terminal were interfaced to the data handling system via a Digital Equipment Corporation PDM-70 programmable data mover. Figure 1 is a block diagram of the automated instrumentation showing the inner-connection of these devices. Each of these devices can operate in a stand-alone mode independent of the data handling system or under the control of the data handling system. The Automated Instrument Users' Manual and the Automated Instrument System Programmer's Manual have been written to provide a detailed description of the operation of this system. The presentation which follows is intended to provide an overview of the automated instrumentation.

The Talos digitizer provides the capability to the Army personnel of automating the data reduction of field strip chart recordings. By placing a strip chart on a 14 inch by 14 inch active area on the Talos digitizer surface, the user through either a four button cursor or a stylus may determine x-y coordinates of any point on this graph to an accuracy of .01 inches. The x-y coordinates of this point are displayed on a front panel display and can be transferred to the data handling system via the PDM-70 by pressing a cursor button or touching the point with the stylus. Some status information such as the cursor push button is also interfaced to the PDM-70. The data handling system can then be programmed with the appropriate data reduction algorithm to arrive at the result. The interface between the Talos digitizer and the PDM-70 was fabricated at Clemson University.

The Fisher Scientific pH/Ion meter provides a 5 digit display on the fron panel of the meter and is interfaced to the PDM-70.

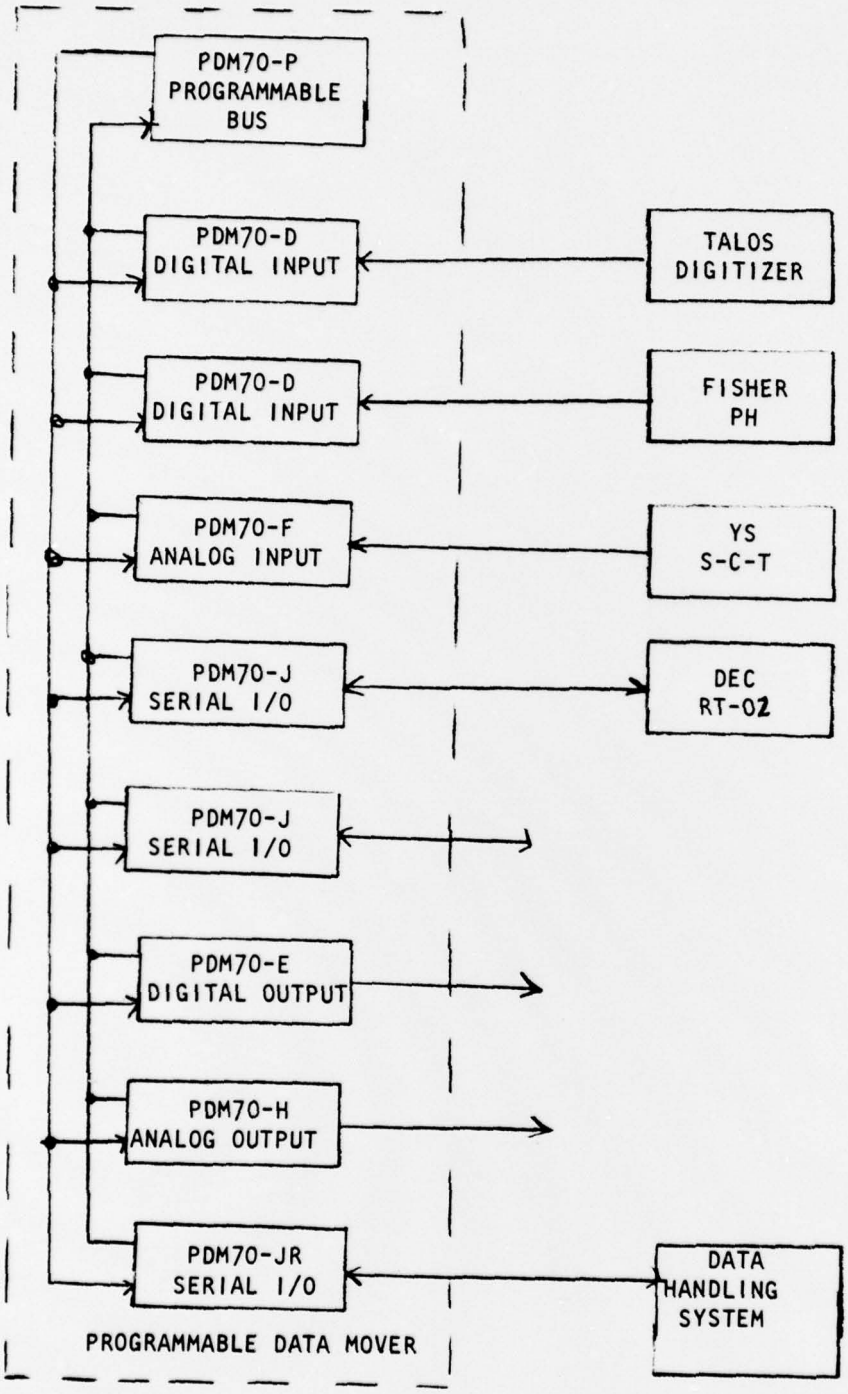


Figure 1 - BLOCK DIAGRAM OF THE AUTOMATED INSTRUMENTATION

The interface between the PDM-70 and the pH meter was implemented at Clemson University and contains a button with a light for data transfer. The measurement value being displayed on the front panel display along with the front panel switch settings and over range indicator is transferred to the PDM-70 by pressing the lighted button on the PDM-70 interfaced.

The Yellow Springs S-C-T meter was slightly modified to permit the meter to give two analog outputs. One output is proportional to the S-C-T meter reading while the other output is coded to give the front panel switch settings. These analog outputs are interfaced to the PDM-70 with a meter reading being transferred whenever a lighted button associated with the PDM-70/S-C-T interface is pressed by the user. This interface was fabricated at Clemson University.

Each measurement handled by the data handling system must have an ID and a measurement value. The DEC RT-02-BA provides the user of the automated instrumentation the ability to enter the ID information via the keyboard for each of the samples whose value is being measured by either the interfaced pH and specific conductivity instrumentation. The DEC RT-02-BA also has a 32 character alphanumeric display and provides the user with messages from the data handling system.

The PDM-70 programmable data mover provides a communications link and formatting facilities for concentrating and transferring data between a selected source and destination. The data may be in an analog, parallel BCD or binary, and format. The PDM-70 can be operated as a stand-alone unit or under the control of a host computer. Integration into a computer-based system is easily accomplished through a standard asychronous serial interface on the computer.

The PDM-70 system accommodes both source and destination modules. Any source module under the control of the PDM-70 can communicate with any or all destination modules. Source modules present in the system are as follows:

2	PDM70-D	Eight digit BCD input
1	PDM70-F	Four channel analog input
1	PDM70-JR	Serial I/O module
2	PDM70-J	Serial I/O module

The destination modules present in the system are as follows:

1	PDP70-E	Eight digit BCD output
1	PDP70-H	Two channel analog output
2	PDM70-J	Serial I/O module
1	PDM70-JR	Serial I/O module

Communication or information transfer from a selected source to the selected destination modules is controlled by the stored program being executed by the PDM-70. This program is normally entered via a PDM70-JR serial I/O module with a connected teletype or remote computer. The programming commands are a sequence of ASCII characters.

A user function for OS/8 BASIC has been provided to allow any BASIC program to remotely program the PDM-70 and to transfer data between the BASIC program and the PDM-70. In addition, the data entry software for the data handling system supports the automated instrumentation.

The OS/8 BASIC program WTHDL.BA is provided for handling the Talos digitizer data. This program receives x-y coorindate information from the digitizer on-line, converts these coordinates from the digitizer units to the units of the strip chart recording, and places these converted coordinates in a file.

The program provides the user with the capability to edit the data received from the digitizer and the data within the data files created by this program. These data files can be accessed by any OS/8 BASIC program.