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Hydrographic Work on MARMAP Cruises

by

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National Marine Fisheries Service
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I. Introduction

Marine Monitoring Assessment and Prediction (MARMAP) cruises began during the summer of 1977. They cover the shelf, with some stations in slope water, from Cape Hatteras to Cape Sable, including the Middle Atlantic Bight, Nantucket Shoals, Georges Bank, and the Gulf of Maine. Cruises are made at least six times a year. Each lasts about a month, divided into two or three legs. Of a total of 180 stations, about a third are arranged in seven transects running across the shelf; the others are distributed over the entire survey area. The main objectives of these cruises have been to monitor seasonal changes in the distribution and abundance of ichthyoplankton and zooplankton, to conduct primary productivity studies, to measure temperatures, and to collect and analyze water samples. The following is a set of instructions for hydrographic work on MARMAP cruises.

II. Equipment

Standard hydrographic equipment used on MARMAP cruises includes 1.7 liter and 5.0 liter Niskin bottles, messengers, protected and unprotected reversing thermometers, sample bottles for dissolved oxygen and salinity analysis, and a Winkler oxygen titration unit, with appropriate log sheets and thermometer correction graphs. A complete equipment checklist is available.

Hydrocasts at depths greater than 250 meters require 15 Niskin bottles labeled 1 through 15. Bottles 1-10 are 5.0 liter Niskin while bottles 11-15 are 1.7 liter Niskins. Hydrocasts at depths of 75 meters or less require 10 or fewer Niskins plus a "bottom trip" bottle. The "bottom trip" bottle is a 5.0 liter Niskin which is designed to take a water sample within one meter of the bottom.

Reversing thermometers are used on all Niskin bottles except the "bottom trip" bottle. Protected reversing thermometers only are used on bottles 1-12 and 14 while both protected and unprotected reversing thermometers are used for bottles 13 and 15.

III. Responsibilities

The hydrographer is responsible for filling out the Master Hydro and Dissolved Oxygen Determination logs for each station. Figures 1 and 2 are examples of Master Hydro logs which have been filled out properly while Figure 3 is a sample D.O. Determination log. Other work includes cocking the Niskin bottles, placing the Niskins on and removing them from the wire, measuring with a Secchi Disk the depth to which light penetrates, drawing water for oxygen and salinity determinations, reading the thermometers, titrating water samples by the Winkler method for dissolved oxygen content, and setting out salinity and dissolved oxygen sample bottles for the next station. On MARMAP cruises, salinities are not normally analyzed aboard ship and XBT work is not normally the responsibility of the hydrographers.

Thermometers must be read twice; once by the hydrographer and once by his assistant. Any discrepancy of more than .02°C in the reading of the main thermometer and 0.2°C in the auxiliary should be checked. If there is sufficient time, thermometer readings should be corrected (Figure 4), dissolved oxygen values standardized with a calculator, and depths corrected for wire angle.

Work involved with primary productivity, nutrient, and chlorophyll analysis is done by the respective specialists and is not normally the responsibility of the hydrographer. However, when needed the hydrographer or his assistant may be asked to assist with nutrient filtering. Similarly, the other specialists may be asked to assist with hydrography. Such requests are normally

cleared with the watch chief or chief scientist.

IV. Niskin Bottle Depths

The standard MARMAP sampling depths at which Niskin bottles are to be tripped are: 1, 5, 10, 15, 20, 25, 30, 35, 50, 75, 100, 150, 200, 250, and 300 meters. The deepest bottle should be placed so that it will trip 5 meters above the bottom even if that is not a standard depth.

For stations less than or equal to 75 meters, a "bottom trip" bottle is also used. In this case, all of the regular Niskin bottles are tripped by the messenger. Then the wire is lowered until a weight, which hangs below the "bottom trip" bottle, touches bottom, causing the bottle to close.

When primary productivity work is done at a station, the primary productivity specialist determines additional special sampling depths.

V. Samples.

The following samples are to be drawn from the Niskin bottles in this order: dissolved oxygen, primary productivity, chlorophyll, nutrients, and salinity. Primary productivity work is done twice daily: once at sunrise and again at local noon. The primary productivity, chlorophyll, and nutrient samples are drawn by their respective specialists.

Samples for dissolved oxygen analysis should be drawn at every station during the plankton bloom period. Otherwise, oxygen samples should be drawn only at transect and selected station. Consult the chief scientist on this matter.

All sample bottles must be rinsed twice with small amounts of fresh sample before being filled. Special care must be taken when drawing water for dissolved oxygen analysis. A tube extending to the bottom of the glass-stoppered bottles should be used. No air bubbles should be allowed to enter and become trapped when replacing the stopper as this will cause erroneous dissolved oxygen values.

VI. Procedure

This section gives step-by-step procedure for hydrographic work on MARMAP stations.

Before arriving on station:

1 - Fill in, as much as possible, the logs. For the Master Hydro Log this includes: Vessel, Consecutive Station Number/MARMAP Standard Station Number, Cruise Number, Date. Also enter the thermometer numbers and the numbers of the salinity and dissolved oxygen bottles which are expected to be used.

2 - Set out the salinity and dissolved oxygen sample bottles in their proper places on the Niskin bottle rack and check against the log.

Upon arrival on station:

3 - Obtain the bottom depth reading from the bridge.

4 - Determine the depths at which the Niskin bottles are to be tripped (Refer to Section IV) and enter into the "Wire Out" column on the Master Hydro Log.

5 - Compute the "Meter Wheel" column (Refer to Figures 1 and 2) and make a copy for the Winchman.

6 - Cock each Niskin bottle needed making sure that the thermometers remain in the upright position, with the large reservoir of mercury at the lower end. Check the thermometers to make sure that <u>all</u> of the mercury has drained back into the reservoir before each Niskin bottle is placed on the wire. If each thermometer is not checked, incorrect temperature readings will occur.

7 - If the station depth is more than 75 meters, place the deepest Niskin bottle on the wire approximately one meter above the 45 kg lead ball. This is best done while the ball is still on deck. The remaining

bottles are hung according to their respective meter wheel values.

If the station depth is 75 meters or less, place the "bottom trip" Niskin bottle approximately one meter above the lead ball and the deepest regular Niskin bottle about one-half meter higher. The remaining bottles are hung according to the meter wheel values.

The winchman will lower the wire so that the highest Niskin bottle is at one meter depth.

8 - Set the timer for 5 minutes. If an XBT is to be made at the station, it should be done now.

9 - Observe the deepest depth at which the Secchi disc can be seen and record it in the Master Hydro Log.

10 - After the 5-minute wait period record the wire angle from the wire angle indicator. Drop the messenger and record the time. Make sure that all of the bottles have tripped. To do this, hold the wire and feel for a pull or tug each time a Niskin bottle trips. If the station depth is 75 meters or less, ask the Winchman to lower the wire until it goes slack, in order to trip the "bottom trip" bottle. Record the wire out when this happens.

11 - Ask the winchman to bring the wire in. Remove the Niskin bottles from the wire and place them on the rack. Draw water samples in the correct order (Refer to Section V) and record any malfunctions, leaks, or other problems. The dissolved oxygen sample should be pickled with Reagents 1 and 2 and then shaken before any other sample is drawn. Record the time of "First Shake" onto the "Dissolved Oxygen Determination" log. Return the filled salinity sample bottles to the salinity case for storage and put the filled dissolved oxygen sample bottles into the hydro lab for titration. Bottlecaps on the stored salinity samples should be checked for tightness within 24 hours.

12 - Read the thermometers twice, no sooner than 15 minutes after they were removed from the water. The hydrographer and his assistant should each read the thermometers once. Enter the temperature of the first reader on the Master Hydro log.

13 - Empty the Niskin bottles and leave them reversed in the rack. This places the thermometers in the upright position and allows the mercury to drain back into the reservoir. Check each thermometer for proper drain.

14 - Return to Step 1.

After preparation for the next station is complete, the hydrographer and/or his assistant should do the following as time permits:

a) Titrate the water samples for dissolved oxygen content by the Winkler Method. An instruction pamphlet "Determination of Dissolved Oxygen in Sea Water by the Winkler Method" is available.

b) Correct the temperatures using the proper "thermometer correction" graphs. Figure 4 is an example of a "thermometer correction" graph.

c) Correct the depths by multiplying the "wire out" values by the cosine of the wire angle. If a station has a bottom depth of 200 meters or more, the correct depths are to be calculated by adjusting the "wire out" values to the differences between the protected and unprotected reversing thermometers caused by pressure.

d) Calculate the standardized dissolved oxygen values, for 50 ml. samples, by the following formula:

$$D.O. = \frac{(11.352)\ (V)}{S}$$

where D.O. is the dissolved oxygen content in milliliters/liter

V is the average of the 2 titrations done for each sample, and

S is the average sodium thiosulfate standardization value.

15 - Before going off watch make sure that all is ready for the next station. Make sure whoever relieves you is aware of any problems or special instructions.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Albatross IV
NO. 3/98
79-13
15 Nov. '79

LAT. 42°30'
LONG. 70°35'
LORAN / D.R.
SONIC DEPTH 71 FM / M

WEA. Clear
SEA 0.9m
SWELL
WET BULB T°
DRY BULB T°

WIND FORCE 22K
WIND DIR. 270°
SECCHI DISC 9m
BOTTOM-SAMPLE NO.
EST. / OBS.

SERIES NO.	WIRE ANGLE	TIME (GMT TH MERIDIAN) START	DOWN	MESS.	START UP	IN
1st	10°	1536	1542	1547	1549	1554
2nd						
3rd						

SAL. o/oo			METER WHEEL	WIRE OUT	FRAME NO.	THERMOMETERS NO.	T'	t'	ΔT	Tw	THERMOMETERS NO.	T'	t'	ΔT	T	Tu-Tw	ΔD	CALC. DEPTH	DEPTH FACTOR	CORR. DEPTH FACTOR	CORR. DEPTH	SAMPLE BOTTLE NUMBERS CL	O2			
			65	1	1	15990	9.74	10.8														A/23	271			
			61	5	2	11857	9.65	10.9			29921	9.70	10.3									24	272			
			56	10	3	14719	9.83	10.6														25	273			
			51	15	4	65437	9.72	10.1														26	274			
			46	20	5	4592	11.15	11.6			29997	9.80	10.2									27	275			
			41	25	6	11849	10.35	10.5														28	276			
			36	30	7	4359	10.30	10.1														29	277			
			31	35	8	11863	9.69	10.1														30	278			
			16	50	9	17562	9.10	15.0			30163	9.10	14.9									31	279			
			0	66	10	15992	8.36	14.7														32	280			
				?	Bottom trip																	33	281			

Figure 1. An example of a Master Hydro Log filled out for a station whose bottom depth is 75 meters or less.

NOTE CURRENTS, TIDE RIPS, ICE OR OTHER PHENOMENA OBSERVED

OBSERVER

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Albatross IV
ON NO. 45/82
79-13
10 Dec '79

LAT. 39°59'
LONG. 70°40'
LORAN or D.R.
SONIC DEPTH 285 FM M

WEA. Clear
SEA 0.6 m
SWELL
WET BULB T°
DRY BULB T°

WIND FORCE 4 KNOTS
WIND DIR. 190
SECCHI DISC ——
BOTTOM-SAMPLE NO.
EST. OBS.

SERIES NO.	WIRE ANGLE	TIME (GMT TH MERIDIAN) START	DOWN	MESS.	START UP	IN
1st	15°	0003	0015	0020	0023	0030
2nd						
3rd						

RR MP. C	SAL. o/oo			METER WHEEL	WIRE OUT	FRAME NO.	THERMOMETERS NO.	T'	t'	ΔT	Tw	THERMOMETERS NO.	T'	t'	ΔT	T	Tu-Tw	ΔD	CALC. DEPTH	DEPTH FACTOR	CORR. DEPTH FACTOR	CORR. DEPTH	SAMPLE BOTTLE NUMBERS CL	O_2		
				279	1	1	29929	14.54	17.7														X/39	301		
				275	5	2	11857	14.48	18.7			29921	14.50	18.4									40	302		
				270	10	3	25864	14.59	18.1														41	303		
				265	15	4	4356	14.49	17.8														42	304		
				260	20	5	30000	14.50	17.8			30164	14.50	17.8									43	305		
				255	25	6	30160	14.49	17.4			29997	14.50	17.4									44	306		
				250	30	7	4359	14.48	17.2														45	307		
				245	35	8	11863	14.42	17.2														46	308		
				230	50	9	17562	14.49	22.3			30163	14.50	22.5									47	309		
				205	75	10	15992	15.50	22.2														48	310		
				180	100	11	29922	14.96	22.3														49	311		
				130	150	12	30165	13.42	22.6														50	312		
				80	200	13	18963	11.17	22.3			U 10746	14.26	23.0									72/1	401		
				30	250	14	20363	9.81	22.5														2	402		
				0	280	15	11263	8.95	23.2			U 16542	12.36	22.0									3	403		

Figure 2. An example of a Master Hydro Log filled out for a station whose bottom depth is greater than 75 meters.

NOTE CURRENTS, TIDE RIPS, ICE OR OTHER PHENOMENA OBSERVED.

OBSERVER

SHEET ____ OF ____

VESSEL	CRUISE	STATION	CHEMIST	DATE ANALYZED
Albatross IV	79-13	3/98.		

ACCEPTED DEPTH METERS	SAMPLE BOTTLE NO.	1st BURETTE ml.	2nd BURETTE ml.	3rd BURETTE ml.	AVERAGE BURETTE ml.	DISSOLVED OXYGEN O_2 ml/L
1	271					
5	272					
10	273					
15	274					
20	275					
25	276					
30	277					
35	278					
50	279					
66	280					
BOTTOM TRIP BOTTLE	281					

NORMALITY DETERMINATIONS

I BLANK RUN

V_b (1st RUN) = ____

V_b (2nd RUN) = ____

V_b (3rd RUN) = ____

TOTAL ____

V_b AVERAGE ____

II STANDARDIZATION OF $Na_2S_2O_3$

V_2 (1st RUN) = ____

V_2 (2nd RUN) = ____

V_2 (3rd RUN) = ____

TOTAL ____

V_2 AVERAGE ____

III NORMALITY OF $Na_2S_2O_3$

$$N = \frac{0.1}{V_2 - V_b} = \_\_\_\_$$

IV DISSOLVED OXYGEN

O_2 = KV = ____

FOR 100 ml SAMPLE

K = 56.76 N = ____

FOR 50 ml SAMPLE

K = 113.52 N = ____

CHECK VOLUME TITRATED

100 ml ☐ 50 ml ☐

Figure 3. An example "Dissolved Oxygen Determination" Log.

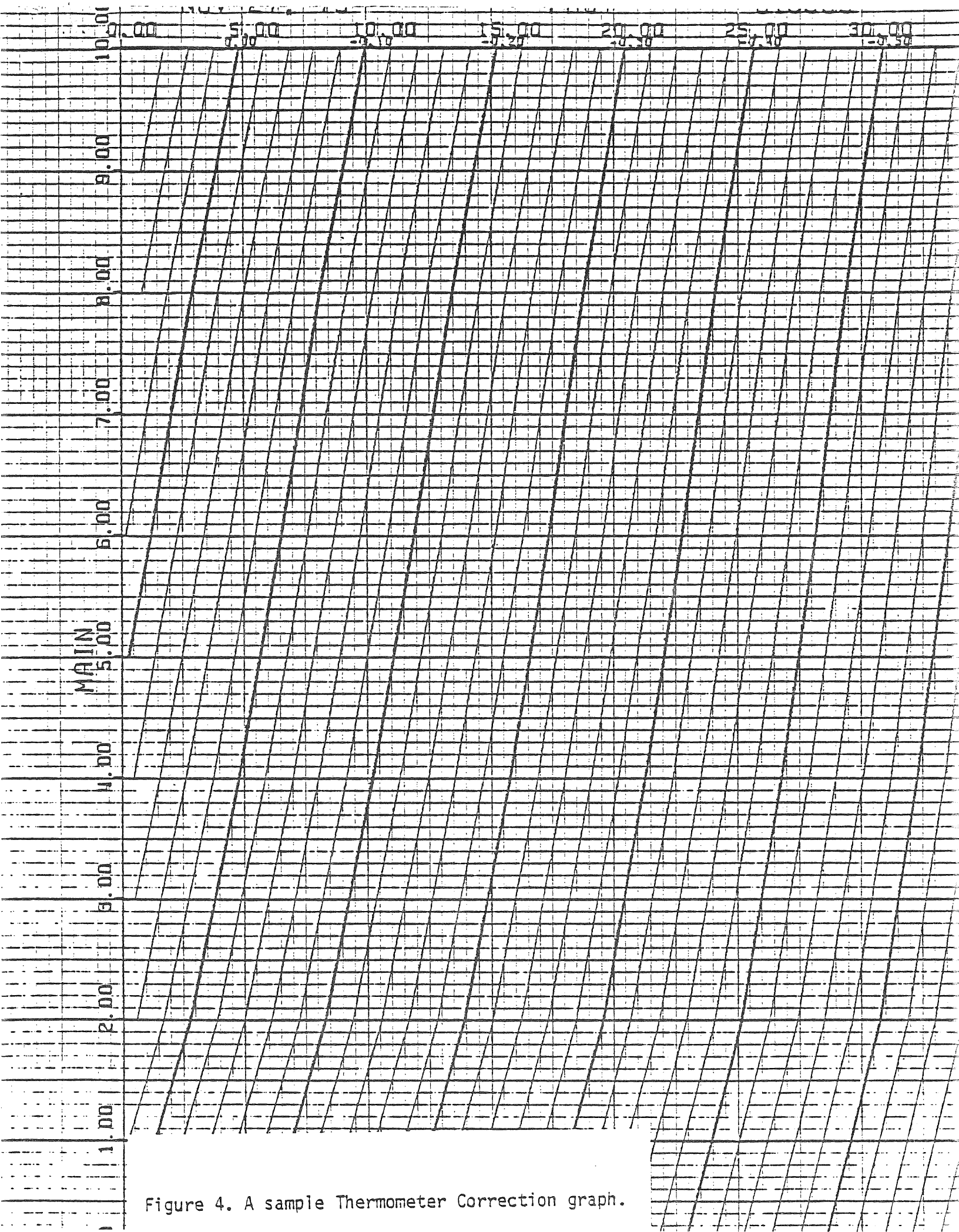

Figure 4. A sample Thermometer Correction graph.