XBT Processing Manual

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INTRODUCTION

The NODC XBT processing scheme, as outlined in the following pages, will consist of the utilization of the CALMA Model 303 A-D incremental digitizer and the data processing and manipulation programs developed by the NODC. Our XBT digitization will basically be the same as that of the Fleet Numerical Weather Central (FNWC) except for the inclusion of the NODC I.D. number, digitization, and ship codes, and the employment of an automated Test and Evaluation program. All XBT processing will be done at the NODC on the IBM 360/40.

PRE-PROCESSING

Analog XBT Records

As XBT data arrive at the NODC, they are brought to the records keeper for a cursory check to see if the pertinent linkages of platform name, position, date, and time are recorded on each trace. If this information is not on the trace, but on accompanying log sheets, checks are made to see if the log sheets can be correlated with the appropriate traces. The cruise is given an accession number and stored in a systematic manner until processing. NAPIS accession record is coded and keypunched to indicate the date, ship, number of observations, and the accession number for the acquired XBT data.

If the records are not complete, they are stored temporarily while a quick check is made to obtain the necessary information. If this information cannot be obtained, the data are destroyed or returned to the originator.

When a given XBT cruise is brought in for processing it is given an NODC Reference I.D. number by the Records Section. The accession record

is pulled and changed to indicate that the cruise is in processing under the NODC Reference I.D. number.

The reference number or "NODC Cruise Number" is entered on each log sheet and/or XBT trace. The NODC considers a cruise to be any consecutive number of observations taken from a particular platform. Each cruise is logged in by recording the NODC Cruise Number, platform name, period of observations, and date received on the cruise instruction sheet.

Digital XBT Data

For the present, incoming reels of magnetic tape containing digitized XBT data will be brought to the records keeper for assignment of the NODC accession number which is written on the magnetic tape container and any accompanying documentation. Each shipment of digital data will be logged in and stored in a similar manner as stated above. It is conceivable that all of the information necessary for logging in the data may not be known until the data are listed, in which case the log shall be completed after the initial processing. FNWC tapes will routinely be accompanied by an inventory.

INITIAL SCREENING

The initial screening phase is the first opportunity to evaluate the quality of the XBT data and prepare the acceptable data for processing. It basically consists of reviewing and preparation of the supplemental information and analog trace for digitization and the generation of the cruise instruction sheet.

Before commencing on the evaluation of the supplemental and trace data, the cruise should be sorted in chronological order and the NODC reference and consecutive numbers entered on each trace.

Analog XBT Data

Supplemental Information - In order for XBT data to be processed by NODC and to be of any value to the majority of the users the supplemental information containing at least the platform name, latitude, longitude, year, and month, must be reported for each XBT trace. This information may be reported on either log sheets or the trace. In a few instances the information may be reported on both in which case the XBT trace is used as the source.

Platform Name - Pending the completion of the NODC Master Ship Code, NODC will be using a six-character, alpha-numeric code. The first two characters being the country code, the second two characters being the institution code, and the third set of characters being the NODC ship code.

Latitude and Longitude - The position should be reported to at least the nearest whole degrees. If positions are recorded to tenths of degrees, the values are converted to minutes and entered on tape. The letters designating the proper hemisphere (N or S and E or W) must always be indicated. Zeros should be prefixed if less than two digits appear for either degrees or minutes. For example, 5°9' is coded as 05°09' if latitude and 005°09' if longitude.

Date - The date should be reviewed for completeness. If the year and month are omitted or considered questionable, the XBT is not processed.

Time - Time should be reported in hours and minutes of GMT. Local time must be converted to GMT.

Depth to Bottom - The sonic depth to bottom reported on the log sheets should be reviewed to determine if it is less than the maximum depth of the XBT probe. If the sonic depth is less, the corresponding strip chart should

be scrutinized for indications of the probes hitting the bottom. The trace should be noted so that the CALMA operator will not digitize below that point, and a "B" will be entered in the supplemental information (in the "bottom" field).

Cruise Instruction Sheet - The Cruise Instruction Sheet (Figure 1), which will be headed by the NODC reference number, ship name, period of observations, the number of observations, and accessions number, will contain the NODC-generated codes to be included on each XBT record. It will indicate which fields and the values that will be constant throughout the cruise, and observations by consecutive numbers that were rejected for processing. This instruction sheet will stay with the analog traces and cruise folder until completion. They will then be filed by reference number.

The NODC-generated codes are as follows:

Grid and Instrument Code	Code describing grid type, units, and scaling (see Table 1)
Platform	NODC-generated code
Bottom Indicator	B = probe hit bottom; blank if it did not
DNP	Declared National Program
Originator's Cruise Number	
Digitization Methods Code	
Digitization Interval Code	(see Table 2)
Data Treatment and Storage Code	

Analog Trace

XBT traces should be checked for the following features:

1. A calibration tic should be present at approximately the 62°F (16.7°C) line. If the calibration tic is not present or if the calibration

CRUISE INSTRUCTION SHEET
XBT DIGITIZATION

CONSTANT THROUGHOUT CRUISE

NODC GENERATED CODES	ENTRY	YES	NO
NODC Reference Number			
Platform (Ship) Code			
Country Code			
Digitization Methods			
Interval			
Treatment & Storage			
Grid Code			
Bottom Indicator			
Instrument			
DNP (Data use code)			
Originator's Cruise Number			

REMARKS: _____

START - indicates calibration tic's (Baseline Temperature)

SFC - indicates beginning of trace at the surface
STOP - indicates end of trace

PLATFORM NAME _____ NODC REFERENCE NUMBER _____

PERIOD OF OBSERVATIONS _____ _____ NUMBER OF OBSERVATIONS _____

PROJECTED OBSERVATIONS:

CONSEC NUMBER	REASON

DATE PRESCREEN | DATE SHIPPED | DATE DIGITIZED | DATE RETURNED | DATE ACCEPTED

Figure 1.

XBT INST FORM(360/40)13JAN71

TABLE 1

Grid and Instrument Code

Instrument	Grid	Inst Code	Code
1 Shipboard XBT		1	
	2500 foot (Ft & F)		1
	750 meter (M & C)		2
	1500 foot (Ft & F)		3
	450 meter (M & C)		4
	1830 meter (M & C)		5
2 Helicopter XBT	Unknown	2	
3 Submarine XBT	Unknown	3	
4 Airborne	Unknown	4	
	1000 foot (Ft & F)		1

TABLE 2

I. DIGITIZATION METHOD

a. Manual	01
b. A-D conversion from original	02
c. A-D conversion from copies	03
d. Optical scanning	04
e. Direct digital output	05

II. INTERVAL CODE

A. Fixed Interval

a. $\leq$1 m; and $\leq$0.1°C	01
b. >1 m but $\leq$3 m; and $\leq$0.1°C	02
c. >3 m but $\leq$6 m; and $\leq$0.1°C	03
d. >6 m; and $\leq$0.1°C	04
e. $\leq$1 m; and $\leq$0.2°C	11
f. >1 m but $\leq$3 m; and $\leq$0.2°C	12
g. >3 m but $\leq$6 m; and $\leq$0.2°C	13

B. Variable (flexure points)

a. Manually determined	31
b. Statistically determined	32
c. Physically determined	33

C. Combination of Fixed and Variable

a. Every 3 m to 900 ft then flexure points below 900 ft

III. DATA TREATMENT AND STORAGE CODE

A. Single Digitization

a. No treatment, stored as digitized	01
DATA COMPRESSION resulting in	01
b. Fit within 0.05°C	02
c. Fit within 0.1°C	03
d. Fit within 0.2°C	04
e. Fit within 0.3°C	05
f. Fit within 0.7°C	06
	07

B. Dual Digitization and Averaging

a. No treatment, stored as digitized	21
DATA COMPRESSION after averaging	
b. Fit within 0.05°C	22
c. Fit within 0.1°C	23
d. Fit within 0.2°C	24
e. Fit within 0.3°C	25
f. Fit within 0.5°C	26
	27

C. Data Points at Fixed Intervals or Selected Intervals Retained and Stored

tic is more than one degree from the 62°F line, the analog trace is rejected for processing.

2. The trace should begin at the surface line or very close to it. If the trace begins more than a 1/4" above or below the surface (approximately 100 feet), the end of the trace should be checked for variations of the like amount. If there is no like ending variation and the preceding and succeeding traces do not show beginning deviation, then the observation should be rejected for processing.

3. The traces should be checked for completeness and sudden change in gradients (see Appendix I for examples). If the XBT malfunctions or hits bottom, resulting in an incomplete trace or unrealistic temperature gradient, draw a line just above the sudden gradient to indicate by arrows the ending of the trace.

4. The XBT grid should be checked with respect to the units scaling and the proper grid and instrument code determined and entered on the XBT material from Table 1.

5. If the trace contains extraneous marks or is too faint, the observation is also rejected.

6. Because of the inaccuracies and distortion from copying machines, no attempt should be made to digitize Xerox or any other copy of the XBT traces unless absolutely necessary. Then a special group of grid control cards must be made according to Appendix III. The presently known XBT instrument and grid combinations and their scaling are shown in Appendix VI.

XBT Digital Data

Digitized XBT data will be received regularly from Fleet Numerical Weather Central (FNWC) and will be completely compatible with the NODC

system. Upon receipt by the XBT Section of any XBT data transmitted from the FNWC, the data will be assigned the NODC reference number and fixed numbers) see Appendix IV for the procedures and requirements).

Digital data from any other source would have to be completely documented, describing format, language, method of digitization, interval of digitized points, treatment of the data points, mode of storage, and all of the other necessary descriptors (i.e., date, position, ship, etc.). With this information the necessary control cards or program can be written so that the data may be included in the NODC file.

REVIEW

A review by the supervising oceanographer with respect to observation acceptance or rejection, generation of codes and accuracy of digitization instructions should be made to insure validity of the decision by working level technicians.

DIGITIZATION

NODC will utilize the CALMA Model 303 A-D converter for digitization of XBT's. The following will serve as supplementary instructions to the basic operating procedures of the CALMA.

The actual digitization may be considered in three phases: CALMA setup, entering the supplemental information, and digitization of the trace.

CALMA Setup

The XBT traces should be placed on the CALMA table with the depth and temperature axis of the charts approximately coinciding with the X and Y axis of the table respectively. The new axis rotation feature of

[illegible] in [illegible]

XBCALMA will automatically and precisely compensate for any small difference in alignment. Check the programming panel located in the back of the machine to insure that the panel is in the Variable Interval Programming (VIP) mode, and the sampling interval is set at one hundredths of an inch (0.01).

Entering the Supplemental Information

In all cases, the date, time, and position will be found on the log sheet or on the XBT trace itself, and should be typed from this source. In a few cases this information will be found on both log sheets and traces. In this case, the information is obtained from the trace unless otherwise directed by the originator. The base line temperature (temperature of the calibration tick and the depth of the calibration tick fields should be typed with blanks (Ø) as these fields will automatically be computed. The reference number and consecutive number will be found on the trace. The other NODC-generated numbers such as platform code, country code, bottom indicator, grid code, digitization methods code, internal code, treatment and storage code, and originator's cruise number, will be found on the cruise instruction sheet. The cruise instruction sheet will also indicate the fields and the values which are constant throughout the cruise and the observations which were rejected.

Eight character positions are allocated for the originator's cruise number. The cruise number should be entered beginning with the leftmost character position (left justified) and continued to completion.. If the cruise number is not present or is less than eight characters long, the space should be blank filled (Ø). This is true with any field in the Header information (i.e., if the hour and minute are questionable or not

present, their respective fields must be blank filled). The total length of the header information must be exactly sixty-seven (67) characters long including the keyboard character [ )].

On the first two traces of the cruise or the first two traces after the loading of a CALMA tape, the supplemental information, including the NODC-generated codes should be typed in its entirety according to the input format (Appendix II).

The CALMA Input format was designed so that the fields which most frequently remain the same for a given cruise are on the extreme right portion of the header (keyboard) record. These fields need not be entered after the first two stations unless there happens to be a change. In that case, the entire supplemental information up to and including the new field entry is typed. Similarly as above subsequent observations need not have the fields retyped if they are the same. It is important to remember that a field may be treated as fixed if (1) it is the same throughout the cruise, and (2) every field to the right of it remains the same throughout the cruise. For example, if the year (Column 13-14) is the same for the entire cruise, but the latitude and longitude varies from station to station, the year cannot be treated as a fixed field and must be entered every time.

If an error was made typing the supplemental information, depress the record delete button and begin again starting with the keyboard button. If the error was made within the first eight characters, randomly type characters to bring the total above eight before following the above procedure. This practice is to insure that the computer will recognize a record as such.

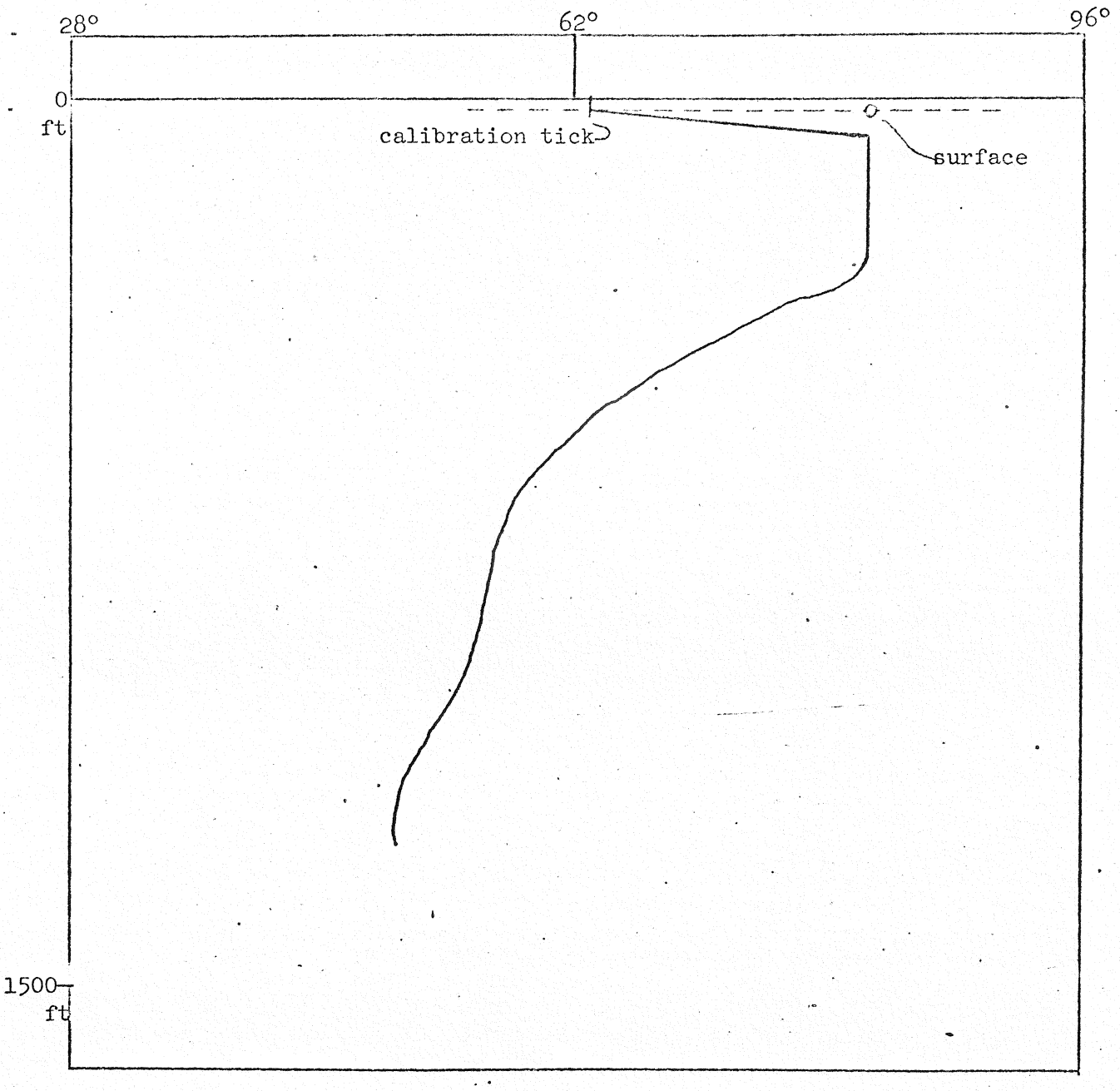
Trace Data

After entering the supplemental information and the IRG, move the stylus to the intersection of the zero (0) meter grid line and a major (bold)

temperature grid line (see Figure 2). Depress the tracer button and take the digitizer out of the skip mode. Move the stylus along the horizontal temperature grid line for about 4 inches (1300 ft or 400 m). Depress the skip button and enter a $_{A}^{B}$ code by depressing the flag pedal. Now position the stylus at the intersection of the 15°C (59°F) temperature grid line and zero (0) meter grid line and take the digitizer out of skip mode by depressing the skip button. Digitize from this position to the intersection of the calibration tick and the vertical line indicating the release of the probe and enter the flag symbol. Move the stylus in the vertical direction to the intersection of the trace and the cross hairs of the stylus. At this point the flag pedal should be depressed to generate a $_{A}^{B}$ code on the tape. Then, with care, the trace is digitized to a point approximately 1/2 inch below the bottom or to the point determined in the initial screening, at which point the skip mode button is depressed then the IRG is entered. If an error is made while digitizing the trace, depress the skip mode button and then the record delete button and go back and begin digitization, starting with the depression of the trace mode button. If the error was made at the very beginning of the trace, move the stylus around before following the above procedure. Again this practice is to insure that the record is of sufficient length so that the computer will recognize it as such.

It is important to note that the present program does not permit inter-record gaps (IRG) during digitization.

These steps are repeated for each BT trace that is digitized, whether it is the same trace that is being digitized for the second time for quality control sample or the next trace in the cruise.



EXAGGERATED ILLUSTRATION

Figure 2.

Procedures for Digitizing AXBT's

The Airborne Expendable Bathythermograph (AXBT) instrument produces a strip chart measuring 2-5/16" across the temperature axis and 10" along the depth axis. The temperature axis is extremely non-linear with the average 1/8" increment yielding a temperature difference of 4°F. From this, one can see that the resolution using the CALMA for digitizing is not as good (.01" = .3°F) as compared with the SXBT whose resolution is .01" = .09°F).

Because of the physical characteristics and the relative precision of the AXBT, there are three required changes in the digitization and evaluation procedures. They are as follows:

1. Because there is no calibration tick on the AXBT, the following digitization procedure modifications are required. After digitizing a major temperature grid line for about four inches (400 ft) and entering the flag symbol as previously discussed, the operator must now position the stylus at the intersection of the zero feet and 25°F grid lines. The skip button is now depressed to take the CALMA out of skip mode and the stylus is moved to the top of the trace. Enter the flag symbol and continue to trace as usual.

2. Because the grid resolution is poorer, the acceptance criteria in the Test and Evaluation program will be 95% within 0.6°C and no temperature difference exceeding 1.0°C.

3. The NODC codes will be 02 for digitization method code, 11 for interval code, and 07 for the treatment code.

It is strongly suggested that some type of plastic envelope be used as a trace alignment guide. The reason is that the stylus tends to snag the edge of the AXBT trace because of the narrow width of the trace.

SMOOTHING AND COMPRESSION

After digitization the CALMA tapes are put on the IBM 360, and the XBT data is smoothed, compressed, and put out in depth and temperature values of the significant points. At this time the constant fields within the supplemental information of the first station will be written on all stations of the cruise. The smoothing operation summarizes horizontal and vertical line segments to effectively eliminate multiple temperatures at the same depth and right angles in the trace. It is also performed to eliminate intermediate points that fall on a straight line. For any horizontal line segment (constant Y axis value or temperature), the last X axis value minus .005 of an inch is retained along with the appropriate Y axis coordinate, $P(X_n - .005, Y_n)$. The vertical segment that intersects with $P(X_n, Y_n)$ will have point $P(X_n - Y_n \pm .005)$ retained. The next horizontal segment that intersects the previous vertical segment will have point $P(X_n + .005 - Y_m)$. This process will continue until the end of the trace at which the last CALMA coordinate will be retained. This routine naturally allows for any variation of direction in the Y axis (temperature); however, only positive X axis (depth) increments are permitted. If any decreasing X values (depths) are encountered, those points are ignored. In the compression routine the number of points to describe the trace is further reduced to essentially "flexure points." This is accomplished again by projecting an imaginary line from the first point on the trace (the flagged point) to the third point. If the second point is within two CALMA units from the line then the line is reprojected from the first point to the fourth point. If the second and third point is within two CALMA units from this line, then the procedure is continued to the fifth point or

until the deviation from any inbetween point to the projected line is greater than or equal to two CALMA units. When this occurs the preceding point is retained as the significant point and is now the initial point for a new series of projected lines. This process is continued to the end of the trace with the end result a series of seven to 100 significant points which can be connected by lines that will not deviate from the original CALMA points by more than two CALMA units or .096°C or .19°F. The resulting flexure points which are distances from the calibration tick, in thousandths of an inch (1/1000), are now converted to depth and temperature values utilizing the relationship of measurement to meters and degrees centigrade expressed by the grid control cards. The flexure points are again checked to determine that each succeeding temperature value increases in depth before the data are put out on disk in the NODC final format (see Appendix V).

TEST AND EVALUATION AND QUALITY ASSURANCE

After digitization and trace compression of a cruise, a sample of 3 to 5 percent of the total should be selected randomly by the supervisor and digitized according to the above procedures. The sample will be compared with the corresponding observations of the digitized cruise on the computer. The output will be a listing of a frequency distribution and a cumulative frequency distribution of the deviation between the identical traces, along with notations indicating differences within the supplemental information of the same traces. A General Internal Logic Test (GILT) will be applied to the supplemental information. This test will evaluate the relationship between the speed of the ship, the elapsed time between drops, and the distance between the BT drops. In addition, all fields will be

checked for garble and inconsistencies. The output of GILT will appear in the above-mentioned listing denoting the type of inconsistencies and the BT traces involved.

The criteria for acceptance of XBT data are: (1) The complete agreement with respect to the supplemental information between the digitized trace and the corresponding redigitized sample if applicable; (2) No apparent inconsistencies from the General Internal Logic Test; and (3) The total adjusted cumulative frequency of temperature deviations should be at least 90 percent at the 0.2°C interval and no point deviation should be equal to or greater than .4°C. The adjusted cumulative frequency is accomplished by utilizing the depth difference in a strong gradient in an attempt to justify a large temperature difference.

If any one of the above three conditions are not met, the entire cruise is rejected for the archives and must be thoroughly scrutinized and corrected. If conditions (1) and/or (2) are not met, the supplemental information should be line-proofed against the original traces, and the necessary information corrected by use of the XBEDIT Program. If condition (3) is not met, the entire cruise must be redigitized.

XBT EDITING

The edit program was written to alter XBT data in cruise order in the NODC final format. With the use of control cards (1 card per change) any XBT observation may be deleted, or any field within the master information portion of a record may be corrected. The intent of this program is to correct XBT data after the data have been evaluated using the XBTEVAL Program. However, it may be necessary to use the EDIT Program after the XBT-CALMA Program to delete the observations because of the use of the wrong

grid code. These observations must be deleted before the submission of the corrected version.

Table 3 shows the code that must be entered for each parameter that must be updated. One card is required for each change, although up to 26 different changes per observation are permitted. All fields must be right justified, except the new value field, which must be left justified.

There are essentially two basic functions the XBTEDIT Program provides. They are: (1) The ability to change one to 25 fields on any number of consecutive observations (maximum of 999 consecutive observations) with one card per change. The consecutive number of observations affected by a card change may overlap with any other change card. All of these change cards designed to alter a group of observations must precede those cards which change a single observation. A maximum of fifty (50) group change cards is permitted. (2) The ability to change any field of any observation with one control card per change per observation. These cards must be in the same sequence as is the data to be changed and must follow the group change control cards. However, the change may affect one of the observations that is also being edited by the group control card(s). There is no limit to the number of such change cards which may be used.

The deletion of a record does not involve the removal of the record at this time, but the addition of the character 'D' in character position 80 of the Header information. Subsequent processing programs will recognize this as a deletion. If by chance a previously deleted record is found to be acceptable, the record can be saved by using the field code of 'keep' and the new value of blank.

After the EDIT Program has been used, the resulting listing should be reviewed to insure that the desired corrections have been made and that other cruises have not been changed accidentally.

Card Columns	Description	Contents
1-6		Blank
7-11	NODC Reference No.	(The observation which is to be cor-
12-14	NODC Consecutive No.	(rected or deleted.
15-21		Blank
22-26	Field to be changed	Enter the particular field representation as in Figure 2.
27-30		Blank
31-38	Value	Enter the new value of the field. (Left justify. Blank if field is to be blanked.)
39	More than 1 trace to be changed	1 = more than 1 trace has a common field to be altered. Blank = only 1 trace being changed by this card.
40-42	Number of observations	Enter the number of consecutive observations to which correction applies. The number includes the first observation, indicated in columns 7-14.
43-64		Blank
65	Delete	1 = delete observation. Blank = change observation.
66	Control	C = another field to be corrected follows for this reference and consecutive number. N = no more - last correction for this observation.

Field to be Changed Table

To Change	Enter in Cols. 22-26
	22----------26 *
Reference No.	REF
Consecutive No.	CON
Day	DAY
Month	MONTH
Year	YEAR
Hour	HOUR
Minute	MIN
Base Line Temperature	BASE
Latitude (degrees)	LATT
Longitude (degrees	LONG
Country	COUN.
Ship Code	SHIP
Grid Code	GRID
Digitization Methods Code	DIGI
Interval Code	INTE
Treatment and Storage Code	TRST
Latitude (minutes)	LAMIN
Latitude (hemisphere)	LAHEM
Longitude (minutes)	LOMIN
Longitude (hemisphere)	LOHEM
Bottom Indicator	BOT
Declared National Program	DNP
Calibrated Depth	CLDEP
Instrument	INSTR
Originator's Cruise Number	ORGNO
Save a deleted record	KEEP

*Right Justify

TABLE 3

XB FINAL

The XBFINAL Program is a special purpose program to put finalled XBT data out onto tape from the working disk file. Utilizing control cards (one card per cruise) with the cruise number of the data to be finalled in the first five columns, the final program will copy these cruises onto tape from the disk file. If the cruise number is not present in the control card, the cruises are written onto another disk file.

A data report is printed at the end showing cruise numbers and number of observations that were finalled, those that were not finalled, and number of stations deleted.

XBT REQUESTS

The XBT retrieval program enables the needs of the requestor to be related to the capabilities of this computer program. The request is analyzed in terms of type of output, medium of output, output unit, interval for the constant depth or constant temperature, and starting temperature for a constant temperature interval. Control cards can then be prepared to utilize the available options.

The request program reads, from tape or disk, the file containing the particular data of interest. XBT data may be selected by one or any combination of the 34 parameters in the header portion of a record. Examples are cruise number, 10° square, and year. This selection is accomplished by inserting FORTRAN "IF" statements as data cards. These statements begin in column 7 and cannot exceed column 72. Typical format is as follows:

```
COL                                          COL
 7                                            49
 IF (HEAD(7) .NE. CHAR ('1969 bbbb')) GO TO 10
```

Where HEAD (7) equals the year and CHAR (1969 bbbb') equals the character representation of the year to be selected. The CHAR configuration must include 8 characters, so blanks should be added when necessary. Ten (10) in statement "GO TO 10" indicates read the next record and not process the present one. If the above condition was what was wanted, a "GO TO 5" statement after the IF would be punched. The example "IF (HEAD(7) .NE. CHAR('1969 ----')) GO TO 10" means if the year does not equal 1969, then read the next record or do not process this record.

The data being read and selected must be in the standard XBT 360 format. The program also reads a control card which determines the form of the output data. The specified output is then produced.

The control card for this computer program must have the following:

Columns	Description
1	Type of output code
2-3	Medium of output code
4-5	Output unit
6-7	Interval for constant depth or temperature
8-9	Starting temperature code for constant temperature interval

These 5 fields may be repeated up to 5 times. The codes are organized in the following way:

Type of Output Code

Inflection points = 1

Header information only = 2

Constant depth interval = 3

Constant temperature interval = 4

Medium of Output Code

Print = 01

Tape = 02 (9-track tape)

Tape and print = 03 (9-track tape and print)

Card image = 04

Card image and print = 05

Plotter tape = 06

Tape = 07 (7-track tape)

Tape and print = 08 (7-track tape and print)

Output Unit

Units may be 10-99

Blank for printout

Tape and punched card output require an output unit number

Constant Depth or Temperature Interval (The first and last depth temperature value are always put out.)

01-99 permitted

Depth: 1 to 99 meters

Temperature: .1 to 9.9 degrees Centigrade

Blank defaults to 05

Starting Temperature for Constant Temperature Interval only.

Code	
00	Start at whole degree
01	Start at surface temperature
02	Start at multiple of .2 degrees
05	Start at multiple of .5 degrees

Blank defaults to 05

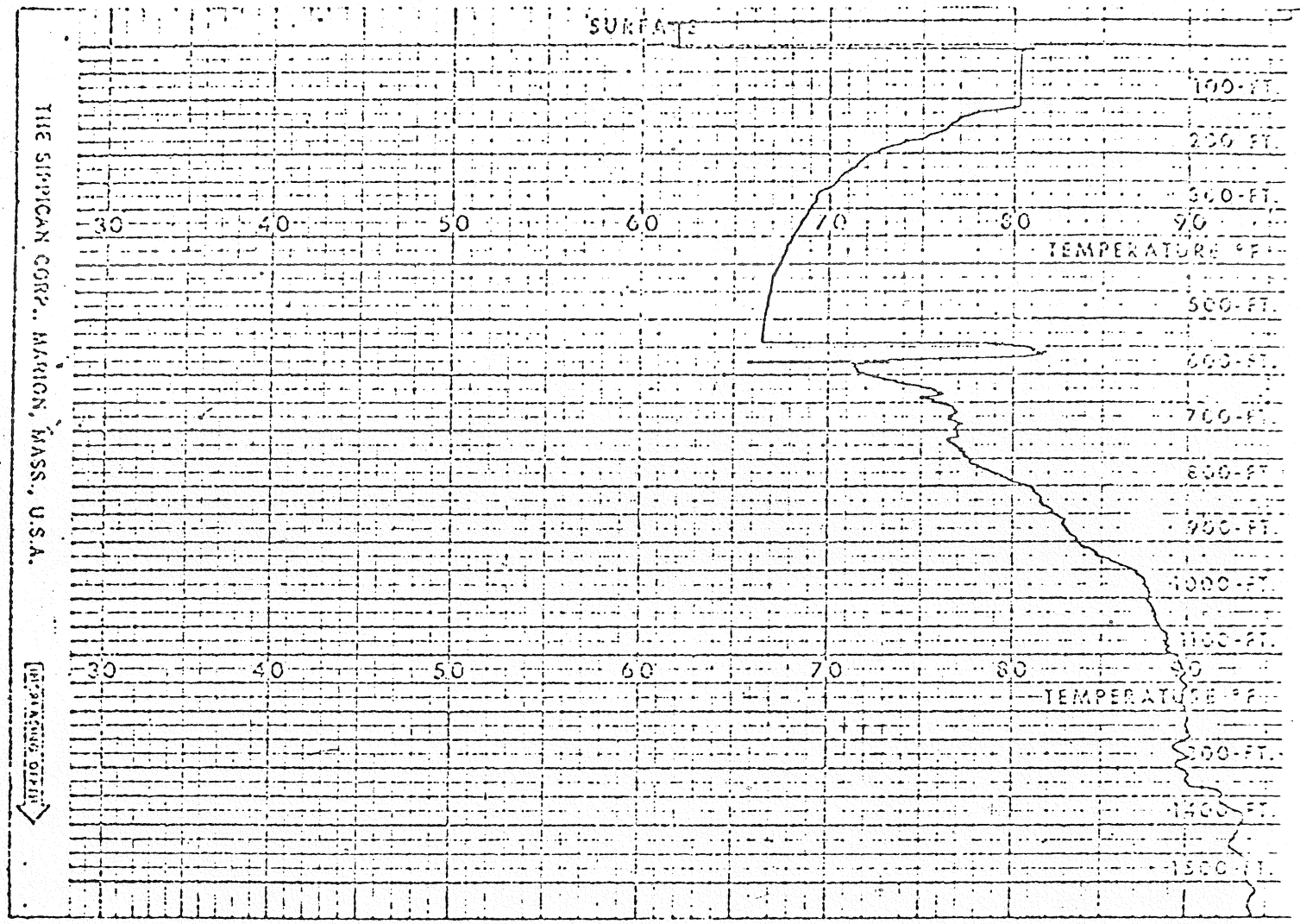
Header information is only available as printout. Up to five kinds of output for XBT data can be created during one computer run. Another restriction is that plotter information is outputted only on 7-track magnetic tape. This tape is then run on the CAL-COMP Plotter to produce graphs.

Job Control Language (JCL) cards are needed for tape or punched card output. In these cases, the output unit field on the control card must not be left blank.

A P P E N D I X I

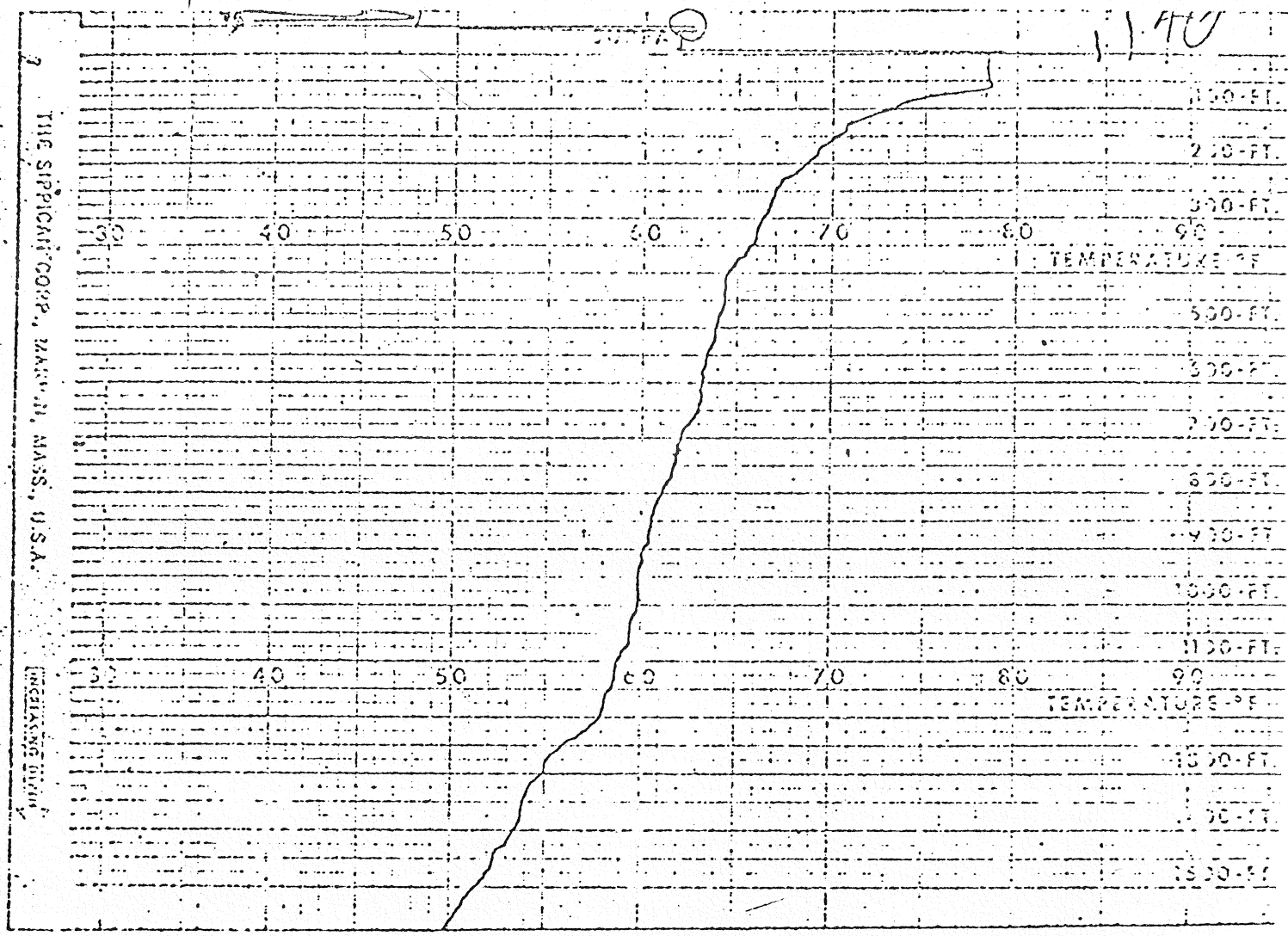
Examples of XBT Malfunctions

WIRE LEAKAGE



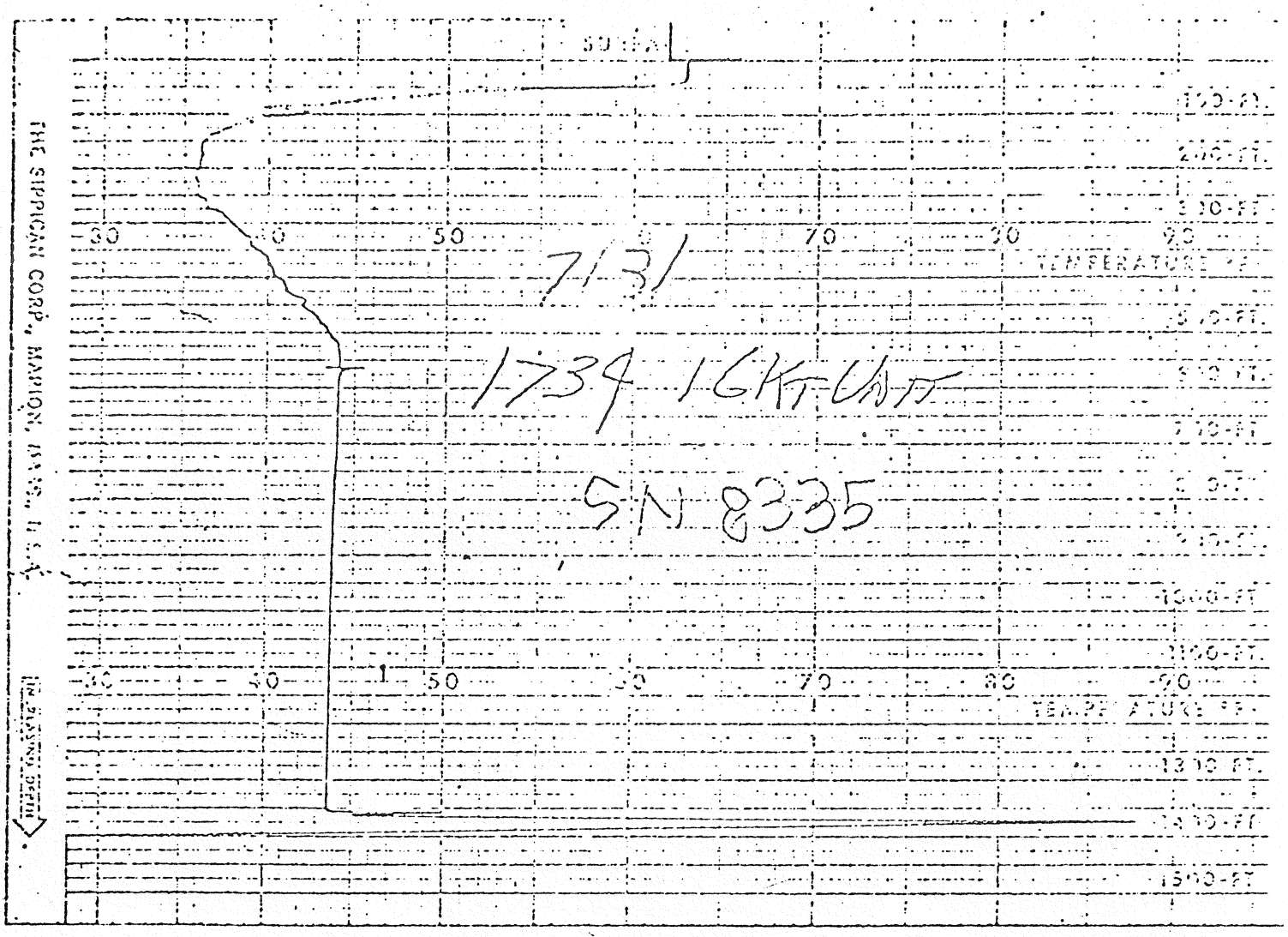
Cause: Damaged insulation on wire leakage appears at 540 feet.

NOISE PASSING THROUGH CHECK CYCLE



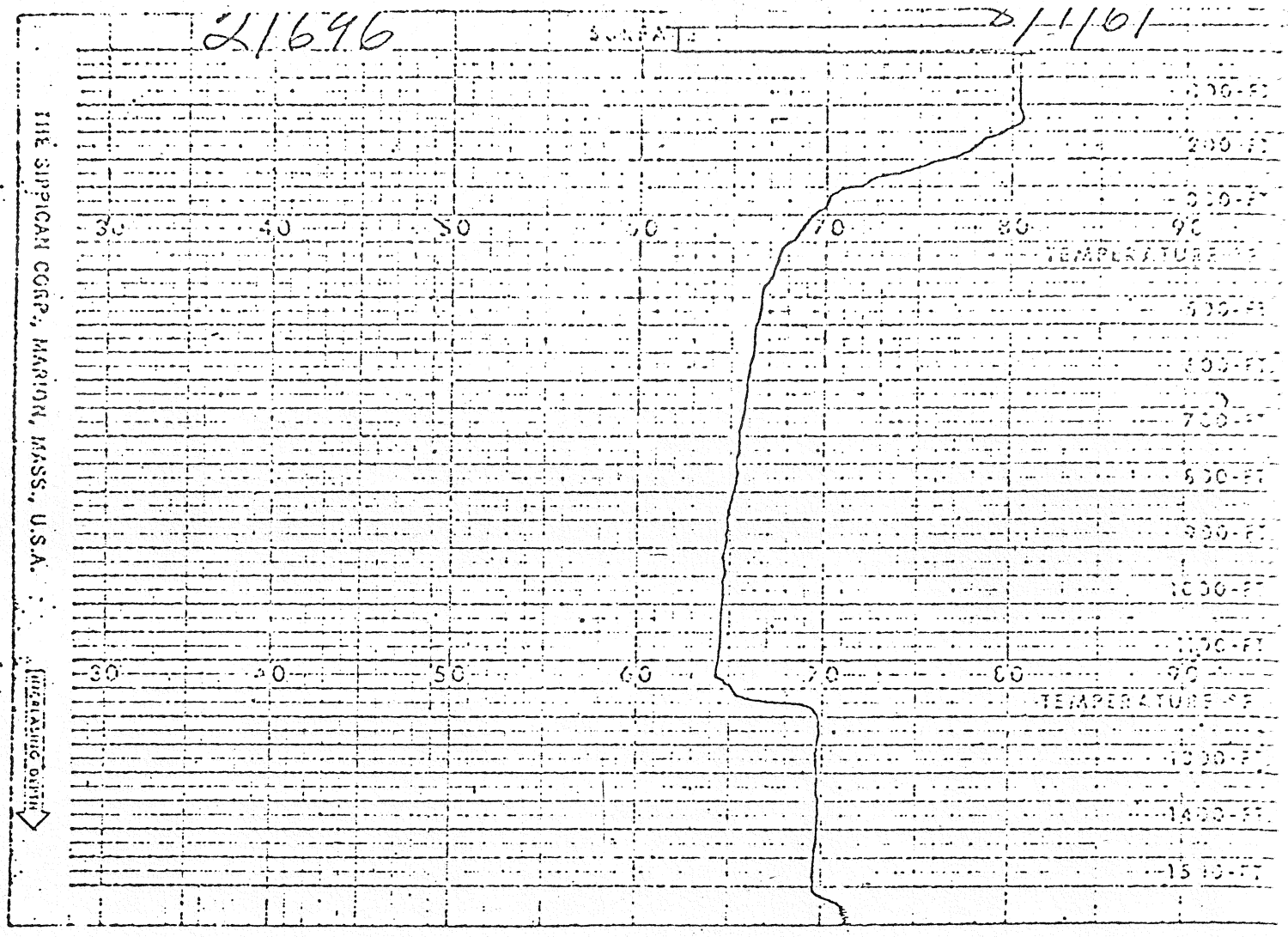
Cause: Defective potentiometer in recorder.

SHALLOW DROP



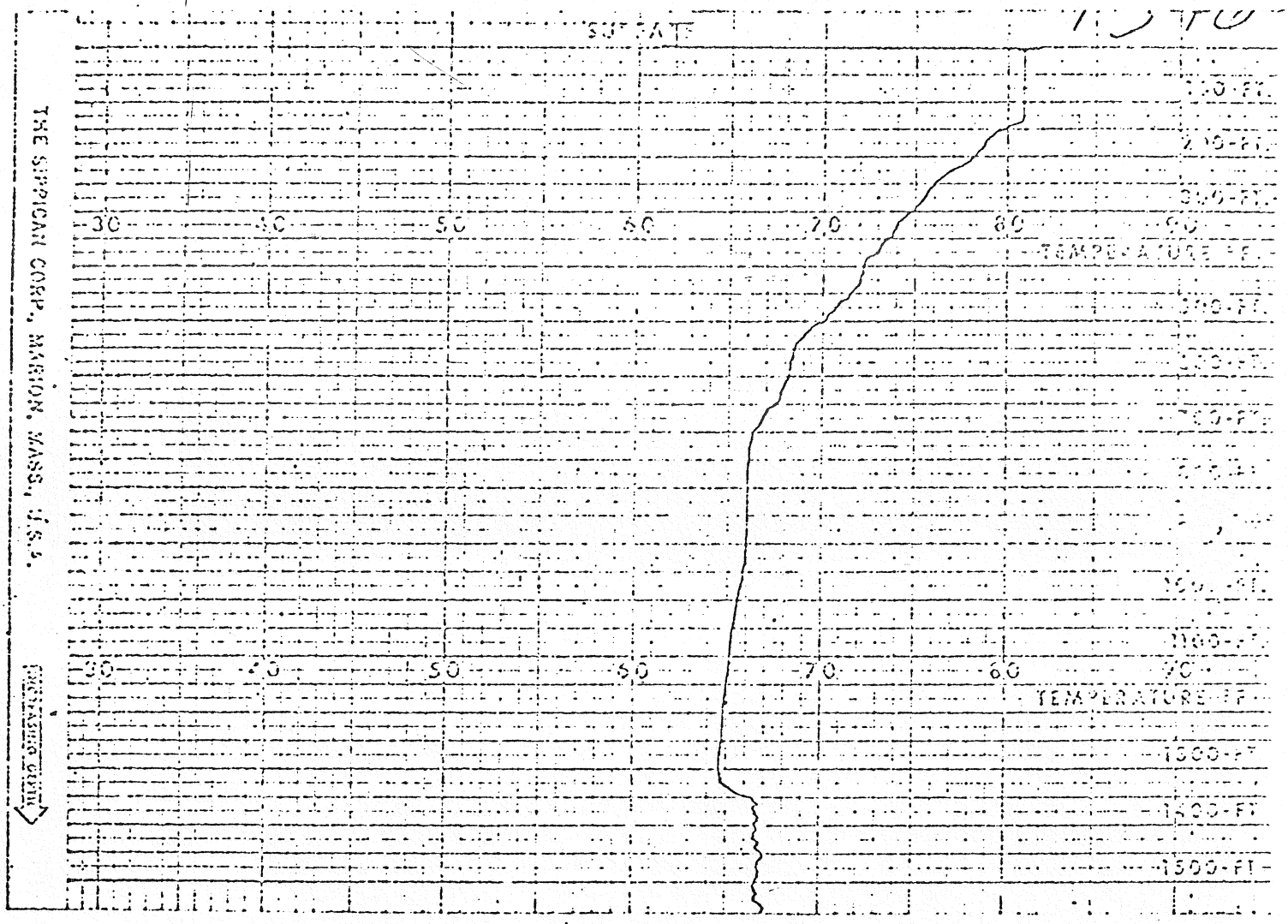
Cause: Probe hit bottom at 565 feet.

TEMPERATURE EXCESSIVE



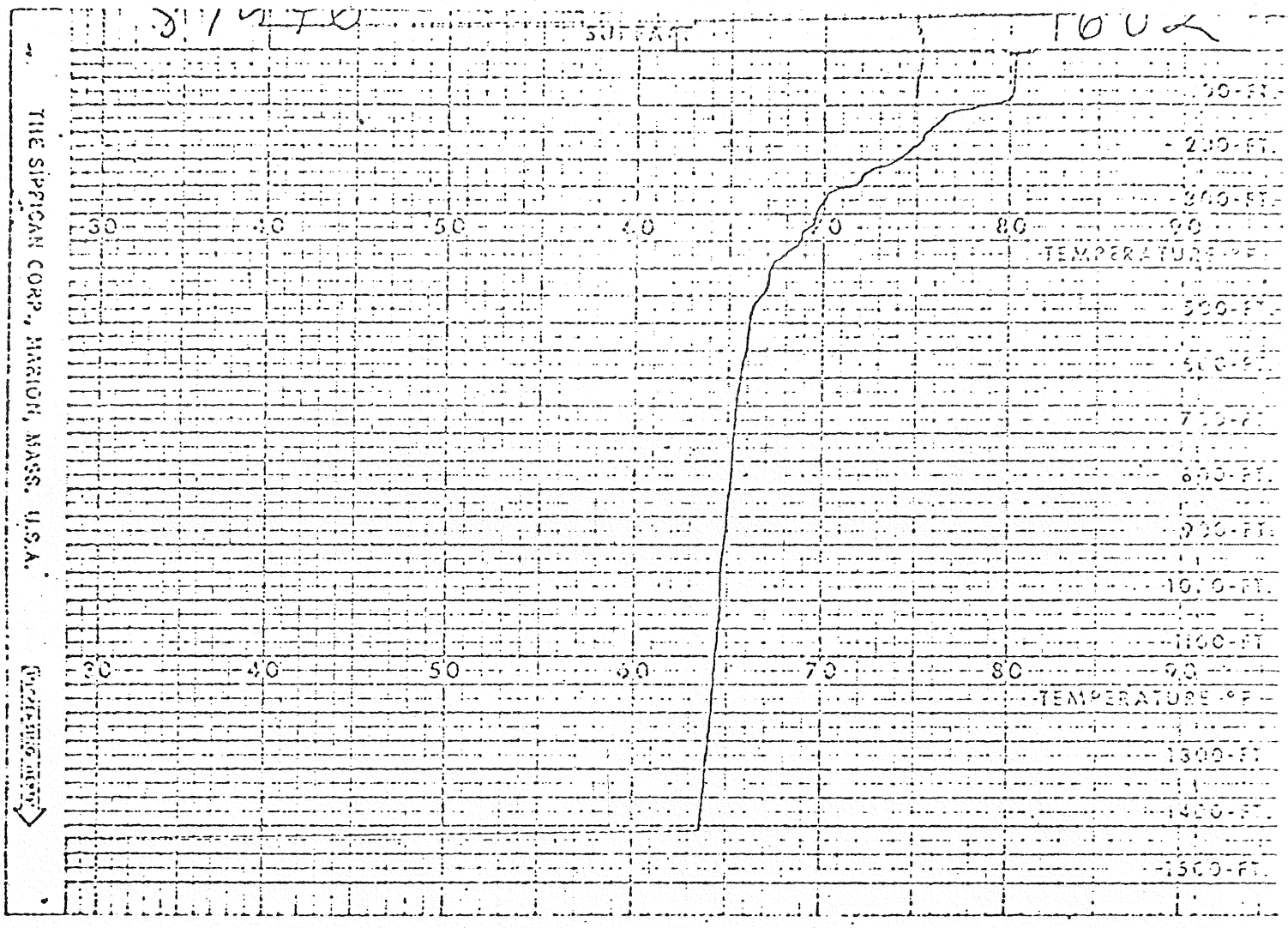
Cause: Leakage in launcher cable. Data lost after 1130 feet.

WIRE LEAKAGE



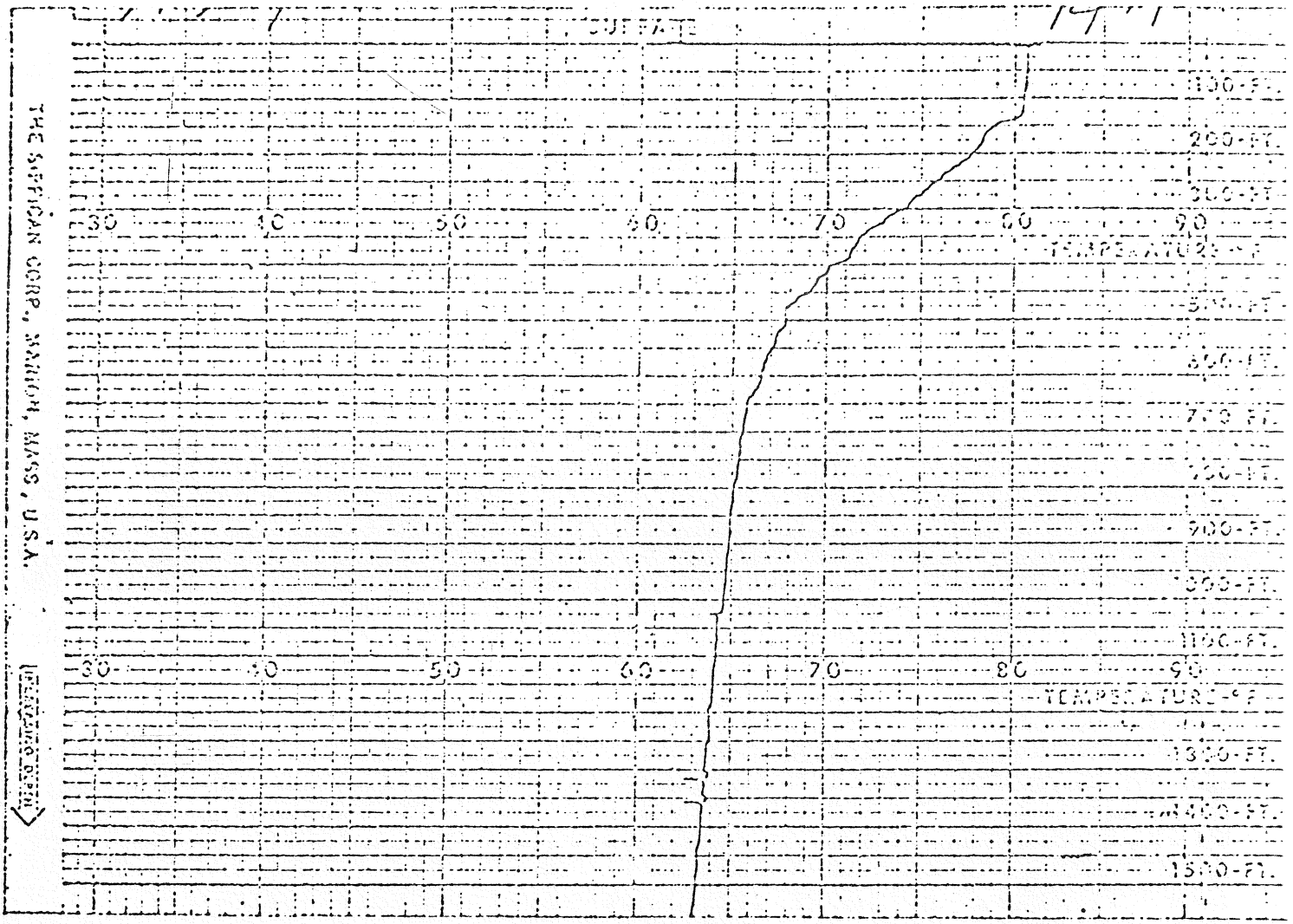
Cause: Wire fouled on side of ship -- notice spikes at 1115, 1185, and 1250 feet indicating a disturbance of insulation. Wire stretch occurs between 1250 and 1350 feet followed by complete insulation penetration.

WIRE BREAK



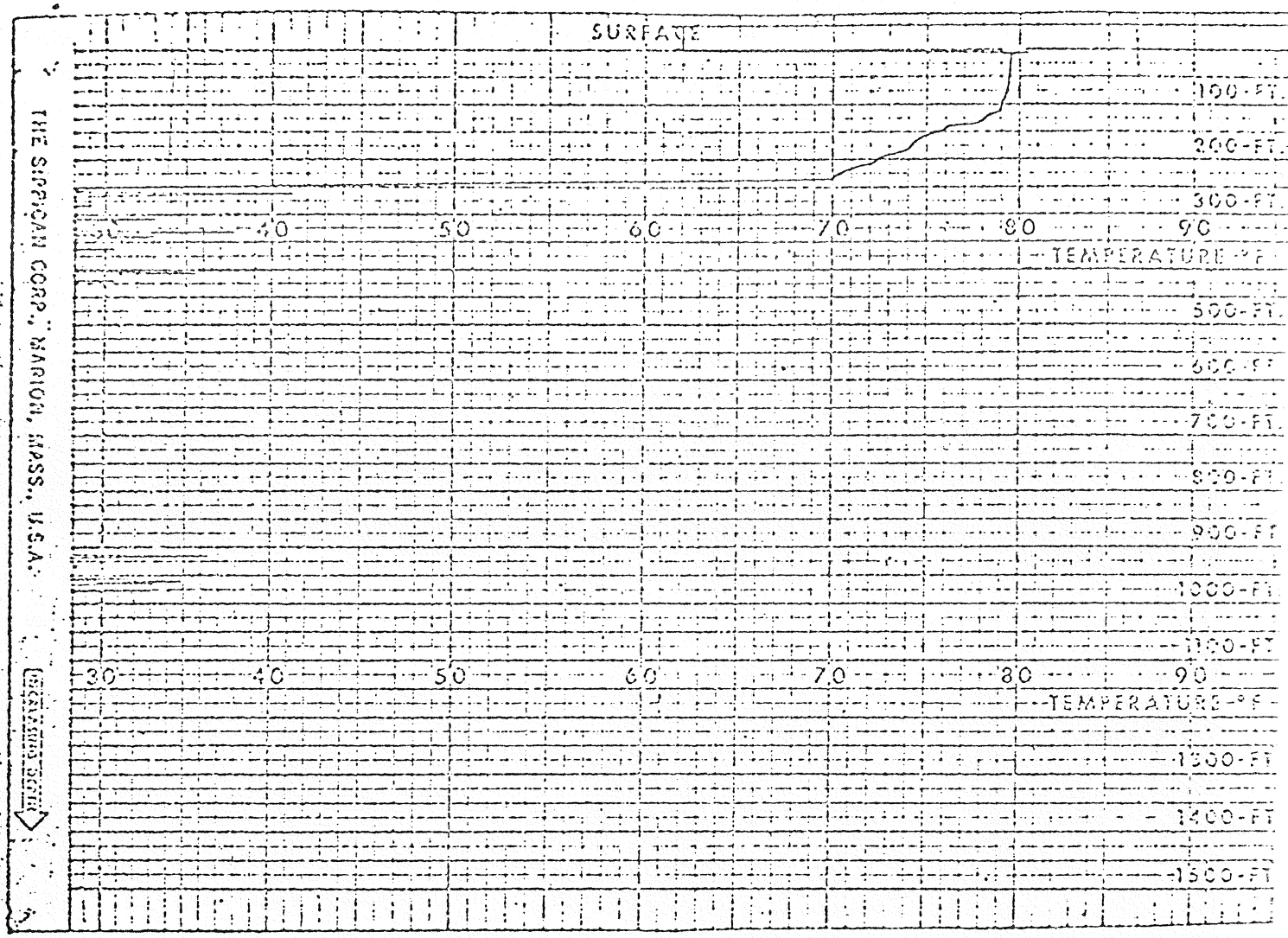
Cause: Wire was probably damaged during manufacture.

NOISE



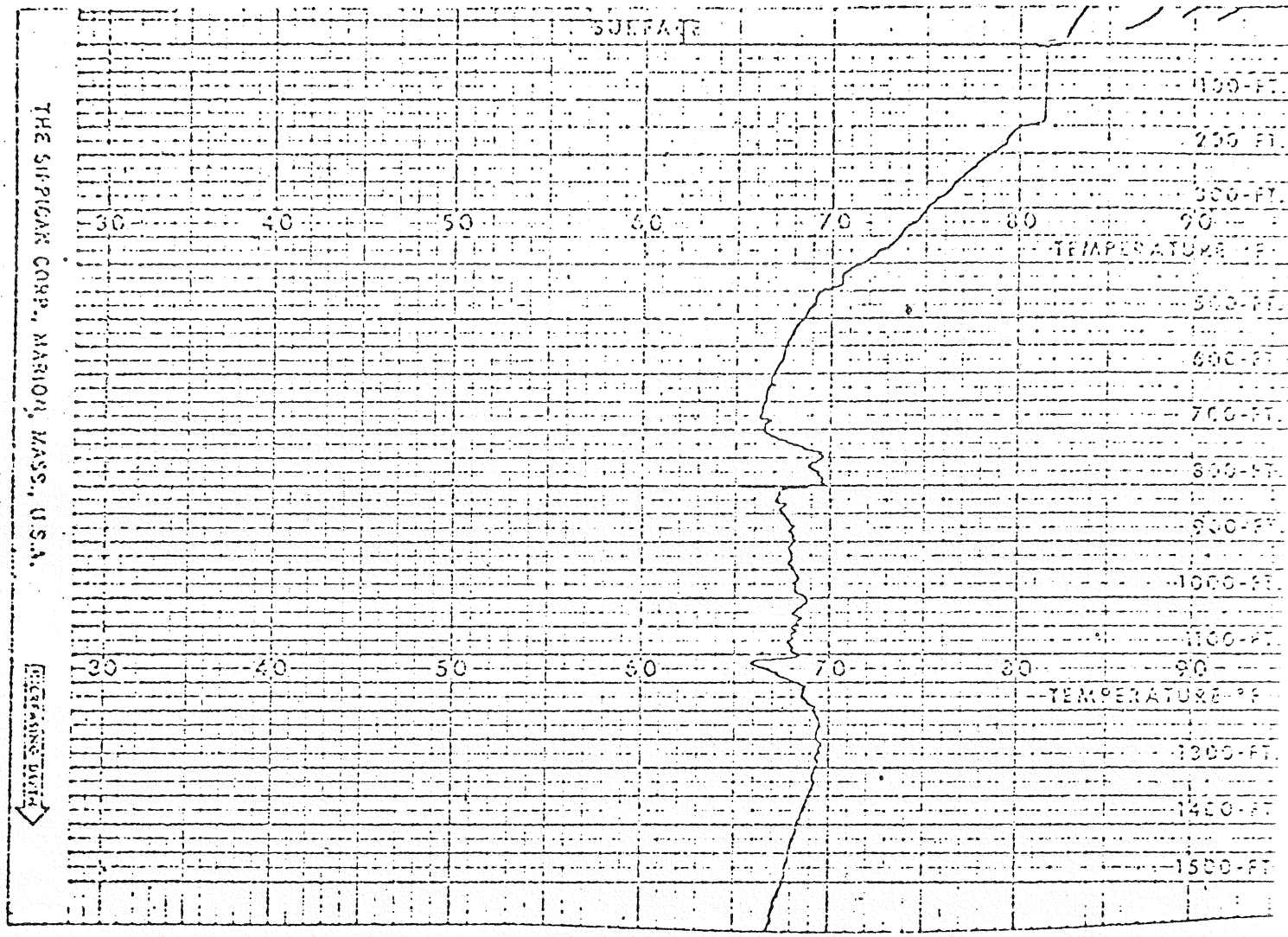
Cause: External interference.

WIRE BREAK



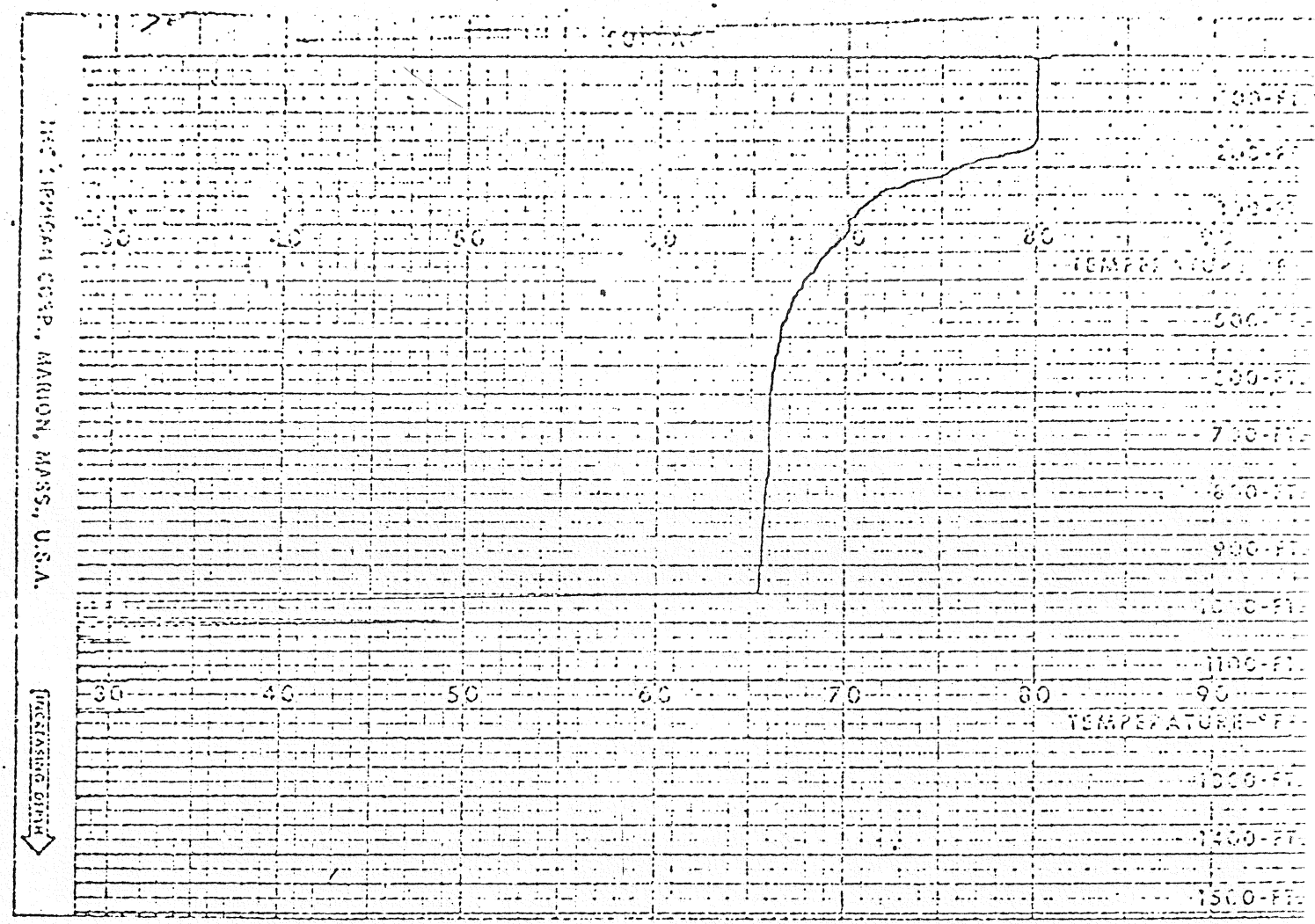
Cause: Wire broke at 235 feet -- no fouling involved --- wire was probably damaged during manufacture.

WIRE LEAKAGE



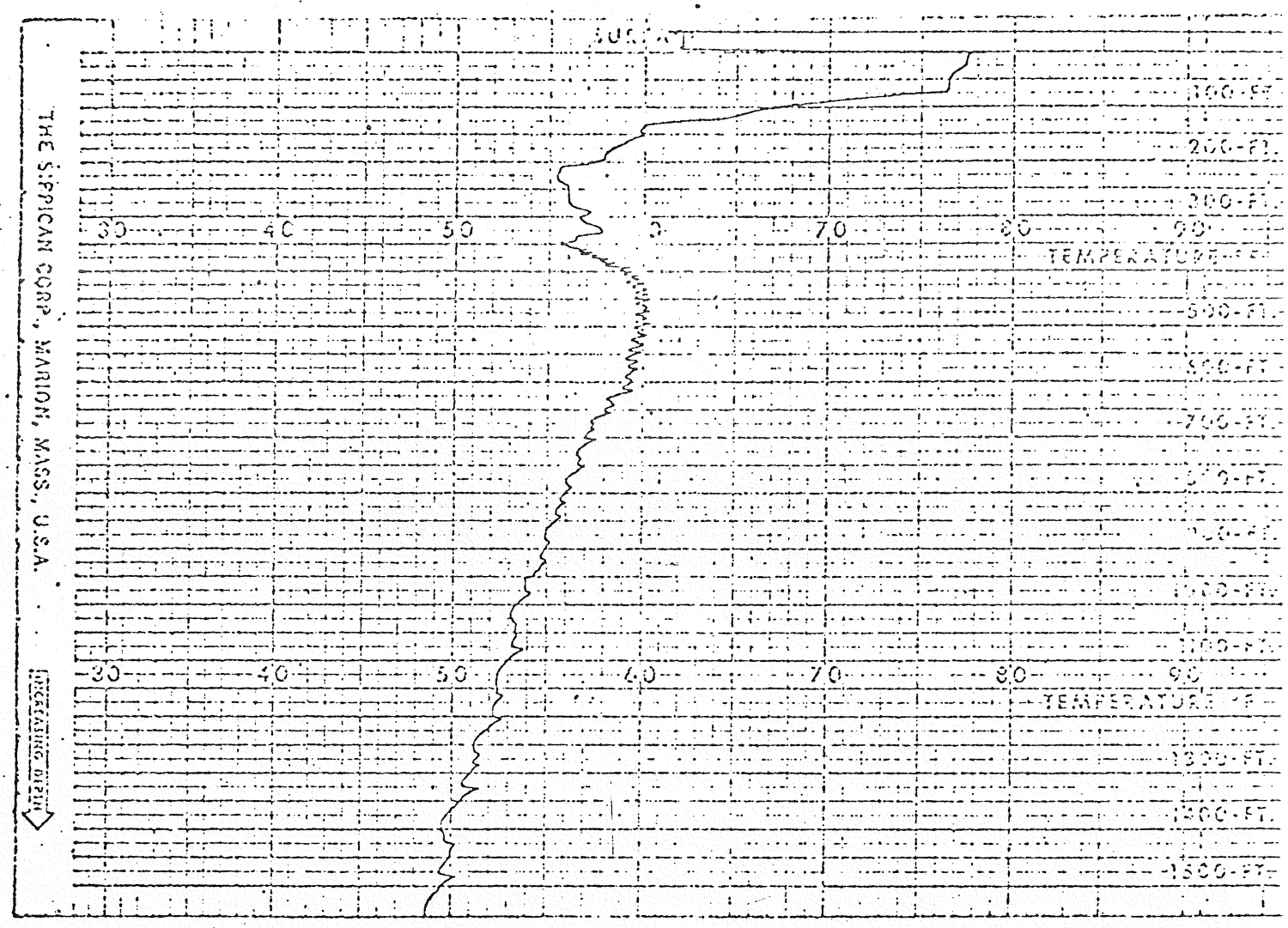
Cause: Wire fouled on side of ship -- note spike at 620 feet indicating a disturbance of insulation -- insulation penetrated at 680 feet.

: WIRE BREAK



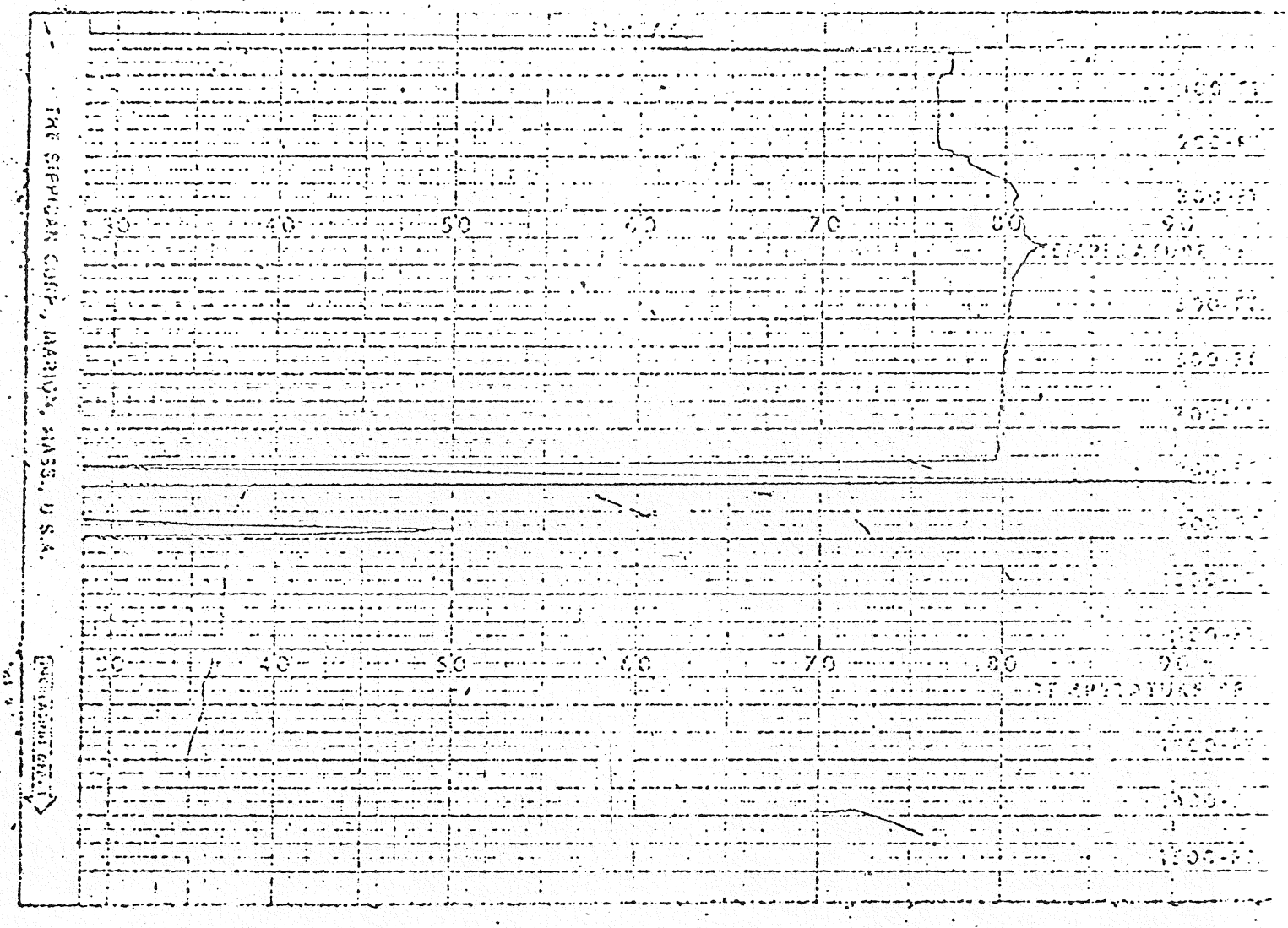
Cause: Note improper check cycle indicating a bad connection. Wire did not break, a system connection failed at 950 feet. This drop should have been aborted.

EXCESSIVE NOISE



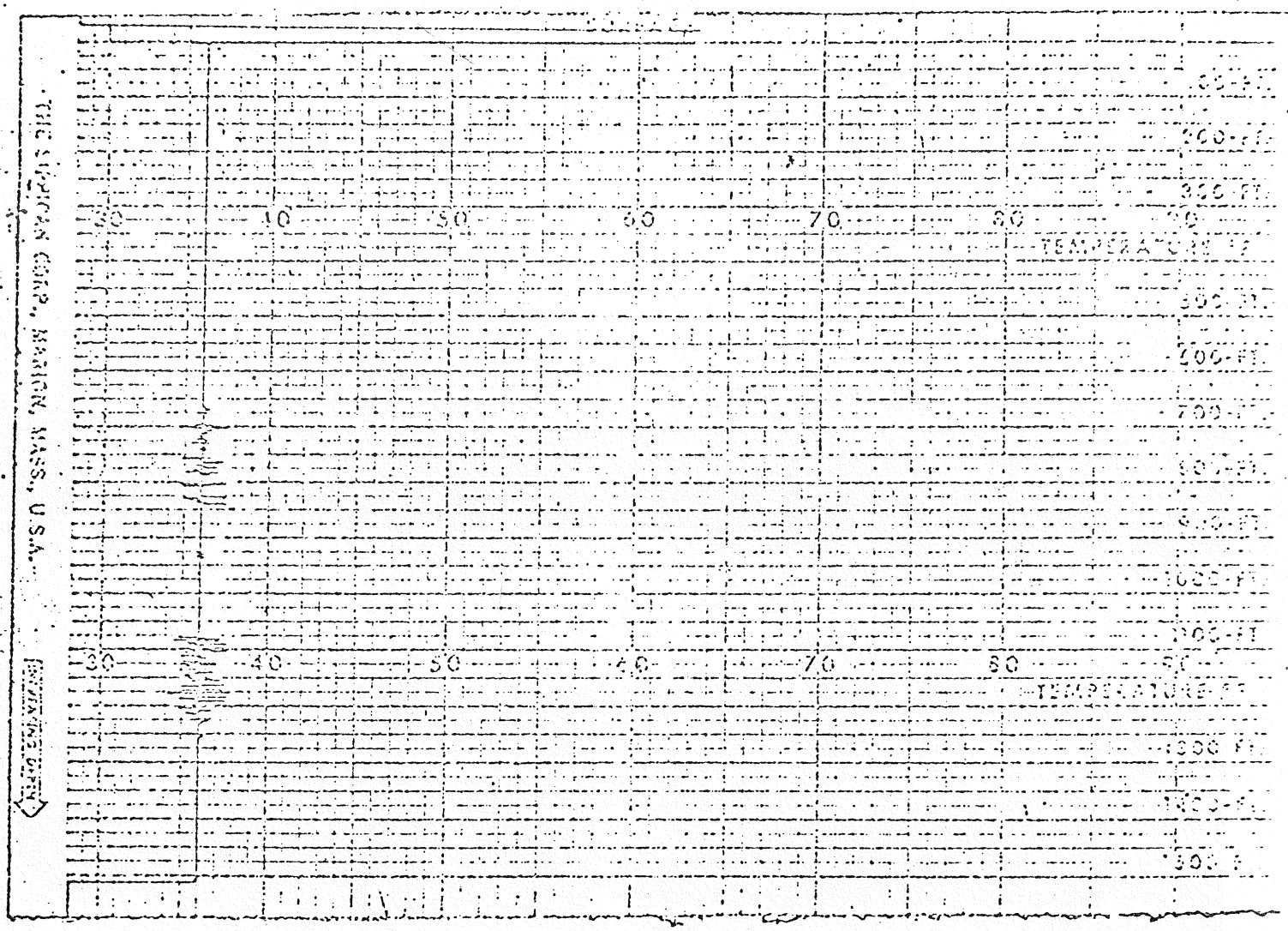
Cause: Excessive leakage in launcher cable.

WIRE LEAKAGE AND BREAK



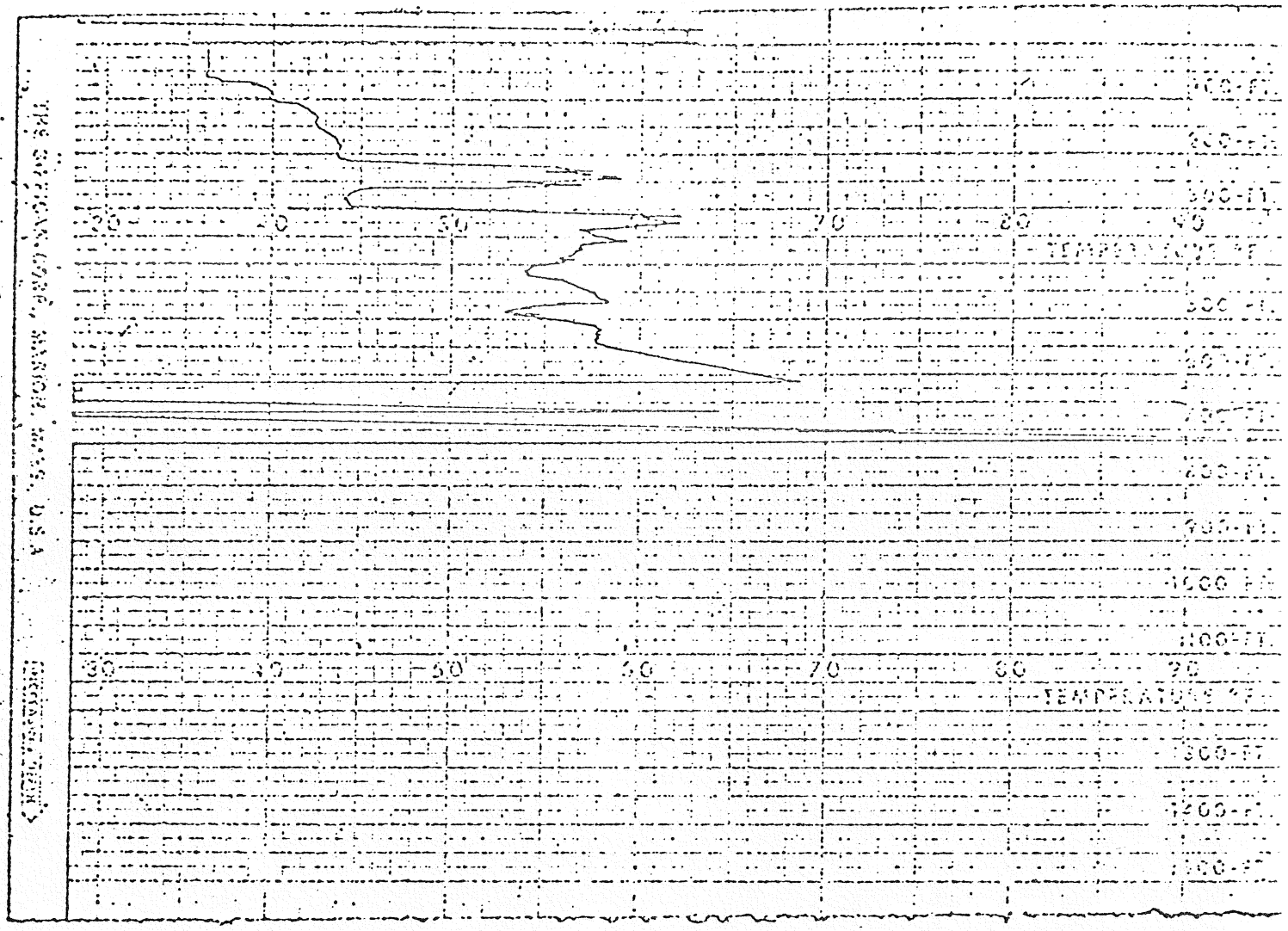
Cause: Wire fouled-insulation penetrated at 170 feet. Fouling continuous until wire breaks at 760 feet.

EXCESSIVE NOISE



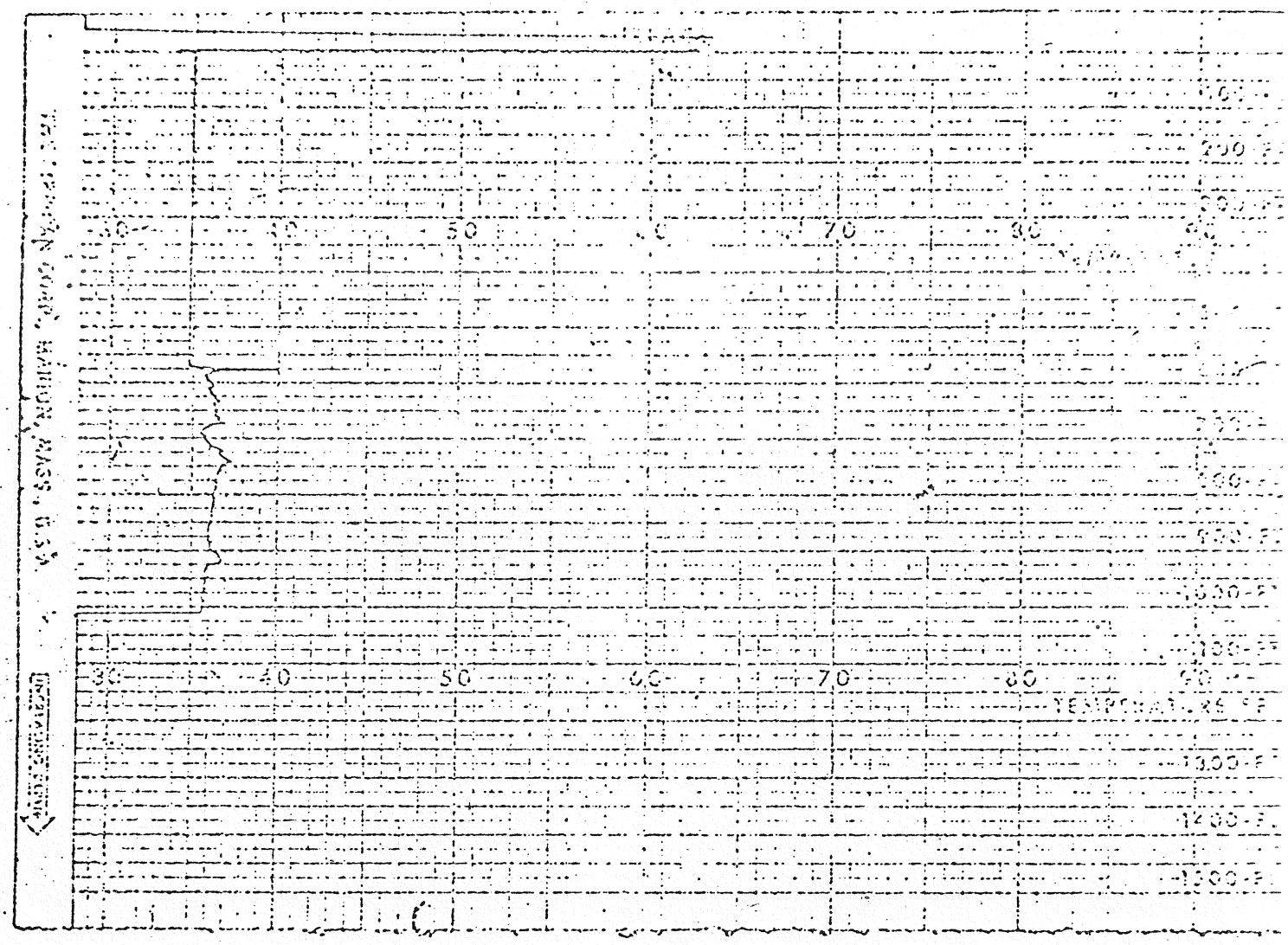
Cause: External source interference.

WIRE LEAKAGE & BREAK



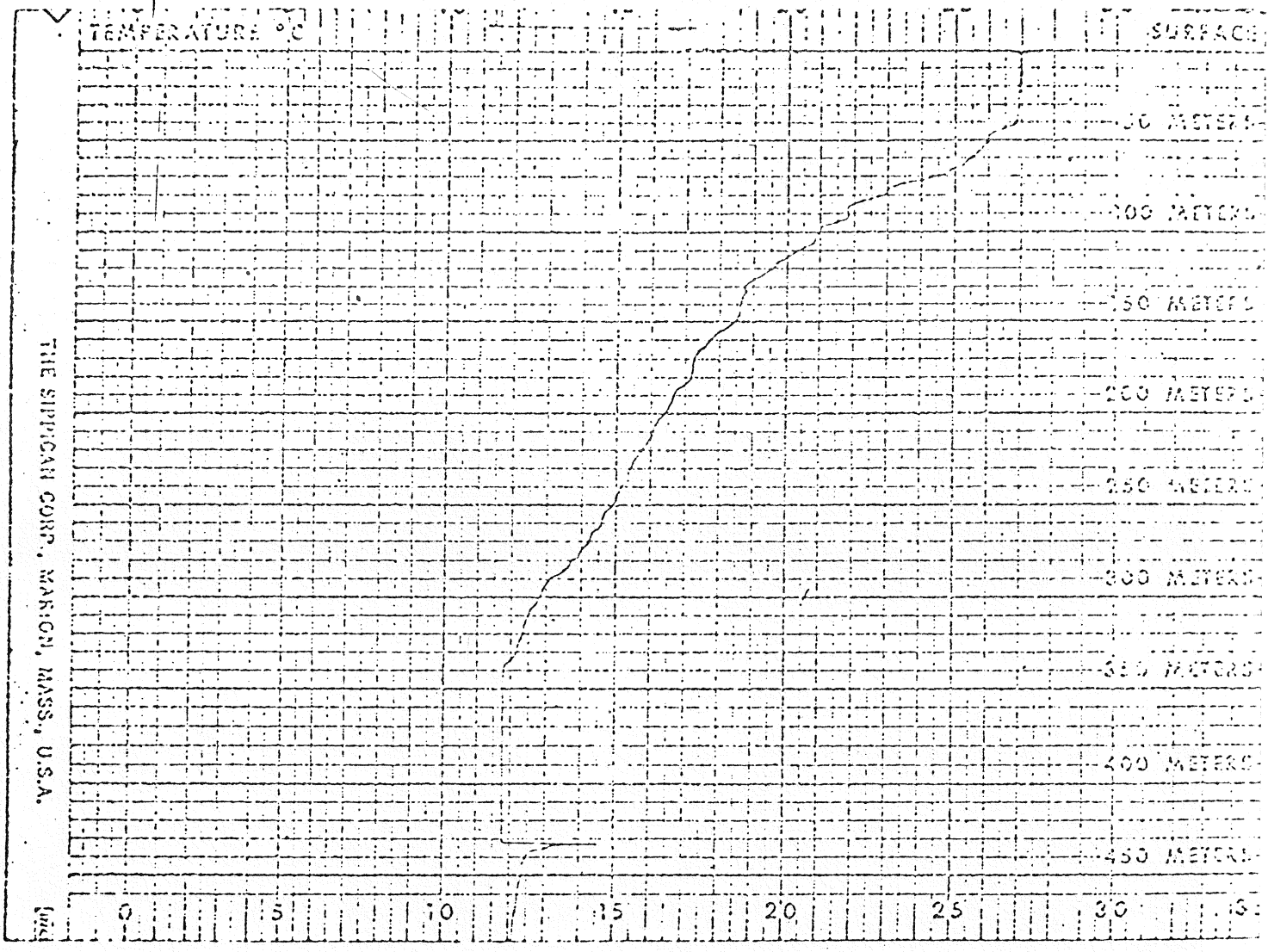
Cause: Wire fouled-insulation penetrated at 60 feet. Fouling continuous until wire breaks at 700 feet.

WIRE LEAKAGE & BREAK



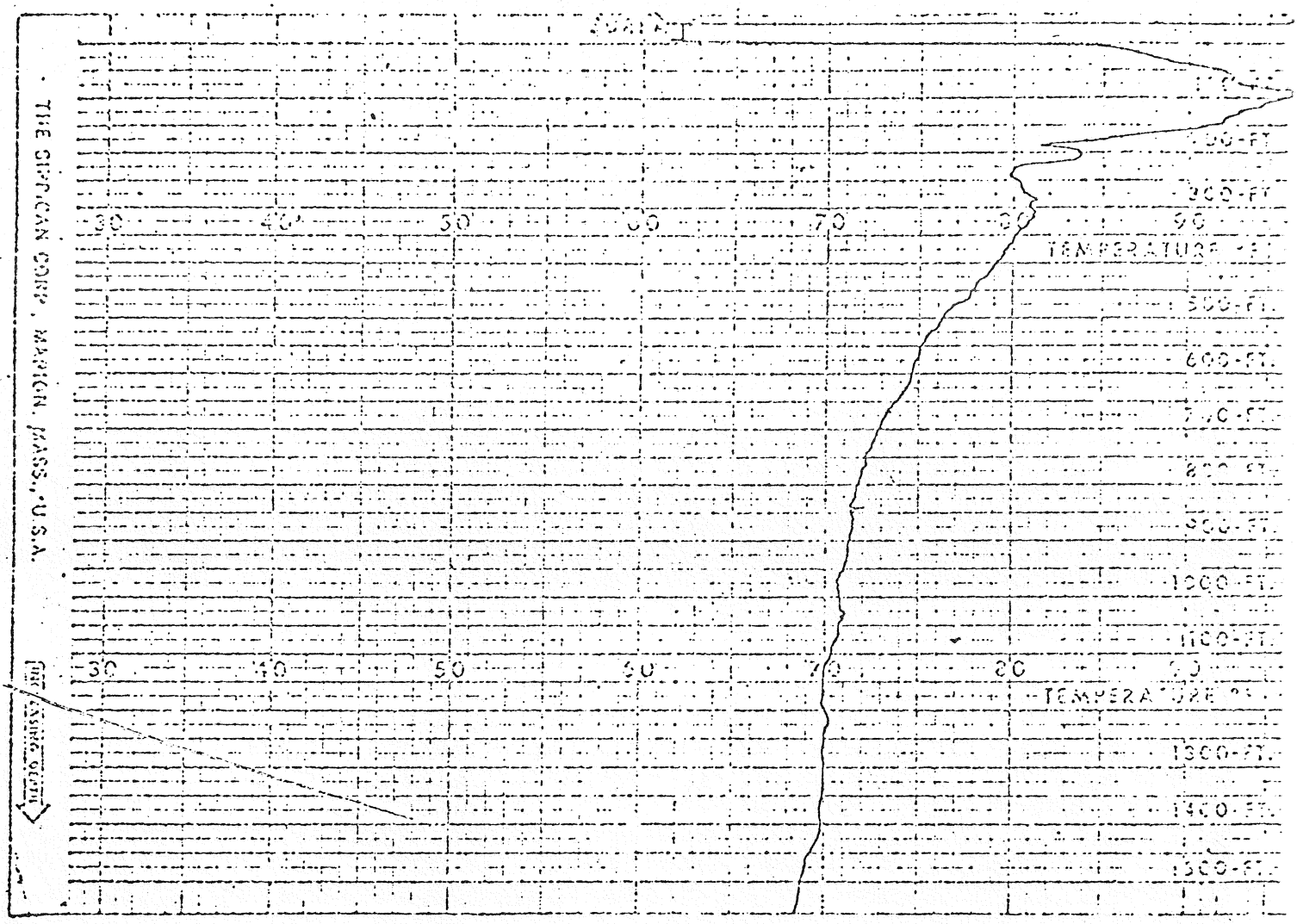
Cause: Wire fouled-insulation penetrated at 570 feet. Fouling continuous until wire breaks at 1010 feet.

WIRE LEAKAGE AND SHALLOW DROP



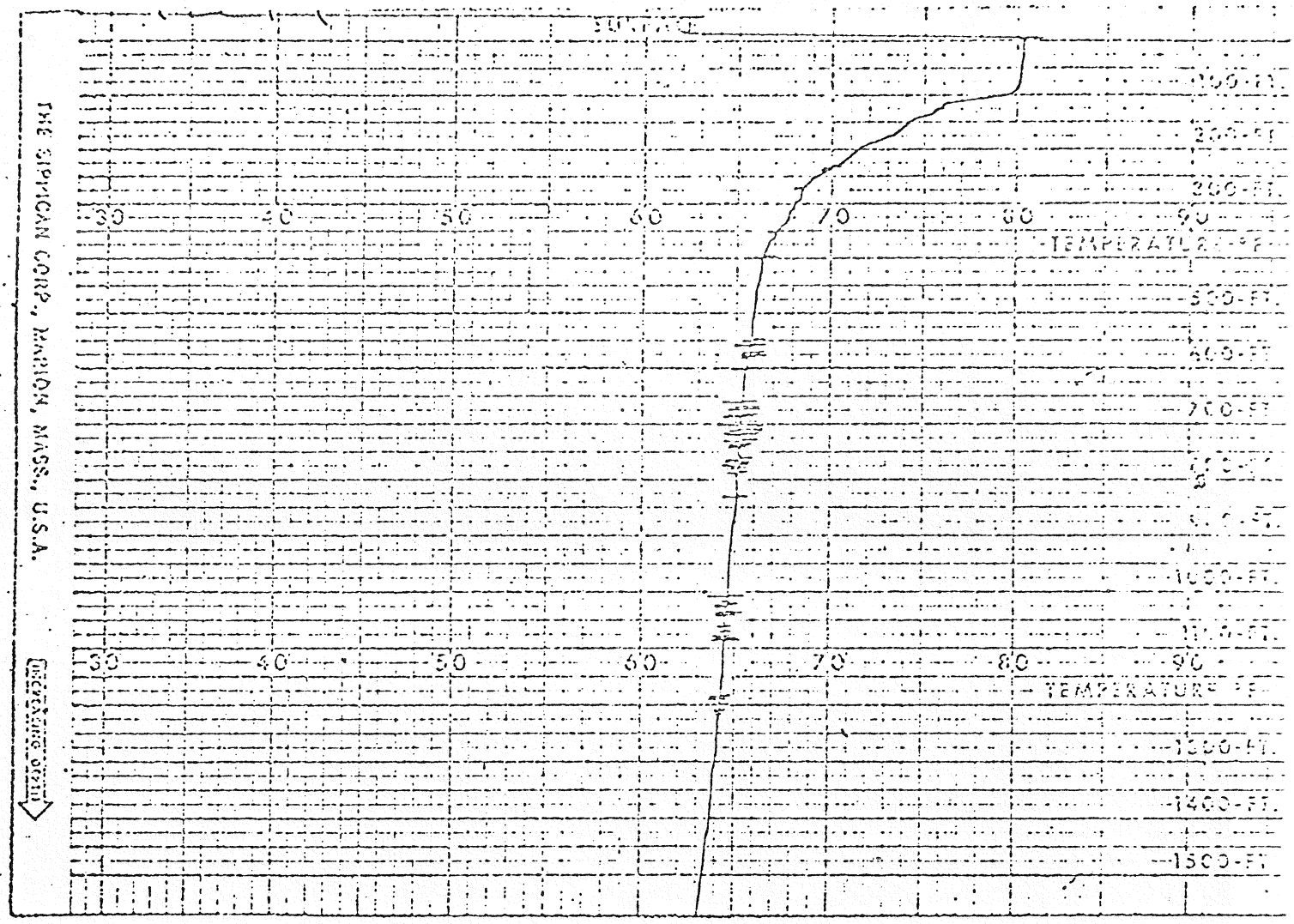
Cause: Probe hit bottom at 345 meters. Wire leakage indication at 432 meters.

TEMPERATURE EXCESSIVE



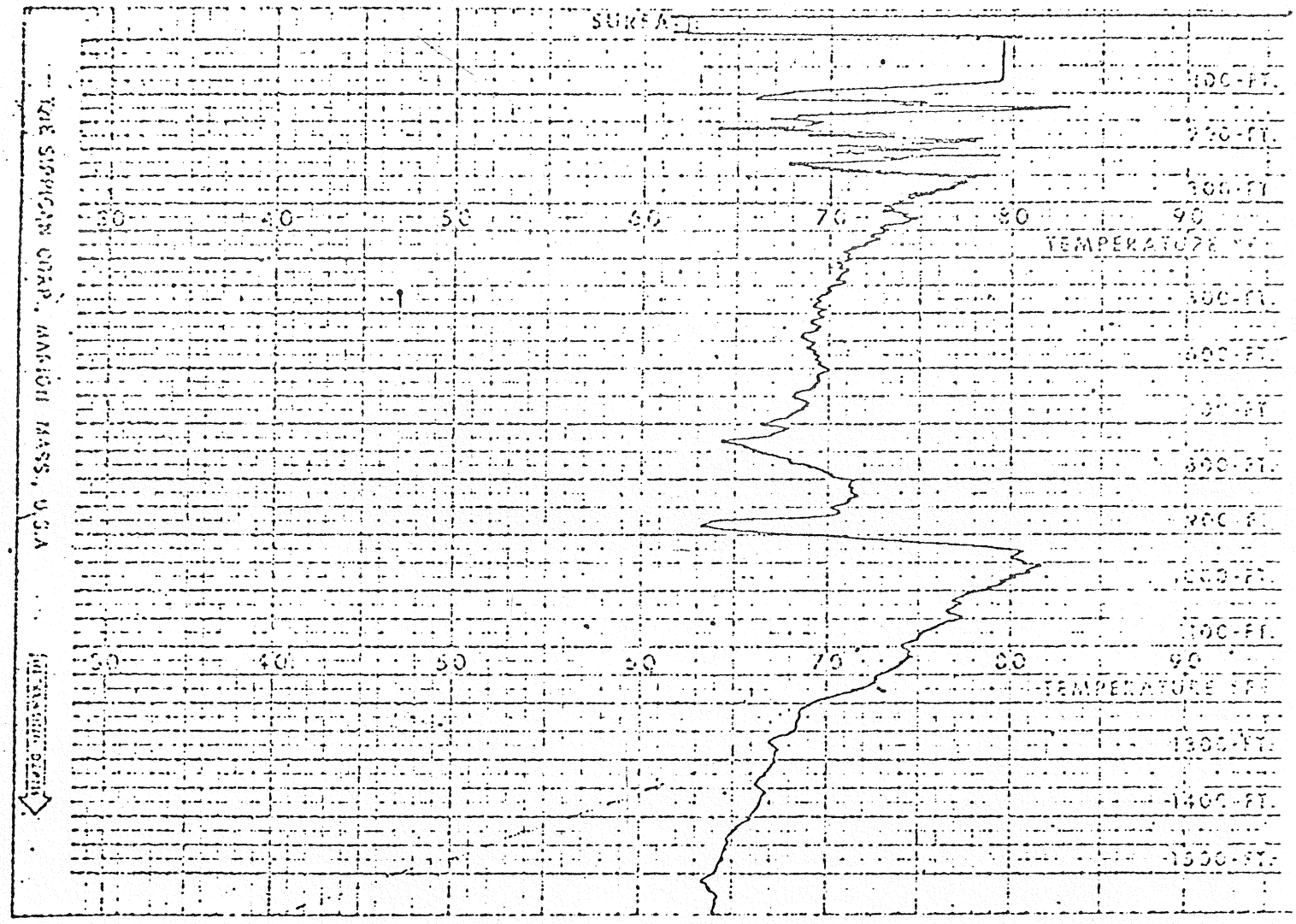
Cause: Poor connection, excessive cable leakage, or fracture of probe potting: in this order.

EXCESSIVE NOISE



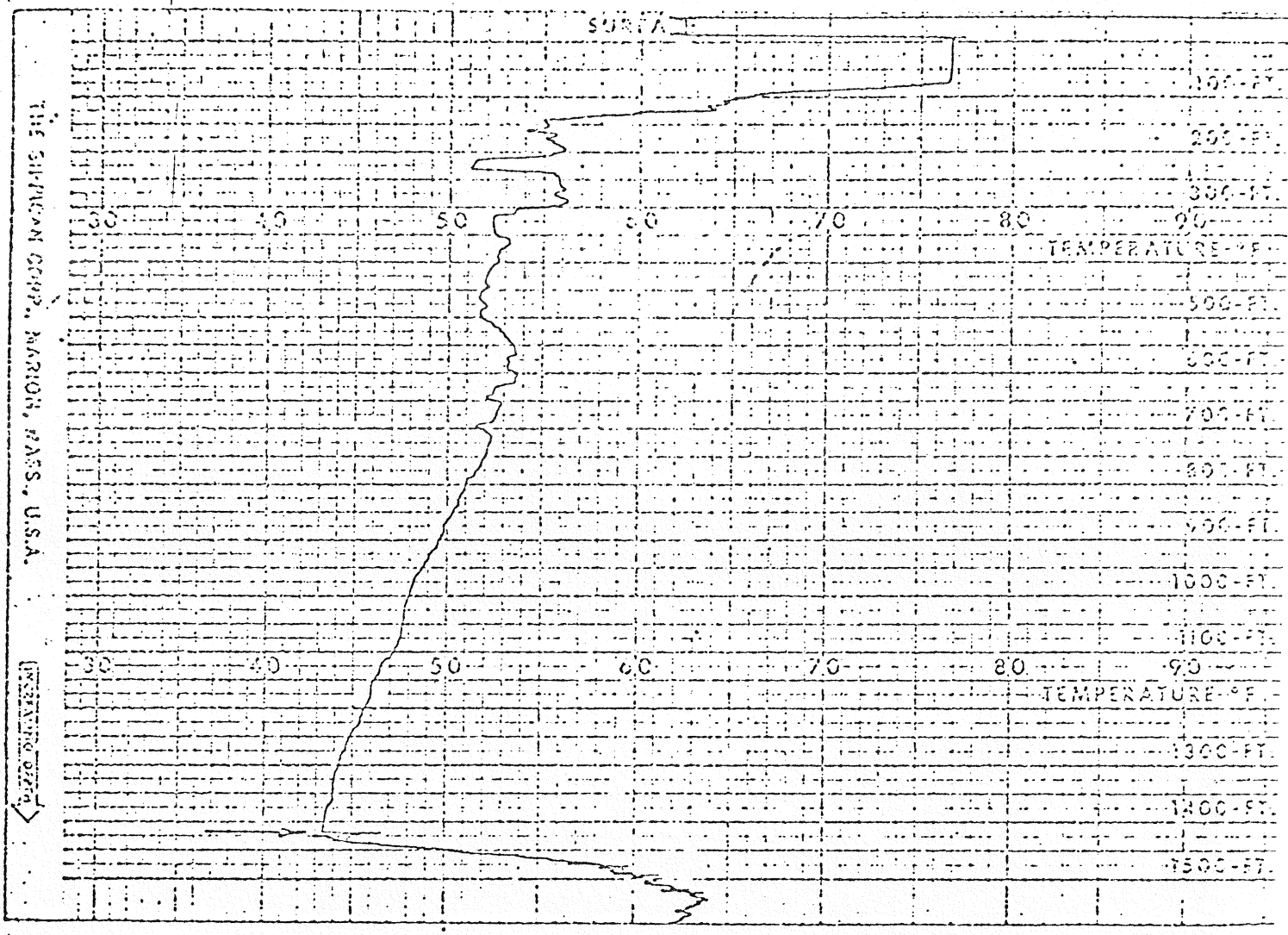
Cause: External source interference.

WIRE LEAKAGE



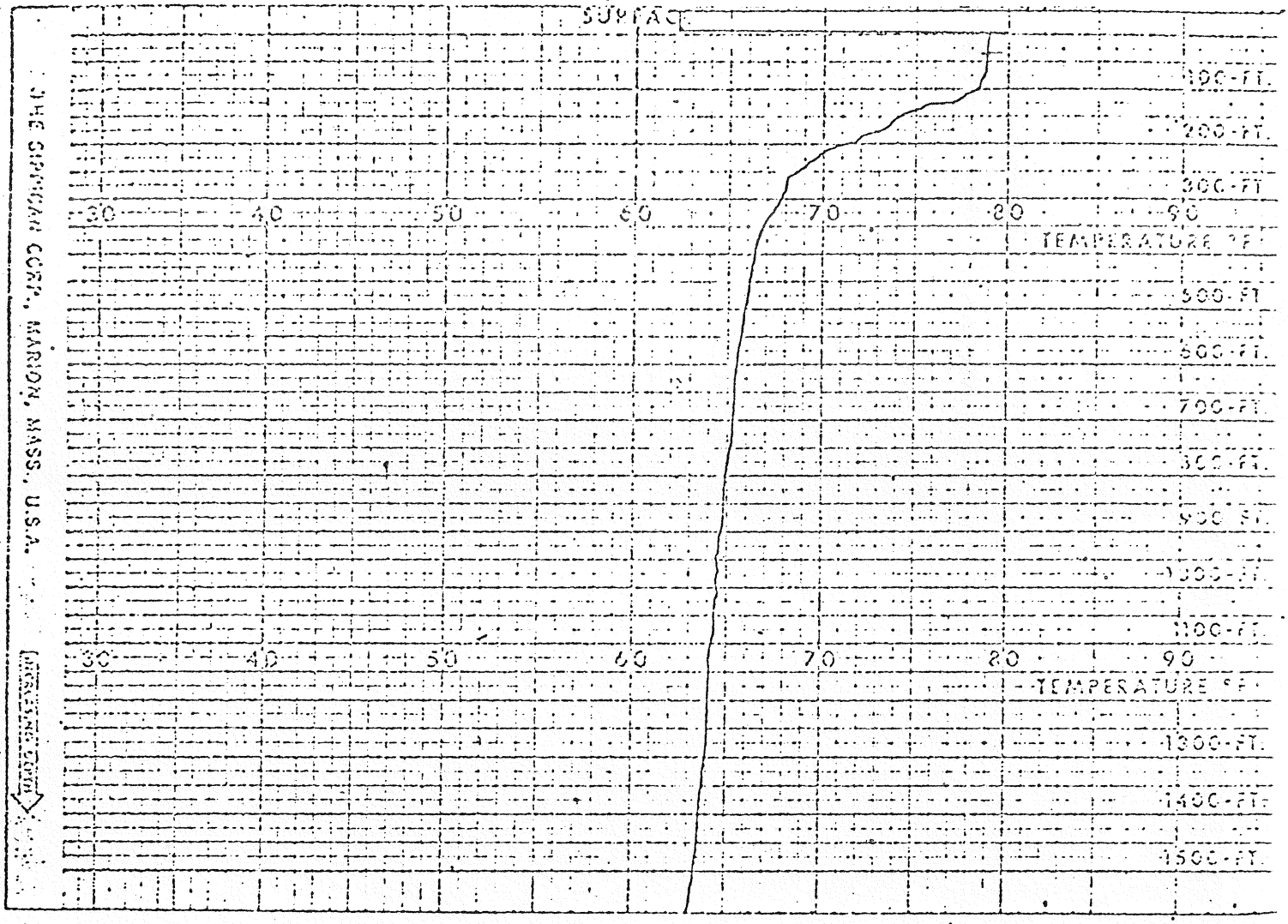
Cause: Wire leakage occurs at 110 feet -- wire damaged during manufacture.

WIRE LEAKAGE



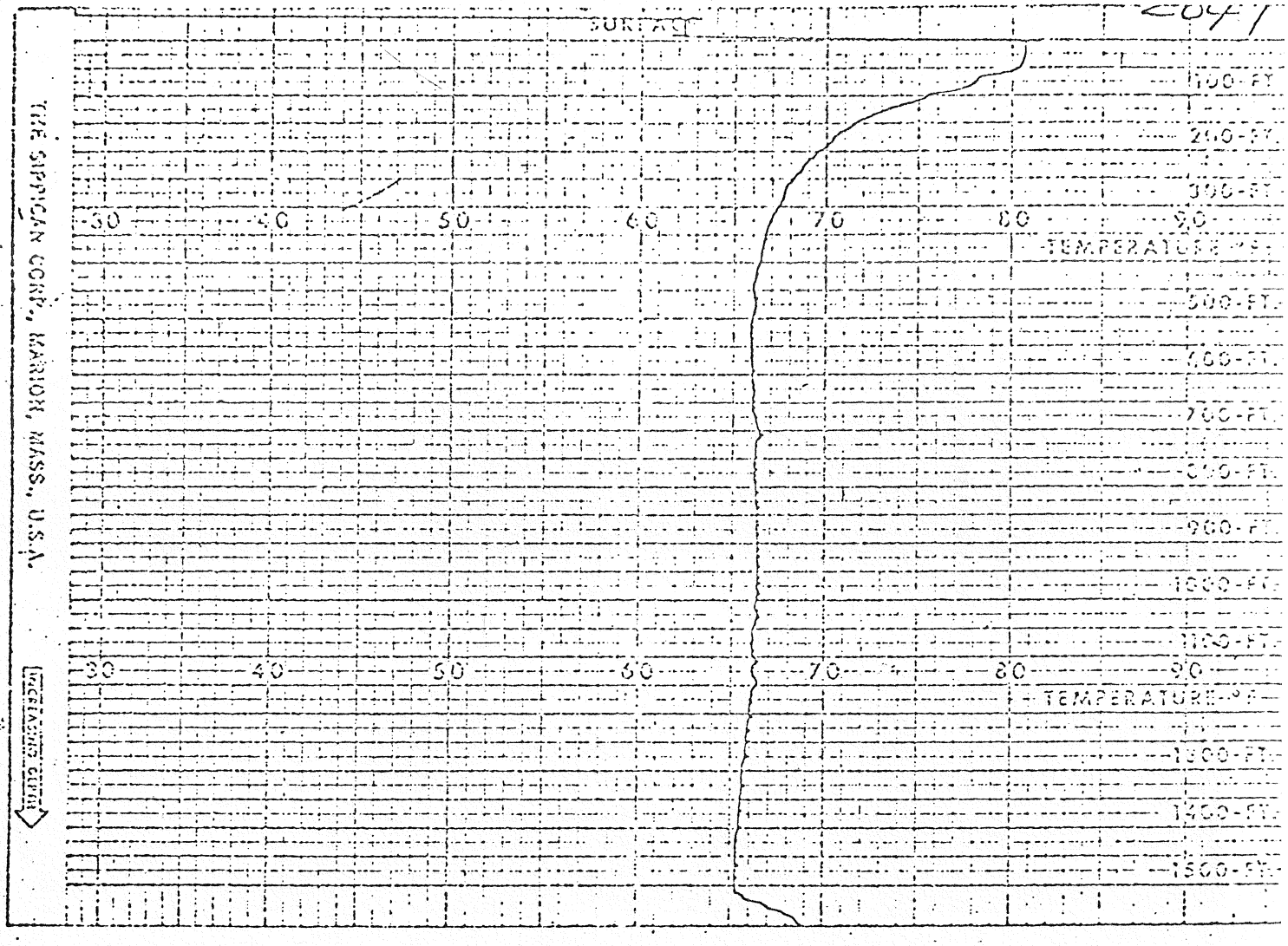
Cause: Wire fouled on ship -- insulation penetrated at 1420 feet.

SPIKE



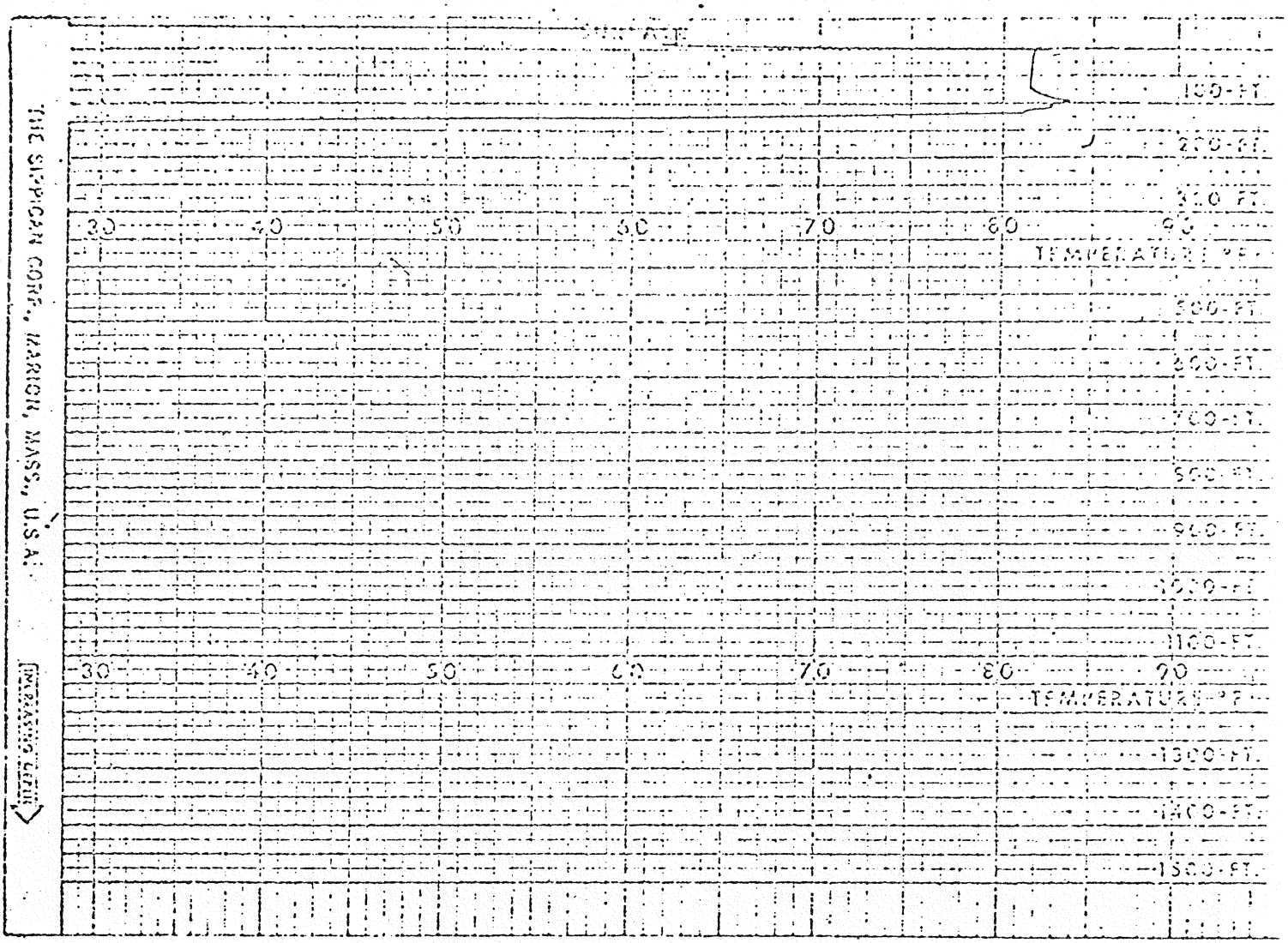
Cause: External interference -- (adjacent XBT system triggering.)

SPIKES & WIRE LEAKAGE



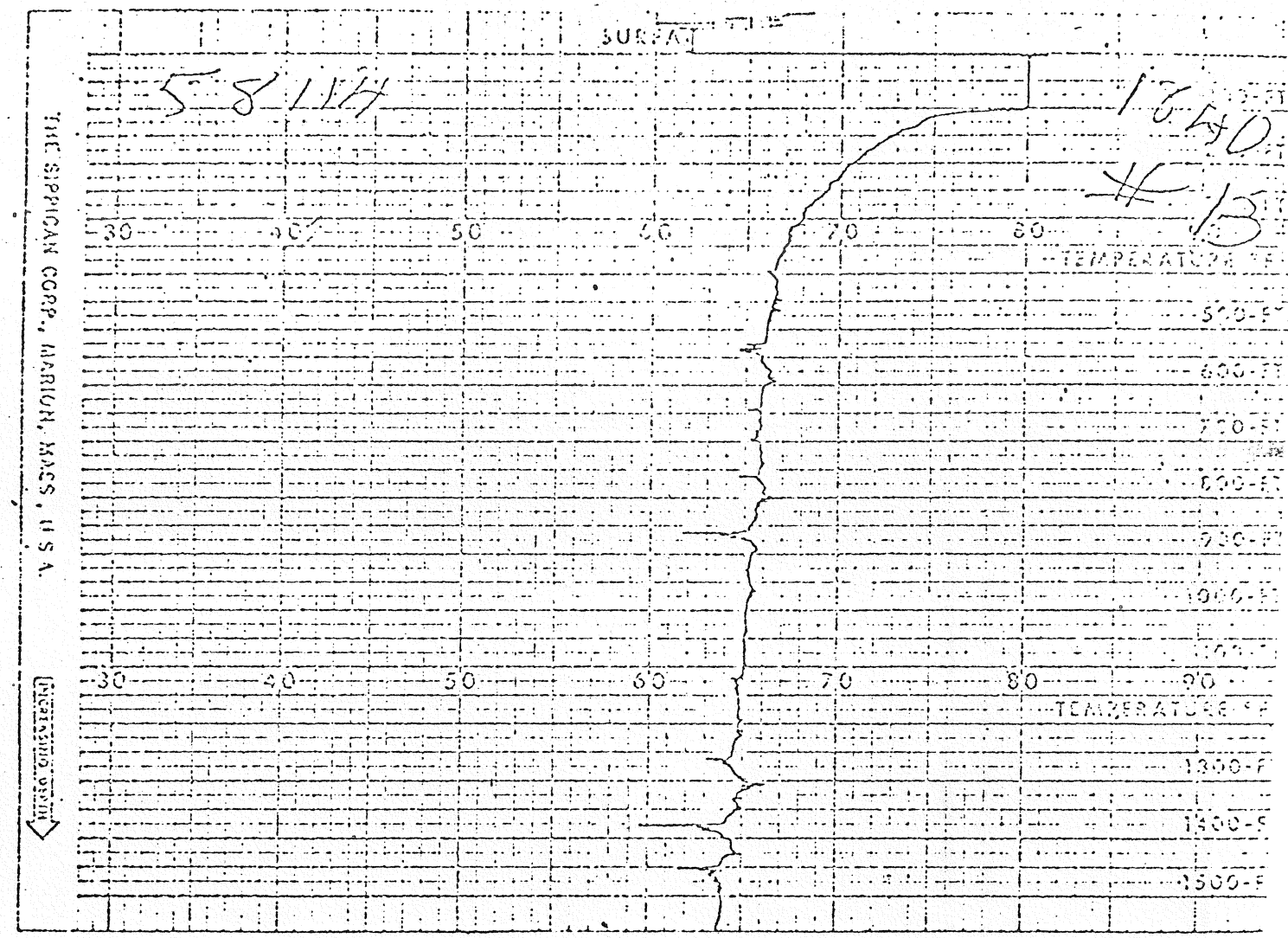
Cause: Wire rubbing against tow (VDS) line.

WIRE BREAK



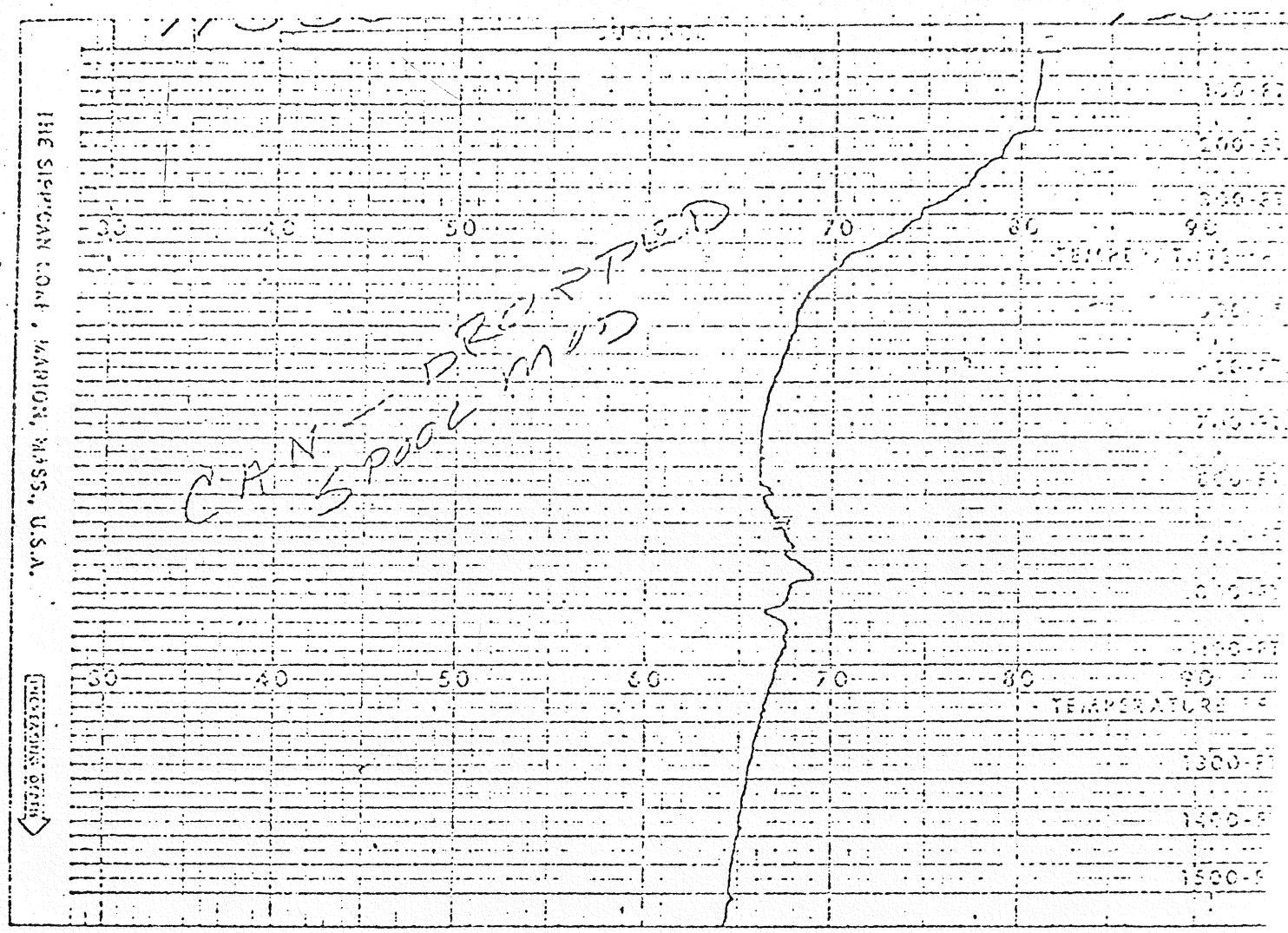
Cause: Wire fouled on tow line -- note stretch from 75 to 100 feet preceding break at 120 feet.

EXCESSIVE NOISE



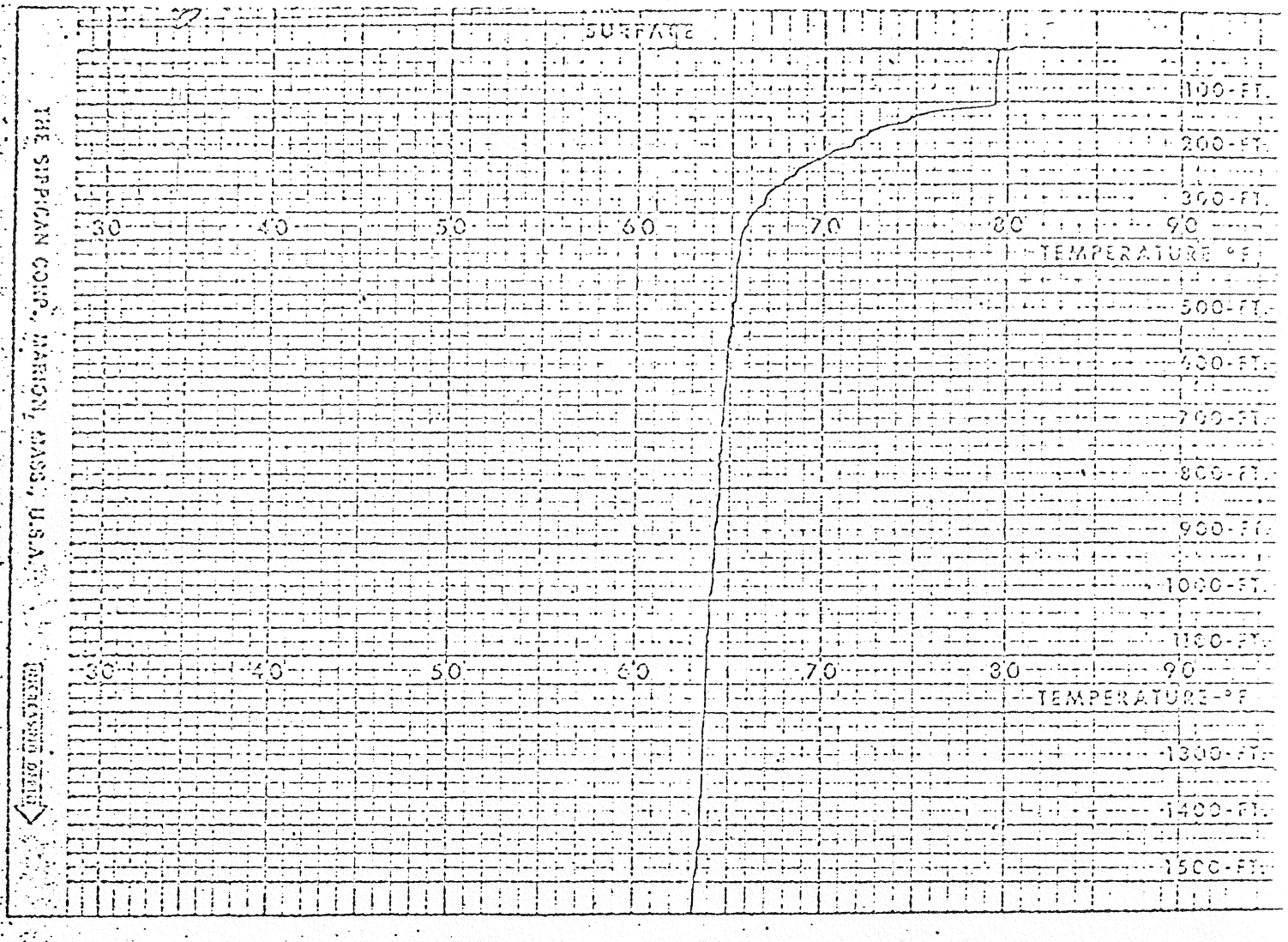
Cause: Loose connection in launcher.

WIRE LEAKAGE



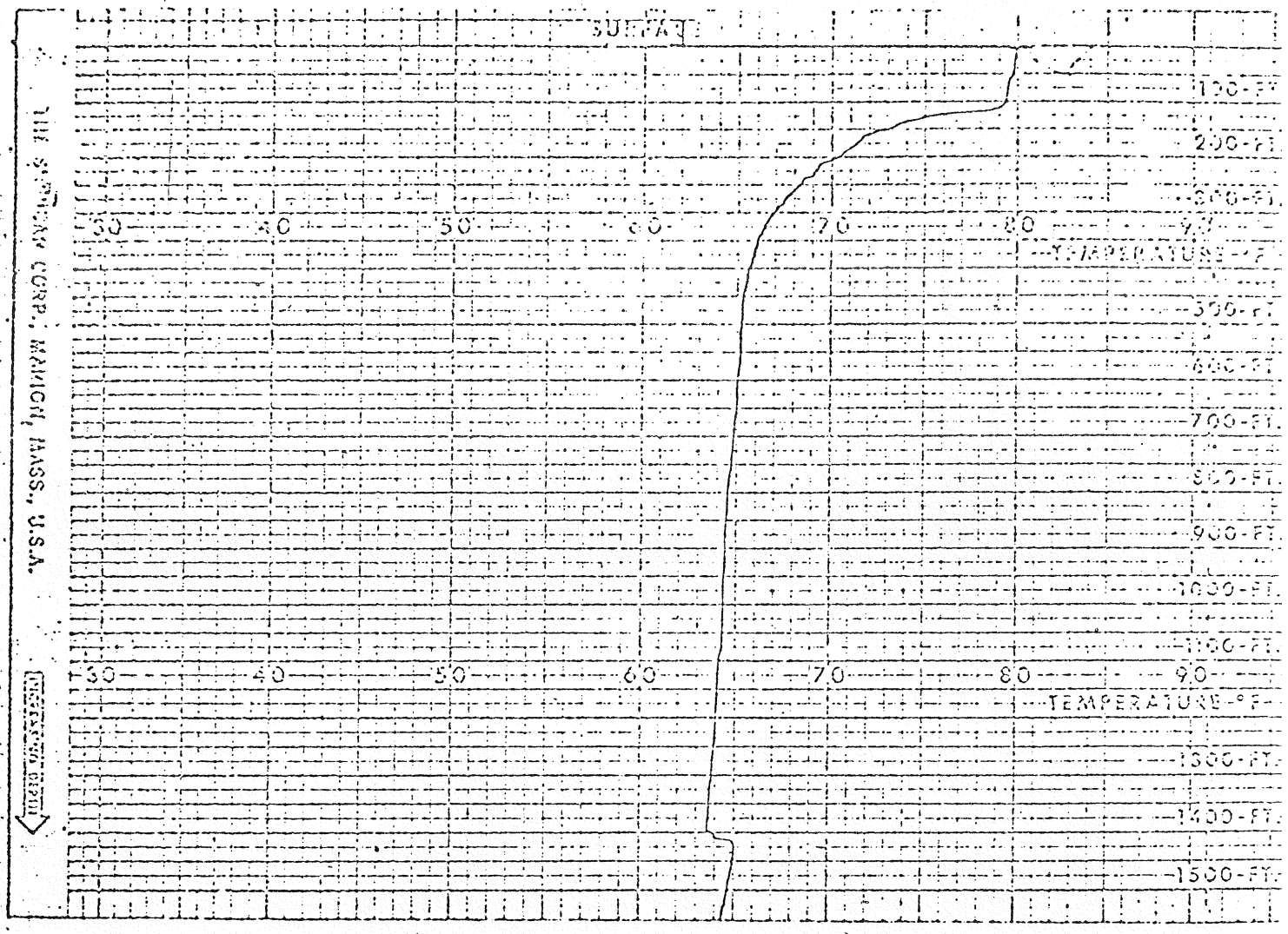
Cause: Canister tube fouled wire -- note spikes, stretch and insulation damage resulting in leakage.

SLIGHT BLIPS



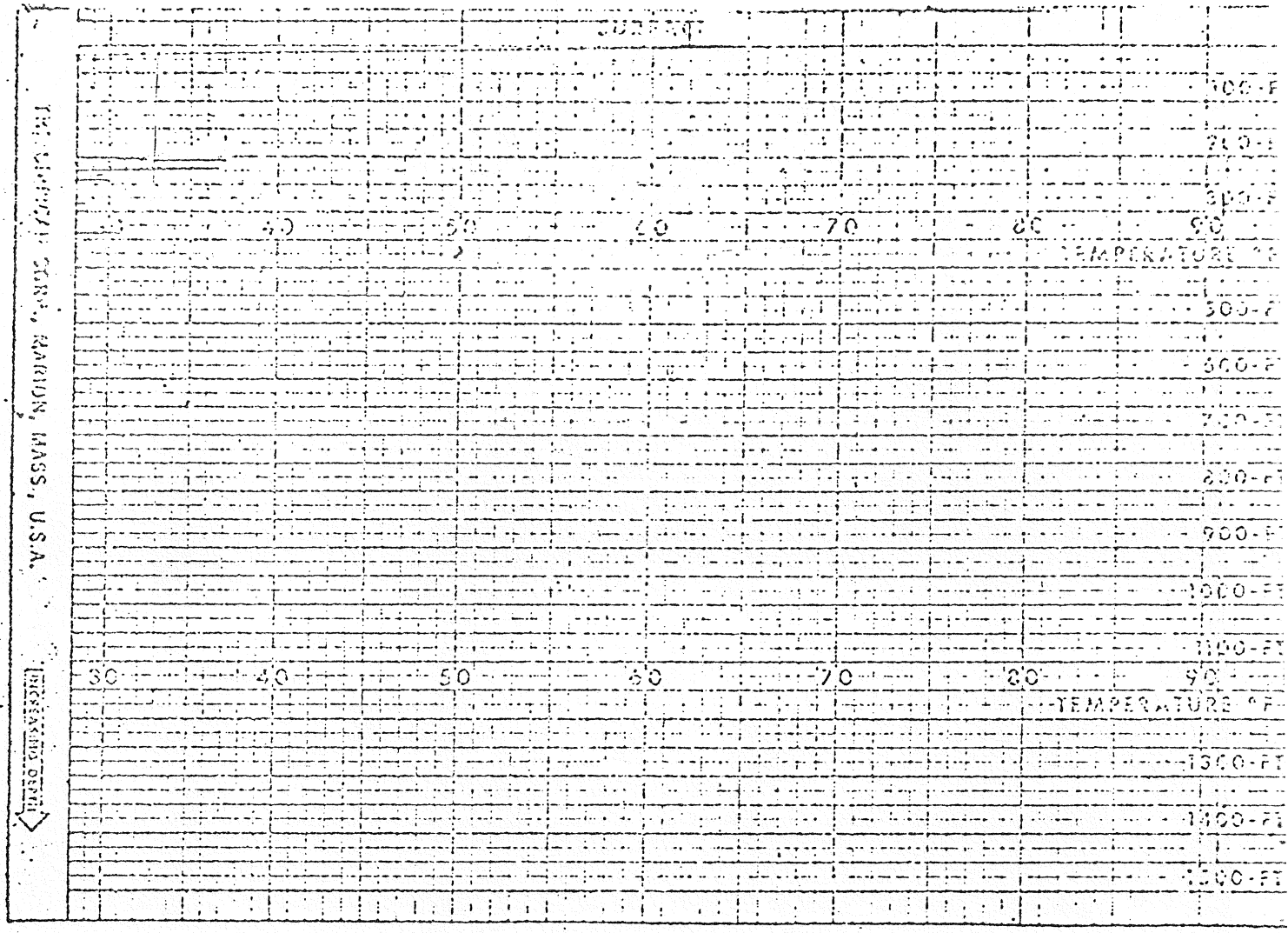
Cause: Chart paper skipping created blips at 510, 735, 760, 865, 930, and 1060 feet.

WIRE LEAKAGE



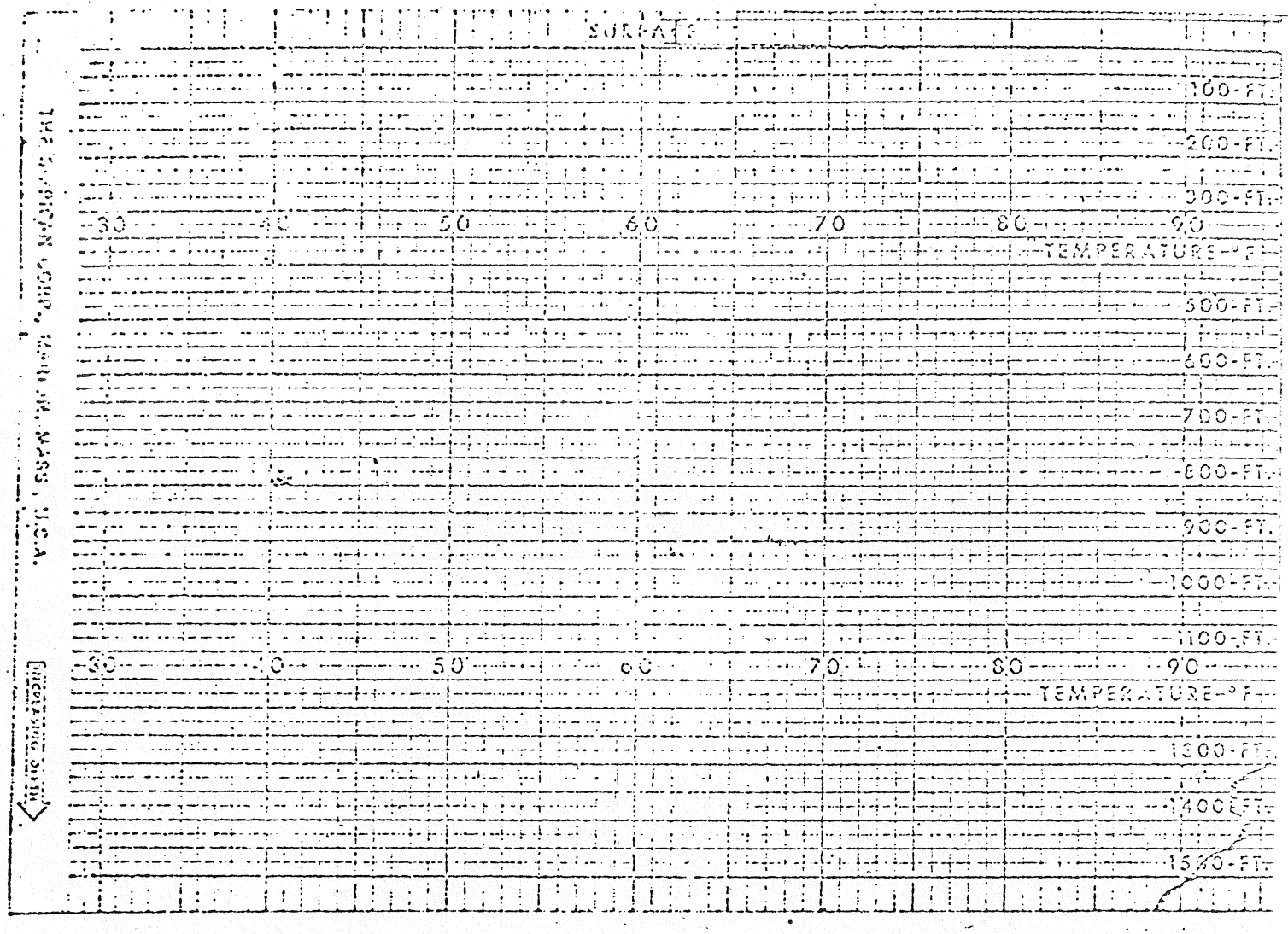
Cause: Damaged insulation on wire -- leakage occurs at 1400 feet.

WIRE BREAK IMMEDIATE



Cause: Damaged wire.

TEMPERATURE EXCESSIVE



Cause: Thermistor insulation damaged -- note recovery attempt after 1275 feet.

A P P E N D I X I I

Instructions for the CALMA Supplemental Information

APPENDIX II

INSTRUCTIONS FOR INPUT TO CALMA-360 XBT PROGRAM

The supplemental information, also known as the Keyboard, master, or header portion of an XBT observation is composed of various identification fields.

Before entering the supplemental information on the Calma, the Keyboard mode must be initiated. The rest of the Keyboard record should appear in the following format:

Character Positions	Description
2-4	NODC Consecutive Number
5-6	Hour (ƀƀ) for questionable or unknown
7-8	Minute (ƀƀ) for questionable or unknown
9-10	Day (ƀƀ) for questionable or unknown
11-12	Month
13-14	Year
15-16	Degrees of Latitude
17-18	Minutes of Latitude (ƀƀ) for questionable or unknown
19	Hemisphere (N/S)
20-22	Degrees of Longitude
23-24	Minutes of Longitude (ƀƀ) for questionable or unknown
25	Hemisphere (E/W)
26	Sign of Calibrated Depth (P/M)
27-28	Calibrated Depth

Character Positions	Description
29-31	Calibrated Temperature
32	Bottom Code
33	Grid Code
34	Instrument Code
35-37	Country Code
38-42	NODC Reference Number
43-48	NODC Ship Code
49-50	Digitization Method Code
51-52	Interval Code
53-54	Treatment and Storage Code
55-57	Operator's Initials
58	Trial Number
59-66	Originator's Cruise Number
67	Data Use Code

The computer program also accepts as input control cards with the same supplemental format. Their purpose is to correct any incorrect items on the Keyboard records transcribed on tape. If a card is inserted to change an item on only one trace, and the following master records to not include the old value, then another card must be prepared and included to reinstate the original figures. This is because items which are the same are not repeated on later Keyboard records.

A P P E N D I X I I I

Grid Control Card Specifications

APPENDIX III

GRID CONTROL CARD SPECIFICATIONS

The grid cards specify the correct scale for the conversion of inches measured on the Calma grid to actual depths and temperatures. There are two cards, one for depth and one for temperature, for each grid that might be used. The temperature card has the following design:

Columns	Description
1-4	Interval at which corresponding values are given when multiplied by .001, gives number of inches.
5-7	Base temperature to 1/10 of a degree
8-10	Temperature increment after 1st interval
11-13	Temperature increment after 2nd interval
. . .	. . .
65-67	Temperature increment after 20th interval
68-70	Maximum number of inches from origin, when multiplied by .01.
71-73	When multiplied by .01, gives size of last, foreshortened interval in inches.
74-76	Code for units-001=degrees Centigrade 000=degrees Fahrenheit

Columns	Description
77-78	Grid Code or Number
79	Code for instrument used to obtain XBT

The depth card has a slightly different format:

Columns	Description
1-3	Number of inches, when multiplied by .01, between points for which actual depths are given.
4-7	Base Depth
8-11	Depth increment after 1st interval
12-15	Depth increment after 2nd interval
. . .	. . .
60-63	Depth increment after 14th interval
66-69	Maximum distance from origin, in inches when multiplied by .01.
70-72	Number of inches in last, foreshortened interval, if multiplied by .01.
73-75	Units code - 000=feet, 001=meters
76-77	Grid Code or Number
78	Instrument Code

Columns	Description
79	Code for last card, = N for final depth grid card.

For each grid, a temperature card precedes a depth card. Unnecessary interval increments must be filled with zeros.

A P P E N D I X I V

Incorporating FNWC Processed XBT's

APPENDIX IV

INCORPORATING FNWC PROCESSED XBT's

Processed XBT data by Fleet Numerical Weather Central (FNWC) are periodically sent to NODC for inclusion in our data base. The format of their seven track binary tapes are indicated in Figure A. The first thing that should done is to obtain a summary listing indicating the beginning and ending dates and the number of observations per cruise, where a cruise is defined by a change in the ship call sign or consecutive observations which are more than four days apart. This summary is obtained by using the NODC program XBFNSM. In the unlikely event that the resulting summary appears to be in no order, the observations should be sorted on ship call sign, date, and time and recycled through the XBFNSM program. The resulting summary will be used by the records section for updating the NAPIS file and assigning NODC cruise numbers.

The XBFNWC program can now be used, along with one data card per cruise for entering the NODC in-house numbers, to reformat the data to the XBT file format. The data card, the format illustrated in Figure B, contains the FNWC ship code and the date of the first observation of a cruise as the key. The supplemental information associated with this key will be entered on each XBT record until there is a match with the key of the next data card.

After reformatting the data using XBFNWC, the XBT's now in the NODC file format should now be processed as if they were just digitized beginning with XBEVAL.

FNWC SPOT FORMAT

VARIABLE LENGTH RECORDS

bits

1 48

Year 7	Mo 4	Day 5	Hour 5	Type 5	f 1	i 1	Zeroes 8	CKSM 12	Word 1

f = 0 observation for forecast
i = 1 final record of a cruise

s 1	Lat. deg 1/10 11	Long. deg 1/10 12	Ships Call Sign (BCD) 24	Word 2

Blanks (BCD) 24	c 2	24 bit Byte Count 10	Lat Add 3	Long Add 3	Time (min) 6	Word 3

Baseline Temp. 16	Surface Temp. 16	Depth 16	Word 4

Temperature 16	Depth 16	Temperature 16	Word 5

Temperature - Reported to hundredths of a degree C
Depth - Reported to whole meters

Figure A.

PUNCH CARD FORMAT

FNWC XBT CONVERSION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
KEY										BLANK		NODC REFERENCE NUMBER*					NODC FIRST CONSEC NO. OF CRUISE*			NODC COUNTRY CODE*			DIGIT. METHODS CODE 02	
FNWC SHIP CALL SIGN				DATE																				
				YEAR		MONTH		DAY																

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
INTER-VAL CODE 01		TREAT. CODE 24		NODC SHIP CODE						INSTRUMENT CODE	ORIGINATOR'S CRUISE NUMBER								DNP	BLANK				

*Enter nines (9) in these fields to delete a cruise.

Figure B.

A P P E N D I X V

NODC XBT File Format

Analyst: ?
Code: Date:

RECORD DESCRIPTION

FILE NAME: RECORD NAME: XBT - 9-TRACK TAPE OUTPUT

RELATION OF RECORD TO THE FILE:

ELEMENT NAME AND LEVEL	LOCATION: Position	LOCATION: Units	LENGTH: Number	LENGTH: Units	REPEAT FACTOR	ATTRIBUTES: TYPE, BASE, MODE, LANGUAGE, PRECISION, ETC.	USAGE AND MEANING OF ELEMENT	CONDITIONS
DEPTH & TEMP								
SURTEM	83	Byte	2	Byte		Integer	Temperature at zero depth to hundredths (1/100 insignificant)	
DEPTH	85	"	"	"		"	First Depth to whole meters	
TEMP (1)	87	"	"	"		"	Temperature at First Depth	
DEPTH (2)	89	"	"	"		"	2nd Depth	
TEMP (2)	91	"	"	"		"	2nd Temperature	
'								
'								
'								
'								
DEPTH (N)		"	"	"		"	Last Depth	Position = 4 * (N-1) + 83
TEMP (N)		"	"	"		"	Last Temperature	Position = 4 * (N-1) + 85
							Average Record Length =	4 * (N-1) + 85 N= 40
								241 bytes

Form: 2430/2003-106B - 3/10/70 - Rev. #4

Analyst: Pearl Johnson
Code: 2310 Date: 7 Aug 1970

RECORD DESCRIPTION

FILE NAME: XBT RECORD NAME: XBT - 9-TRACK TAPE OUTPUT

RELATION OF RECORD TO THE FILE:

ELEMENT NAME AND LEVEL	LOCATION Position	LOCATION Units	LENGTH Number	LENGTH Units	REPEAT FACTOR	ATTRIBUTES: TYPE, BASE, MODE, LANGUAGE, PRECISION, ETC.	USAGE AND MEANING OF ELEMENT	CONDITIONS
FILE ID	1	Byte	2	Byte		CHAR (2)	File I.D.	NODC Deck No.
QUADRT	3	"	1	"		CHAR (1)	WMO 3333	1-7
TEN SQ	4-6	"	3	"		CHAR (3)	Ten Degree Square (WMO)	000 - 918 Use with Quad.
FIVE SQ.	7	"	1	"		CHAR (1)	Five Degree Square	1 - 4
TWO SQ	8-9	"	2	"		CHAR (2)	Two Degree Square	00 - 24
ONE SQ	10-11	"	2	"		CHAR (2)	One Degree Square	00 - 99
DATE								
YEAR	12-15	"	4	"		CHAR (4)	Prefix '19'	65 (GMT)
MONTH	16-17	"	2	"		CHAR(2)	01 - 12	
DAY	18-19	"	2	"		CHAR (2)	01 - 31	
TIME								
HOUR	20-21	"	2	"		CHAR (2)	00 - 23	
MIN	22-23	"	2	"		CHAR (2)	00 - 59	
REF ID								
CNTRY	24-26	"	3	"		CHAR (3)	NODC CODES	
REF NO	27-31	"	5	"		CHAR (5)		
CONSEC	32-34	"	3	"		CHAR (3)		
SHIP	35-40	"	6	"		CHAR (6)		
LATITUDE								
LAT DEG	41-42	"	2	"		CHAR (2)	00 - 90	
LAT MIN	43-44	"	2	"		CHAR (2)	00 - 99	
LAT HEM	45	"	1	"		CHAR (1)	N or S	
LONGITUDE								
LONG DEG	46-48	"	3	"		CHAR (3)	000 - 179	
LONG MIN	49-50	"	2	"		CHAR (2)	00 - 59	
LONG HEM	51	"	1	"		CHAR (1)	E or W	

Analyst: 7
Code: Date:

RECORD DESCRIPTION

FILE NAME: RECORD NAME: XBT - 9-TRACK TAPE OUTPUT

RELATION OF RECORD TO THE FILE:

ELEMENT NAME AND LEVEL	LOCATION		LENGTH		REPEAT FACTOR	ATTRIBUTES: TYPE, BASE, MODE, LANGUAGE, PRECISION, ETC.	USAGE AND MEANING OF ELEMENT	CONDITIONS
	Position	Units	Number	Units				
NODC CODES								
BOTTOM	52	Byte	1	Byte		CHAR (1)	B= Probe hit bottom, b = did not	B or blank
DIGMTH	53	"	2	"		CHAR (2)	Method of digitization	01 - 99 NODC Codes
INTER	55	"	2	"		CHAR (2)	Interval of digitization	01 - 99
TRESTO	57	"	2	"		CHAR (2)	Method of treatment + storage of initial points	01 - 99
OPERATOR								
INIT	59	"	3	"		CHAR (3)	Operator's Initials	
TRIAL	62	"	1	"		CHAR (1)	Number of attempts at digitizing trace	
CALDEP	63	"	3	"		CHAR (3)	Depth at Calibration Tick in Units of the analog grid	
CALTEM	66	"	3	"		CHAR (3)	Temperature at Calibration Tick in Units of the analog grid	
INSTRUMENT	69	"	1	"		CHAR (1)	1 = XBT, 2 = HXBT, 3 = SXBT, 4 = AXBT	
GRID	70	"	1	"		CHAR (1)	Grids Codes of the Instrument	1 - 9
Orig. Cr. No.	71	"	8	"		CHAR (8)	Originators Cruise Number	Alpha-Numeric
DNP	79	"	1	"		CHAR (1)	Declared National Program	1 - 4
SKIP	80	"	1	"		CHAR (1)	Blank For byte boundary aligment	
LENGTH	81	"	2	"		FIXED Binary (16)	Number of Temperature Values	

A P P E N D I X V I

MASTER Grid Tables

APPENDIX VI

MASTER GRID TABLES

Table A

The following are temperature values for 1/4" increments from 16.7°C (62.0°F) and depth values for one inch increments from zero meters. Table A is to be used for XBT's having an instrument code of 1 and a grid code of 1, 2, 3, or 4.

16.7°C		0 meters	
±1/4 inch	± 1.2°C	1 inch	96 meters
±1/2	± 2.5°C	2	192
±3/4	± 3.8°C	3	288
±1	± 5.1°C	4	381
±1-1/4	± 6.4°C	5	474
±1-1/2	± 7.7°C	6	565
±1-3/4	± 9.0°C	7	657
±2	±10.4°C	8	747
±2-1/4	±11.7°C	8.16	762
±2-1/2	±13.1°C		
±2-3/4	±14.5°C		
±3	±15.9°C		
±3-1/4	±17.4°C		
±3-1/2	±18.9°C		

Intermediate values are to be derived by linear interpolation of parameters against distance within each appropriate interval.

MASTER GRID TABLES

Table B

The following are temperature values for 1/4" increments from 16.7°C (62.0°F) and depth values for 1-1/2 inch increments from zero meters. Table B is to be used for deep XBT's having an instrument code of 1 and a grid code of 5.

16.7°C		0 meters	
±1/4 inch	1.2°C	1.5 inches	152 meters
±1/2	± 2.5°C	3.0	304
±2/3	± 3.8°C	4.5	453
±1	± 5.1°C	6.0	600
±1-1/4	± 6.4°C	7.5	747
±1-1/2	± 7.7°C	9.0	890
±1-3/4	± 9.0°C	10.5	1031
±2	±10.4°C	12.0	1171
±2-1/4	±11.7°C	13.5	1311
±2-1/2	±13.1°C	15.0	1447
±2-3/4	±14.5°C	16.5	1581
±3	±15.9°C	18.0	1713
±3-1/4	±17.4°C	19.33	1830
±3-1/2	±18.9°C		

Intermediate values are to be derived by linear interpolation of parameters against distance within each appropriate interval.

Table C

The following are temperature values for 1/8" increments from -3.9°C (25.0°F) and depth values for 1" increments from zero meters. Table C is to be used for XBT's having an instrument code of 4 and a grid code of 1.

-3.9°C		0 meters	
+1/8 inch	+ 2.1°C	+ 1	+ 30 meters
+1/4	+ 4.0°C	+ 2	+ 61
+3/8	+ 6.2°C	+ 3	+ 91
+1/2	+ 8.4°C	+ 4	+122
+5/8	+10.7°C	+ 5	+152
+3/4	+12.9°C	+ 6	+183
+7/8	+15.4°C	+ 7	+213
+1	+17.8°C	+ 8	+244
+1-1/8	+20.1°C	+ 9	+274
+1-1/4	+22.6°C	+10	+305
+1-3/8	+24.9°C	+10.8	+329
+1-1/2	+27.3°C		
+1-5/8	+29.6°C		
+1-3/4	+31.9°C		
+1-7/8	+34.2°C		
+2	+36.3°C		
+2-1/8	+38.4°C		
+2-1/4	+40.6°C		
+2.31	+41.7°C		

Intermediate values are to be derived by linear interpolation of parameters against distances within each appropriate interval.

A P P E N D I X V I I

XBT Utility Programs

APPENDIX VII

XBT UTILITY PROGRAMS

1	XBCONV	Converts data from the old CDC 3800 format to the present file format.
2	XBCRSM	Produces a summary listing of cruise numbers and the numbers of observations in each. Maximum of 500 cruises.
3	XBCRST	Utilizing the 360 sort-merge package, this program sorts XBT's by Reference Number, Consecutive Number, and the Delete character.
4	XBGEST	Utilizing the 360 sort-merge package, this program sorts XBT records by the Quadrant, tem, five, two, one degree squares and the month.
5	XBGEOSum	This program summarizes the geo-sorted data to indicate the number of obs in any ten degree square or one degree square and season.
6	XBPLOT	This program enables one to produce single or composite plots of XBT data.
7	XBTSELC	This is a first PL1 program for selection of XBT data off of a file.
8	XBTLOCAT	Provides horizontal cruise tracks with surface temperatures.