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SUMMARY OF CURRENT METER OPERATIONS IN 1968

by

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TECHNICAL REPORT

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Summary

This report describes work done with Geodyne current meters and wind recorders during 1968. Techniques for testing instruments prior to use at sea, instrument performance at sea and instrument changes evolved during the year are discussed.

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During 1968 the transition from Geodyne film to Geodyne tape recording current meters was completed. Previous current meter observations were predominantly from film recording instruments, but delays associated with film reading and subsequent data editing were excessive. While operational performance of magnetic tape instruments in previous years had been poor, the growth potential for this class of instrument was judged to be better than that for the film instruments. Three general goals for the tape recording current meter program were (are):

1. Develop thorough and practical instrument checkout procedures for the model 850 current meter.

2. Reduce data processing time to a scale which allows results from one experiment to influence the following experiment.

3. Increase instrument reliability while developing techniques for handling increasing numbers of instruments.

A discussion of progress toward these goals follows.

1. Instrument Checkout Procedures

Techniques for testing all tape current meters as complete units before use at sea have been developed. (Film instruments are no longer used.) As knowledge of modes of instrument failure has increased the checkout sequence has evolved, but basically each instrument is component-tested, assembled and then run on a test stand. The results of the test stand data are reviewed by means of a special tape reader and computer display program. The types of tests found most useful are:

a. Component tests

Compasses and vane followers are tested visually for sticking at room temperature and at 0°C. It was found essential to test both units at reduced temperature. The tape reader alignment and format is checked via "magnasee" fluid. This test gives a visual check of the information written on the tape. Such things as tape slippage, head alignment, record gaps, bit density and channel switching are checked. The electronics is tested by observing key wave forms in the current meters and in the tape reader. Batteries are stored in a deep freeze and terminal voltage tested under load before use.

b. Instrument tests

Each instrument is rotated at a constant rate with the vane held in a fixed direction by magnets. The recorded data is then read into a computer and the test data plotted on the computer's display oscilloscope. Several thousand test observations can be inspected in a few minutes with this equipment. Satisfactory results at this stage complete the checkout procedure. To date no vibration or temperature tests are performed on the entire instrument.

The cartridge tape reader is shown in Figure 1 to the right of the PDP-5 computer. (A considerably less elaborate computer could be used for the same purpose.) Figure 2 shows the oscilloscope display of an instrument test. Switches on the console control the parameters plotted and allow the operator to position the IBM tape containing the data read from the current meter cartridge tapes. The display has revealed many instrument malfunctions not detected by other means. It represents the final stage in the test sequence from sensor through

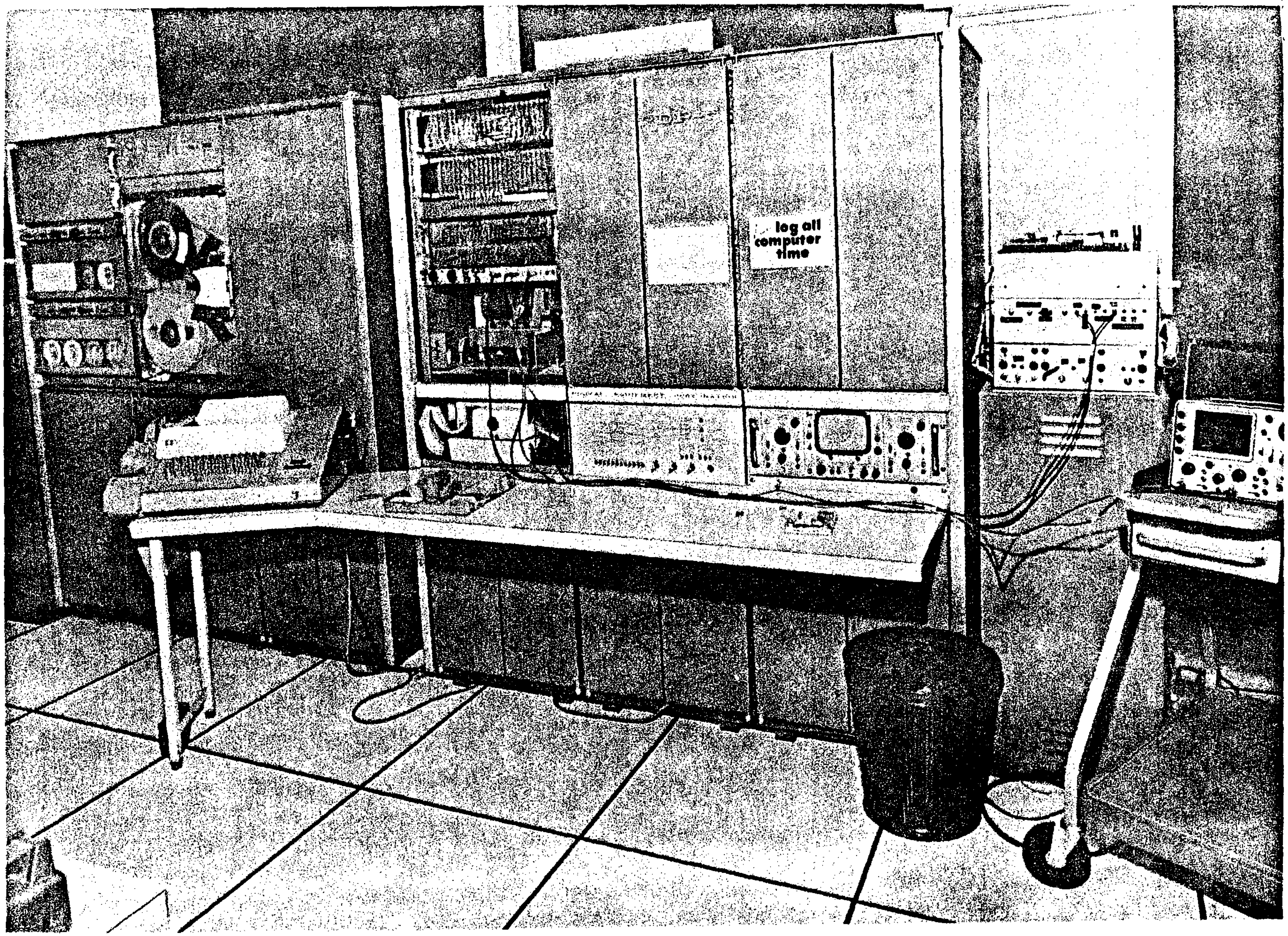

Figure 1. Equipment used to convert Geodyne magnetic digital tapes to IBM compatable magnetic tapes. The PDP-5 computer, cartridge tape reader, display oscilloscope, reader interface, and IBM tape transport are shown.

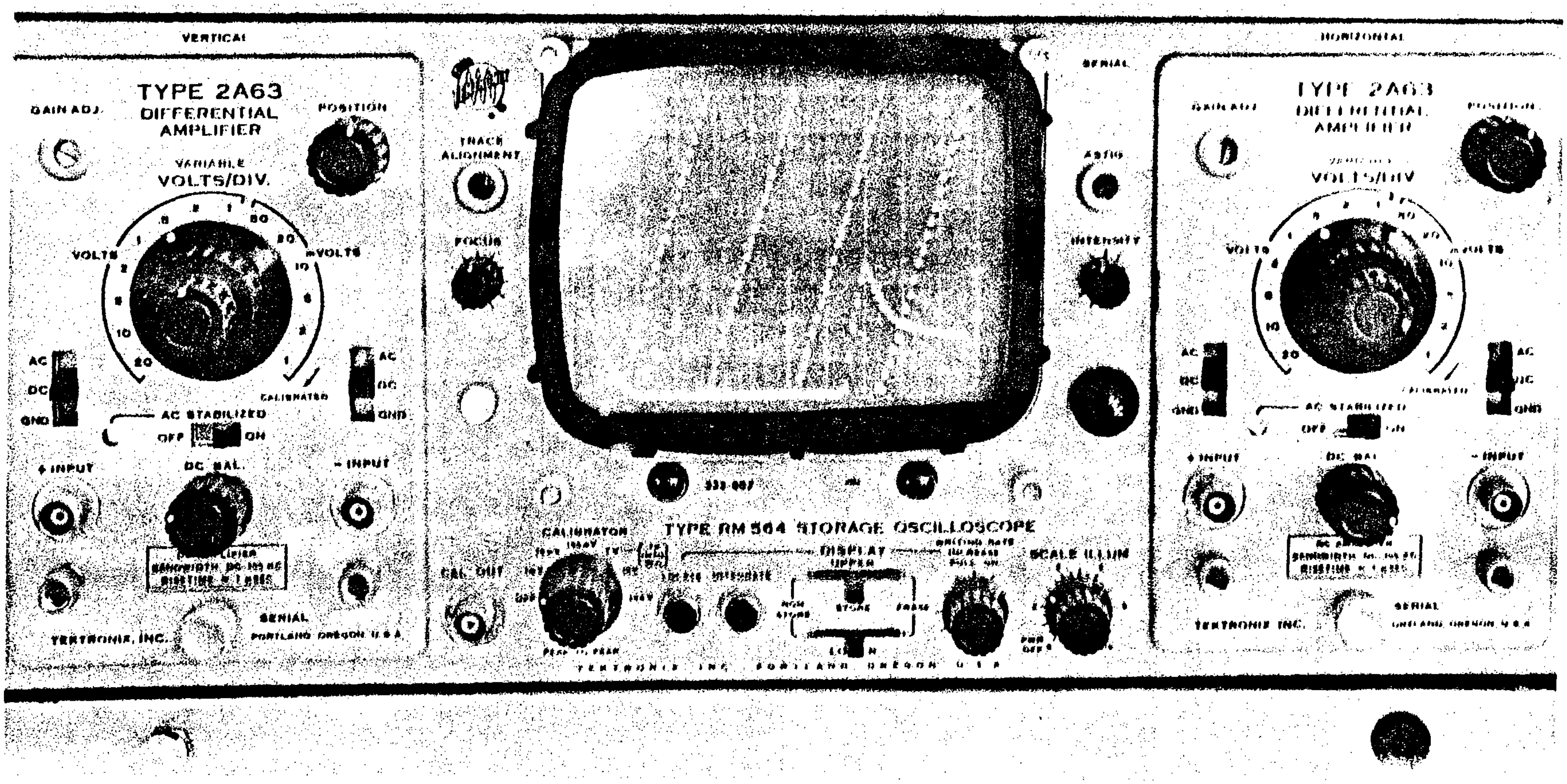

Figure 2. Display oscilloscope showing rotor and compass data from an instrument test.

computer readout.

The tests have detected numerous instrument malfunctions; indeed few instruments tested (including several new ones) functioned properly on the first trial.

2. Rapid Reading of Ocean Data

The ability to rapidly process the million or so observations collected every two months has three significant advantages:

a. Knowledge gained from one experiment is known early enough to be applied to the next experiment.

b. Instrument malfunctions can be detected immediately after the meters are uncased.

c. The interest of both scientific and operations groups can be more easily sustained when the interval between experiment and results is short.

3. Instrument Reliability

The probability of a tape current meter functioning properly is still not good, but has reached a level equal to or better than that achieved with film instruments. During the year the likelihood of getting a good tape record has increased from about .3 to about .7, with a reasonable hope of achieving yields of .8 to .9 within the next year.

Table I lists the general quality of data retrieved on all 1968 cruises. The "usable" records contain some useful data but are not complete records. The table shows a general increase in both the quantity and quality of data collected during the year.

Table I.

General quality of data collected in 1968.

Cruise	Good	Usable	Unusable
April	--	--	--
June	--	2	2
Aug.	5	4	2
Oct.	2	2	1
Dec.	7	3	3

Problems encountered at sea included tape tangling (3), clock failures (6), shut-off failures (3), handling errors (5), compass-vane failures (6) and miscellaneous component failures (7). Of 33 records taken, 14 were of good quality, 11 usable but not good, and 8 were not usable. A detailed list of all instruments set and notes concerning various malfunctions is given in Appendix I. Appendix II discusses instrument modifications and handling techniques evolved during the year. Appendix III gives an outline of check-out techniques.

These appendixes assume the reader is familiar with the Geodyne Model 850 current meter which is described in the Geodyne instruction manual number B-3921 date December 1968.

Appendix I

Table 2 lists all magnetic tape records (wind recorders, current meters and digitizer) accumulated during the year. The four film wind recorder and two film current meter records taken in 1968 are also listed. Where data quality is not good, the cause of failure is listed. The type of instrument is indicated by the instrument number prefix (W = wind recorder, M = tape current meter, D = digitizer, H = film current meter, suffix X = tape recording wind recorder). The first three digits of the data number identify the mooring while the last digit identifies the relative position of the instrument from the top of the mooring.

Table 2

1968 Instrument Summary

Data Number	Inst.	Set	Back	Good	Usable	N.G.	Comments
2634	M-173	Apr	Jun			X	Connector pin damaged, no data, dropped
2641	W-101-X	Apr	Jun		X		Clock failure caused shut-off failure
2643	M-172	Apr	Jun		X		Shut-off failure, design error, compass stuck
2662	M-177	Jun	Jun			X	Tape tangle, no data
2673	M-170	Jun	Aug		X		Some sticking compass, bad rotor switch, battery leak
2681	M-175	Jun	Oct	X			O.K.
2691	W-101-X	Jun	Aug	X			O.K.
2693	M-174	Jun	Aug			X	No rotor first part, shut-off failure, design error
2713	M-142	Aug	Aug	X			Extra clock failed
2721	W-125-X	Aug	Aug	X			O.K.
2722	M-177	Aug	Aug		X		Low order vane bit stuck on
2723	M-124	Aug	Aug		X		Not full record, dirt in recorder gears
2724	D-172	Aug	Aug		X		No rotor, corroded connector
2725	M-127	Aug	Aug			X	Tape tangle, clock failure, rotor failure
2726	M-122	Aug	Aug	X			Extra clock failed
2735	M-159	Aug	Aug	X			Extra clock failed
2742	M-172	Aug	Oct	X			O.K.
2743	M-173	Aug	Oct		X		Stuck vane bit
2744	M-135	Aug	Oct		X		Stuck compass
2753	M-145	Aug	Oct			X	Clock failure, no data
2791	W-101-X	Oct	Dec	X			O.K.
2793	M-127	Oct	Dec			X	Tape not degaussed, no data, rotor failure
2801	W-125-X	Oct	Dec	X			Dirt in tape gears, some data lost
2803	M-122	Oct	Dec	X			O.K.
2804	M-142	Oct	Dec		X		Stuck compass

Table 2 (cont.)

1968 Instrument Summary

Data Number	Inst.	Set	Back	Good	Usable	N.G.	Comments
2805	M-159	Oct	Dec	X			O.K.
2832	M-198	Dec	Dec			X	Tape tangle, no data
2833	M-177	Dec	Dec		X		Stuck rotor bit
2834	D-172	Dec	Dec	X			O.K.
2835	M-192	Dec	Dec			X	Flooded, no data
2836	M-195	Dec	Dec		X		Vane stuck, compass sticky
2837	M-196	Dec	Dec	X			O.K.
2842	M-173	Dec					at sea
2843	M-145	Dec					at sea
2845	M-124	Dec					at sea
2852	M-170	Dec	Dec	X			O.K.
2861	W-123-X	Dec					Lost
2863	M-135	Dec					Lost
2871	M-175	Dec					at sea
	TOTALS			14,	11,	8	= 33

<u>Film Instruments</u>

Data Number	Inst.	Set	Back	Good	Usable	N.G.	Comments
2631	W-175					X	Handling error
2633	H-871				X		Clock and motor troubles
2651	H-877			X			O.K.
2671	W-123				X		Transport and rotor logic bad
2711	W-177			X			O.K.
2751	W-174			X			O.K.

Appendix II

Instrument and Handling Techniques

A brief description of the major instrument and handling improvements made during the year is given. In some cases these represent "rediscoveries" of problems that were previously identified but were poorly documented. Improvements now incorporated by Geodyne in new current meters are marked with an asterisk.

1. Split Battery *

Useful instrument life was increased by isolating the power supplies used for the digital logic from that used for other "noisier" components. Noise transmitted through the power supply busses becomes increasingly troublesome as battery terminal voltage fades and internal resistance increases. With this modification a fresh battery provides adequate energy at 0°C to exhaust the data storage capacity of the meter. Figure 3 shows loaded terminal voltage as a function of time for a modified current meter operated in the continuous mode with its battery at 0°C.

2. Clock winders *

The mechanical switch closures that wind each of two mechanical clocks were replaced with electronic winding circuits. Clock failures represented a major class of instrument failure at sea in 1968.

3. Secure tape cartridges

Hard rubber pads are used to hold the tape cartridges firmly in place. This improves tape legibility when instrument vibration is present.

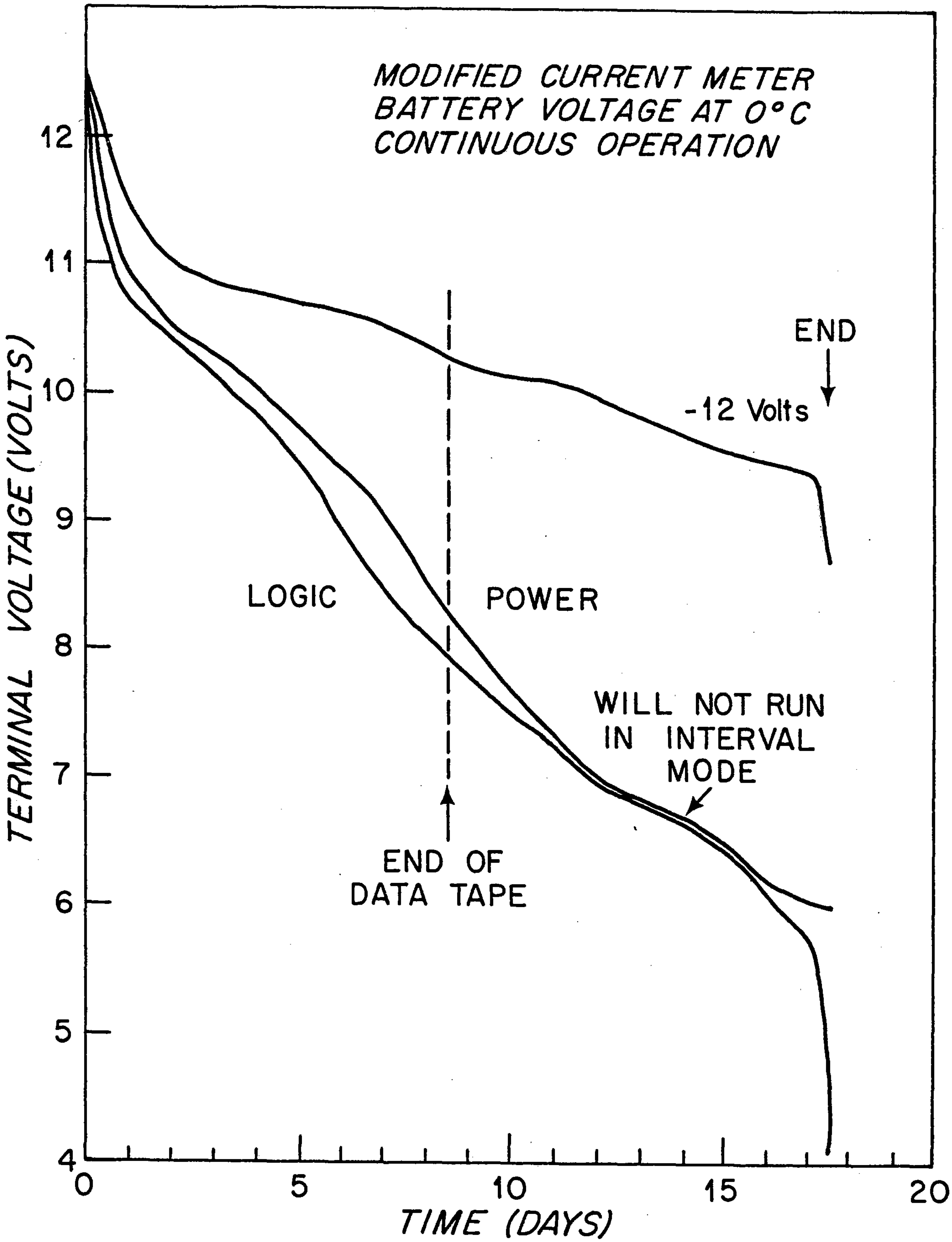

Figure 3. Battery terminal voltage as a function of time for each of three independent supplies of a modified Geodyne current meter. The battery is the standard 4-section 12 volt Leclanché package.

4. Adjust tape capstan *

Tape slippage was eliminated in improperly adjusted recorders by readjusting the tension on the rubber pressure wheel. Newer instruments now use a spring to solve this problem.

5. Tape cartridge tests *

Tape cartridges must be checked before use since they are not uniformly of good quality. Severe harmonic distortion of recorded data can result if tape write pads are improperly aligned. The cartridge should also be pressed near the bend in the wire tape guide while the tape is running. Errors in a cartridge molding capable of causing tape stalling and resultant tangling can be detected. The foil length should be examined and replaced if too long. Data is not recorded through the foil, but the lost data can be reduced by short foils.

6. Tape tension *

Cartridge tapes do not run face downward without developing a loop of tape outside the cartridge; even a small loop can not be accommodated in the recorder without tangling the tape. By tightening the wind the tapes can be made to run upside down, but unfortunately vibration, time and temperature can alter the wind tension so proper tension only decreases the chances of tangling. If the wind is made too tight the tape will be damaged by bunching and curling in the spool of tape. The margin between too loose and too tight is so small that the problem can be considered only partially solved. Tape cartridges and recorders of improved design are under study.

7. "This side up" tags

To prevent tape tangling on deck instruments are marked externally with a "this side up" mark. No failures resulted when 17 instruments were set with tighten wind and right-side-up deck operation while three out of 21 failed when these precautions were not taken. The tape tangling problem is not solved but is under control.

8. New magnetic tape wind recorder

Three current meters were modified and used as wind recorders. The instruments worked satisfactorily on each of five settings during the year. Wind recorder checkout and data processing is compatible with current meter techniques. The wind recorder design is not good, but it should serve the purpose until a better instrument is developed.

9. Uniform sampling

Normally the instrument suppresses every 32nd observation in the "continuous" mode. The user is thus forced to discard alternate samples (i.e. use half the data) or resort to some interpolation scheme for the periodic missing data. Instruments were modified to allow continuous sampling by eliminating the usual record gaps and providing 2-bit-long gaps at the start of each 32-bit long observation. Tape reader hardware and programs to handle this format were developed.

10. Continuous mode time marks

The normally unused one-hour clock was rewired to provide a time base for continuous mode operation. Otherwise, the only time base is that of the R-C oscillator used to set the sampling rate of the current meter and the infrequent and less accurate 12-hour clock micro switch closures. Large time uncertainties will be encountered if this modification is not used in the continuous mode.

11. One-hour clock calibration

The time of closure of the one-hour clock micro switch is logged before and after use at sea. In the past, times were recorded for any tooth of the normal four lobe cam resulting in 15 minute ambiguities in the calibration. Now one tooth of the cam is marked and used for the start and stop times reducing the ambiguity to one hour.

12 Eccentric timing cams

When the conventional current meter mechanical clocks are used to provide asynchronous time events, cams with one lobe filed off are now used. The one-hour clock, for example, is used with a four lobe cam less one lobe to provide 15 minute and one hour time information. Similar cams are used with the 12 hour clock in both the continuous and interval modes. Uncertainties in the time base are greatly reduced by this technique.

13. Continuous mode time of observation

Computer programs to estimate the time of observation in the continuous mode were written. The awkward time recording scheme combined with an unfortunate tape design involving channel switching makes the time base of continuous mode observation extremely difficult to reconstruct. Concurrently a digital crystal clock is being developed to provide more accurate and more easily interpreted times of observation.

14. Error detection counter

Recording redundancy for error detection was improved somewhat by including a sample number with each sample recorded. The present scheme uses only two bits for this number but is nonetheless an improvement. Considerably more data checking information should be included in the recording. New logic to provide such checking is under study.

15. New sampling modes

Existing components are rewired to provide more flexible interval sampling modes. Long-term records now use a burst of 23 samples every 15 minutes instead of the 31 samples used in the past. This scheme allows data overlap from one cruise to the next.

16. Proper speed-direction pairing

The usual order (rotor, compass, vane) in which meter readings are grouped to form one observation or "strobe"does not give the proper pairing of magnitude and direction readings. Each compass-vane group should be associated with the following rotor reading not the previous reading. This situation is presently accounted for in our data reduction, but would more appropriately be corrected in the instrument to avoid wasting instrument life by recording unusable data at the start and end of each burst. Useful life in the interval mode with 23 strobes would be increased about 4% and about 16% for 7-strobe operation.

17. Increase data capacity

Unnecessarily long record gaps on the magnetic tape have been shortened to increase useful instrument life in the interval mode. In the 23-observations-per-burst mode the instrument life is increased by about 9% or roughly an extra week of recording. The 10-second delay used to generate the larger gaps can be eliminated.

18. Compass and vane follower tests

It has been found necessary to test all compass and vane followers at reduced temperature to assure proper operation. The photoresistors and light pipes on the compass and vane follower assemblies continue to be troublesome. Some 18 failures were detected in 1968: an increased effort to correct this problem is needed.

19. New compass

Sticking compasses have been a continuing source of lost data in both the film and tape current meter. The compass has proved to be the least reliable component in the instrument. A compass of improved mechanical design is being fabricated locally from standard compass parts to solve this problem. This is an interim solution, however, until a reliable compass is available.

20. Coated boards

Logic errors caused by condensation have been eliminated by spray coating the electronics with krylon. More desiccant has also been used but the humidity problem is severe when instruments are cased on humid summer days and then immersed in ice water temperatures. It is planned to purge instruments to eliminate this problem and provide a final check of pressure-case integrity.

21. Change in clock position *

The mechanical clocks were moved slightly to prevent the clocks from pounding on the pressure case. (Smooth spots had been hammered on several clocks due to vibration at sea.)

22. Tape recorder gears

The tape recorder gears are exposed to the cartridge tape compartment and thus to dirt accumulation. Such contamination of the gear grease can stall the recorder and resulted in lost data at sea in 1968.

23. Pin damage

The electronic cards have no guides to help pin alignment during board insertion. One record was lost before this problem was recognized; no adequate solution has been implemented.

24. Shut-off error *

A design error which allowed current meters to run beyond the tape storage capacity was isolated and corrected. The error had caused loss of data from the middle of several earlier records.

25. Channel switching

The need to eliminate the tape recorder channel switching became increasingly evident as the number of tape records processed increased. Since the time base of the data is heavily dependent on the sequence of records recorded, any breaks in the recording necessitates expensive and time consuming hand editing of the data. The computer time for such editing can represent a large fraction of the total data reduction costs. A suitable means of eliminating channel switching is being sought.

26. Battery disconnect error *

A design error which allowed the meter to draw current from the battery <u>after</u> final shut-off was found and corrected. Batteries are also put in plastic bags to reduce damage should they leak. (The bags provided by Geodyne, however, leak and should be replaced.)

27. Battery cold storage

Battery shelf life is greatly increased by cold storage. All batteries are now stored in a freezer. A technique for estimating the quality of new batteries by means of the rate of voltage change under light loads was developed. The test has not been necessary, however, for batteries stored in the freezer. The recurring problem of battery failure seems to be solved; no data was lost due to battery failure during the year.

28. Long life instrument

The possibility of drastically reducing instrument power requirements by low power MOS circuits was recognized. A modified current meter draws about 65, 30 and 25 milliampers from the +12 volt logic, +12 volt power and -12 volt supplies respectively. The tape motor draws 18 while the lamp flash and clocks each draw .4 ma. With MOS circuits and a single-pass tape total power requirements could be reduced by an order of magnitude or more. Further, the data storage requirements could be reduced by a factor of 10 to 30 by proper averaging or the tape capacity could be increased by using multiple track tape heads.

29. Data monitoring techniques

Techniques for reading the current meter data at various stages of testing have evolved. The bit stream can be examined at the tape write head with an oscilloscope or special shift register, on the tape with "magnasee" fluid, at the analogue oscilloscope display of the tape reader, and finally through the computer playback on the computer display oscilloscope. The magnasee record showing bit density, record gaps, alignment, channel searching, etc. is logged after the meter is properly adjusted.

30. Final interval mode test

It is necessary to test current meters in the interval mode to detect compass-vane photoresistor warm-up failures and erratic shut-off of the instrument between recording bursts. If an instrument does not start and stop properly at each interval the improperly sequenced records will hopelessly confuse the time base of the observations.

31. Computer checkout

Since each instrument is intended to record some 120,000 observations at sea, tests involving at least thousands of observations have been found necessary to isolate failures. Special computer programs designed to allow efficient review of such volumes of test data have been developed during the year. The programs perform the following functions:

a. Plot rotor, compass, vane, direction, and time values on a CRT display
b. Plot sampled rotor values on the Calcomp plotter
c. Dump specific records on the teletype
d. Dump records on the high-speed printer and
e. Check the format of data transferred to IBM tape. (This is used to identify bad IBM tapes.)

32. Maintenance log

Instrument changes are now logged chronologically by instrument. This and a status-board mounted on the wall of the instrument room have consolidated the performance history of each meter. Two meter failures during the early part of the year would have been avoided by the new system.

33. Standardization and spare parts

To simplify maintenance and operation of current meters, an effort to up-date old instruments to present standards continues. A larger spare parts inventory is now maintained to reduce trouble shooting, repair and re-order delays.

34. Problems with new instruments *

Of 13 new instruments received, only 2 were in good repair. Troubles detected at the time the instruments were first uncased included recorder slippage (3), sticking compasses (5), sticking vane followers (3), unimplemented design corrections (6), mechanical problems (2), bad switch (1), bad electronics cards (3), clock troubles (2) and bad tapes (4). The number of malfunctions uncovered in each new instrument were 4, 8, 4, 0, 2, 2, 1, 2, 0, 1, 2, 3 and 1 for instruments 192, 195, 196, 198, 203, 204, 205, 206, 209, 210, 211, 212, and 213 respectively. A considerable effort to correct this situation is being made by the manufacturer.

Appendix III

This appendix contains outlines of tests performed on new instruments, pre-cruise tests, final casing procedures, and post cruise procedures. The presentation assumes a detailed understanding of the model 850 current meter. The content of the outlines may be helpful for others using the model 850 current meters.

850-1 RECEIVING INSPECTION TEST PROCEDURES

1. Check rotor and vane bearing adjustments and freedom of movement.
2. Check all tie rods for buggy bumpers.
3. Check tie rod securing nuts (top and bottom) for maximum thread engagement and adjust if necessary.
4. Check paint for large scratches and/or flaws.
5. Uncase instrument. Check general quality of workmanship, solder joints, security of screws and fasteners, wire routing.
6. Check pressure case O-ring surfaces for nicks, scratches, irregularities, anything that will prevent a watertight seal.
7. Check top and bottom O-ring grooves for nicks, scratches, etc.
8. Remove battery, check for at least 12.0 volts on each section with 120 ohm load. Leave load on each section for 10 seconds, making sure voltage doesn't drop slowly from its initial reading.
9. Insert volt/current test box into battery and plug instrument into it.
10. Make sure both clocks are running.
11. Turn instrument on in continuous mode and check voltages in operation. All three should be at least 12.0 volts.
12. Check ripple on +12 volt logic buss. Should be 50 mv or less. (except for lamp flash)
13. Check operation of magnetic shut-off switch.
14. Make sure each of the 1-hour clock cam lobes turns the instrument on.
15. With scope or D.D.M., check data at Dt. Make sure all compass and vane bits are alive, also rotor and I. D.
16. Check data at tape head. (pin 1012) Should be narrow pulses, +3 volts for binary 1, -3 volts for binary 0. (approximately)
17. Check current drain from all three supplies.
    +12 logic = 80 ma or less
    +12 power = 50 ma or less
    -12 = 40 ma or less

850-1 RECEIVING INSPECTION TEST PROCEDURES (cont.)

18. Check all three current drains between intervals. Should be less than 2 ma.

19. Check channel switching.

20. Check re-arm between intervals.

21. Check auto-shutoff. After shutoff, check all three current drains. Should be less than 2 ma.

22. Check compass and vane for proper code, leakage, bubbles, proper height of bellows.

23. Check for tape cartridge tangle when run upside down.

24. Check each interval for proper length.
    E4 = approx. 50 sec.
    E5 = approx. 90 sec.
    E6 = approx. 170 sec.

25. Make magna-see record of channel A and B. Check head alignment, skew, and gaps.

26. With instrument on rotating test stand, visually check for compass sticking.

27. Remove compass and vane follower and put them in freezer for one hour. Then check again for sticking.

28. Install 25 ft. tape cartridge and run overnight test in E6 mode on rotating test stand. Read test tape and, if readable, check performance of instrument with computer display.

PRE-CRUISE PREPARATION AND CHECKOUT PROCEDURES

1. Install used battery. (9-11 volts under load)

2. Check both clocks. (Should wind, after short delay, and start running)

3. Turn on instrument in "continuous" mode.

4. Press "Reset", then press "Test" button. Whether or not the instrument begins running, the channel "A" light and the "RE-ARM" light should come on.

5. Check operation of magnetic shutoff switch.

6. Check for, and install if necessary, the following modifications:

   a. 2-bit gap
   b. E6 mod. (23 strobes per interval)
   c. Re-arm diode
   d. 1 meg resistor in "8" bit of I.D. board
   e. Clock winder (W.H.O.I. mod #5 or Geodyne)
   f. 1-hour clock switch closures displayed in "8" bit of I.D. field
   g. 12-hour clock switch closures displayed in "4" bit of I.D. field
   h. Strobe counter
   i. Split battery mod.
   j. Shutoff mod.
   k. All circuit boards coated
   l. CR-4 moved on Log-3 (new instruments will have a Log-3B, which has diode moved)

7. Make sure each lobe of 1-hour clock cam actuates micro-switch.

8. Check for true one hour orientation of 1-hour clock cam.

   a. In long term instruments with more than one cam lobe, paint one lobe red for one hour sync. (Chronometer first and last pulse orientation)
   b. In short term instruments, make sure the cam is eccentric rather than symmetrical. (This enables the data analyst to identify each individual cam lobe in the record)

9. Check ripple on +12 logic. Should be under 100 mv pk-pk. (except for lamp flash). Amplitude of ripple will vary inversely with battery voltage. The lower the battery voltage, the higher the ripple.

PRE-CRUISE PREPARATION AND CHECKOUT PROCEDURES (cont.)

10. Check data at Dt and Tape head. (Pin 1012) Make sure all compass and vane bits are there; check rotor, time marks, and strobe counter.

11. Check all three current drains while running and also between intervals. The maximum values are absolute and should not be exceeded. If they are, chances are good that the instrument will not go through both channels of tape. In practice, the current drains should be somewhat less than these maximums.

	RUNNING	BETWEEN INTERVALS
a.	+12 Logic = 80 ma.	Less than 2 ma.
b.	+12 Power = 50 ma.	Less than 2 ma.
c.	-12 = 40 ma.	Less than 2 ma.

12. Check channel switching.

13. Check Re-arm between intervals.

14. Check period of one cycle of K1. Should be 156 millisec. + or - 2 millisec. Each alternation should be 78, plus or minus 1, millisec.

15. Check interval length.

E4 = approx. 50 sec.
E5 = approx. 90 sec.
E6 = approx. 170 sec.

16. Check automatic shutoff. After shutoff, all three current drains should be less than 2 ma.

17. Make magna-see record of channel "A" and "B". Adjust tape guides and tape head if necessary. If instrument under test is to be used on a long term mooring, be sure to make the magna-see record in interval mode, and check for bursts of 2-bit gap data with larger gaps separating the bursts. Log magna-see record in current meter work book.

18. De-magnetize tape head and clean, if necessary.

19. Check pinch wheel for flat spots.

20. Check pinch wheel tension when engaged and adjust if necessary. (detent type)

PRE-CRUISE PREPARATION AND CHECKOUT PROCEDURES (cont.)

21. Clean pinch wheel.

22. Check tape recorder drive gears for gunk and clean if necessary.

23. Check rotor and vane for damage, freedom of movement, and bearing wear and adjustment.

24. Remove compass and vane follower and put in freezer. After one hour, remove compass and vane follower from freezer and check for sticking.

25. Re-install compass and vane follower. Install degaussed 25 foot test tape. Run test on rotating table in operating mode to be used at sea. (If long term, run in interval mode; if short term, continuous mode.) Continuous mode tests should be run for at least three hours. Interval mode instruments should be run overnight.

26. If readable, read tape and use display and/or teletype dump to analyze problems, if any.

27. If all O.K. remove battery and set instrument aside until checksheet time. Log all maintenance performed in current meter work book.

INSTRUMENT CASING PROCEDURES

1. Obtain blank Current Meter Data Quality sheet from file, making sure it has a sheet number in the space provided.

2. As the instrument casing procedure is accomplished, log required information on the sheet. (Leave data name blank.)

3. Take new battery from freezer, check it with 120 Ω load and install current measurement test plug. Plug current meter into test plug.

4. Check data at D_t and tape head. Make sure all bits are alive. (strobe counter, rotor, 1-and 12-hour time marks, and all compass/vane bits)

5. Check interval length, if applicable, current drains between intervals, channel switching, re-arm between intervals, current drains after automatic shutoff.

6. Remove current measurement test plug and install battery in current meter, logging date installed on battery with marksalot.

7. Check clocks for proper cams. Make sure each cam lobe of each clock actuates clock microswitch.

8. Calibrate clocks with tickoprinter. Try to get within 10 seconds per day.

9. Install re-wound, degaussed tape cartridge and hard rubber pads as needed to restrict cartridge movement. Attach gummed label to cartridge with following information: instrument number, operation mode, type of mooring (long science, short engineering, shear, etc.). Tape rotor and vane to keep them from moving.

10. If long-term instrument, run several intervals in Lab to check tape transport, and log number of Lab records in "remarks" space on data quality sheet. If short term instrument, run for at least 5 minutes to check tape transport, and log time run in "remarks".

11. Take 1-hour and 12-hour 1st pulses. If clock cam is eccentric, take 1st pulse on first cam lobe after blank. If symmetrical, take first pulse on marked (red) cam lobe.

12. Double-check mode switch for proper setting. Press reset, then test buttons and make sure ch. "A" and "Re-arm" lamps come on.

13. Install shutoff magnet.

14. Clean O-ring grooves and install new O-rings, greased with Dow-Corning #4 compound.

15. Install 2 dessicant packages.

16. Clean pressure case O-ring surfaces, checking for scratches, flaws, etc.

17. Install pressure case and torque to 10 ft.lbs.

POST CRUISE PROCEDURES

1. Log instrument "In Lab" in instrument file and status board.

2. Uncase instrument. Check for timers running, battery leak, tape tangle, compass or vane leak, overall condition of instrument. Log in current meter work book and status board.

3. Check rotor and vane for damage. If damaged, log in current meter work book and status board.

4. Check for channel switching and shutoff, of applicable. (If instrument was at sea long enough) Log any discrepancies in current meter work book and status board.

5. Remove tape cartridge. Write data number on both edges of cartridge with marksalot.

6. Take one-hour and twelve-hour chronometer last pulses.

7. Finish filling out Current Meter Data Quality sheet.

8. If cartridge has no data, (tangled, flooded instrument, instrument malfunction) write "no" in "PDP" reading by space on checksheet. If cartridge has data, write "yes" in this space. Send checksheet, with or without cartridge, to data processing and log date sent on checksheet. Make Xerox copy for Buoy Lab records.

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13. ABSTRACT

This report describes work done with Geodyne current meters and wind recorders during 1968. Techniques for testing instruments prior to use at sea, instrument performance at sea and instrument changes evolved during the year are discussed.

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