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PUERTO RICO NUCLEAR WaNThR

?A MANUAL FOR HYDROGRAPHIC CRUISES

Propared for the Puerto Rico Water Resources Authority

By the Staff of Puerto Rico Nuclear Center of the

University of Puerto Rico

May 1975,

OPERATED BY UNIVERSITY OF PUERTO RICO UNDER CONTRACT

'NO- AT (40-1)1833 FOR US ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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By

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May, 1975

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A MANUAL FOR HYDROGRAPHIC CRUISES

by

E.D. Wood

INTRODUCTION

This handbook is intended to serve as a guide to persons

planning and executing hydrographic cruises and those Uho

{ALeTPFet and evaluate the resulting data. It is expected

{hat persons reading this manual will have some basic

knowledge of the subject and will use the references cited

The general process is outlined in Table 1 and explained

jaeghe, fexts, The Appendix contains examples of data sheets,

fetailed explanations for the station lop shcet and conputer

Programs used in data processing.

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Table 1.

QGRAPHIC RESEARCH

»_}? : A suvvoxt }

~~}

Information required

Stat ions-Depths

Sampling frequency

Coordination with other investigators

[erasnine FOO

Personrel

Equipment

vessel

Procedures

i

Temperature

Salinity

Dissolved Oxygen

Nutrients

Special water chemistry

Associated Data

---Page Break---

Table 1 (continued)

SAMPLE ANALYSES 4 STANDARDS

Rev. Therm.

BY Plots

|?Salinitics

\?D.0..

Nutrients

pH, T.E., BOD, COD, R.N.

DATA ASSEMBLY

para repucTION -?- ?

Computer Print Out

Plots

Standard hepths Conversion

Plots

-

Reports

Supporting Agency

ut-of -house

Publ ications

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HYDROGRAPHIC PROCEDURES

fivdrographte Cruise Numbers

Bach cruise of a boat or ship receives a unique serial number containing two letters of the ship's name, a dash,

and a three-digit arabic number. For example, for the

RY RLF. Palumbo, "PA", then dash "-", then the S-digit number, "123." The final serial number reads PA-123-

Usually the number is used for all ship sampling from the

tine the vessel leaves pert until it returns. ?The same cruise number may be used even though the vessel has put

into port if the work is at one site or region. Multiple cruise numbers may be assigned if the chief scientist and/or the mission change before the vessel returns to its home port.

Station Nunber

Each station occupied by the ship receives a unique station number. Station numbers run consecutively con= tinuing from one cruise to the next. The combination of the three digits of the cruise number and the last three digits of the station number make up the reference aunber tor station.

Bridge Log

At the tine of sampling the bridge officer is responsible for filling ou: a bridge log in duplicate. This log contains the following information: cruise and station numbers, dates and times, weather conditions, position, and type of sampling. The original copy goes to the chief scientist and the carbon copy is placed in the ship's file. (Fxample in Appendix.)

fic Crew

?The ship's captain has the overall responsibility for the ship's operation, the safety of the ship, and all persons on board,

A scientist, usually the ranking staff member on the cruise, is designated as "Chief Scientist" and is responsible for the successful completion of the scientific effort. ile

is assisted by a "Cruise Leader." One or more "Group Leaders? muy also be designated on a multiple discipline or round-the-clock sampling type of cruise.

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ch

The chief scientist is responsible for the seientitic effort and coordinates with the ship's captain to carry out the scientific effort. A eruise plan is male out under th slirection of the chief sciontist aml Curnished to the ship's captain and members of the scientitic crew, The basic welfare of the scientific crew regarding job assignments, proper rest and nourishment, cleanliness of staterooms, etc, are the responsibilities of the chief scientist, as well as supervising the proper procedures and techniques for obtaining the desired seientitic goal crow

The scicntific crew ix obliged to refrain from ship's

crew activities except when requested to act by a responsible

menber of the ship's crew, or if action is necded to prevent

dunage or harm to the ship, personnel or equipment. Any un=

solicited actions are reported to the watch officer as soon

as practical. Upon request from the captain, the chiel

Scientist should Curnish a List of scientific personnel who

can participate in the ship's wate

The chief scientist may delegate any or all of the above

nentioned activities, but he is not relieved of responsibil

ities for them,

A cruise plan is a flexible schedule of work to he done and a bricf description of how the work is to he accomplished. iow well it is followed depends upon the forethought of the originator, the preparedness of the entire crew, and the vecurrence of non-controllable interferences, The cruise plan ineludes the following headin

I. Researeh Vessel Personne)

HLL Support ing? Agency Seuss ion

TIL Craise Name aad Nupher tions

WW. bates: Faui pment

Vi Total pays & Miles

VIL ohjeeti

and maps showing the crui

A copy of the cruise plan is distributed to the scientific crew, the ship (several copies), project leader, division

head, office in-charge of the ship, and other interested parties. The Cruise plan should be followed closely to accomplish the objectives, hut changes can be at the discretion of the chiet Scientist and/or the ship's captain.

---Page Break---

Hydrographic Station Log

The data for each hydrographic station are recorded in duplicate on a station log sheet by the persons working on Voth. This sheet is composed of three sections. It is Slesigned to have the data key punched for computer analysi

ihe First section is called the "Master Card" and contains

the following: mame of ship, cruise and station identification, position, Jate, time, depth, weather, and sea conditions.

The second section ic the "harameter Card? which provides inforsation on the casts: number, time, depths, oxygen catcu- Litton factor, and meter wheel correction factor. the third scetion js the ?bata Card? and has the actual data for cach sispth. The cast number, depth of the sample, water sampling bottle number, thermometer numbers and readings, and ind

vidual sample? bottlc numbers are recorded in this section. U.S. Navy lydrographic OF. Pub. 607 § G14). (A step-by- top explanation for filling out the station log is given fn the Appendix.)

Most oceanographic ships are equipped with a mechanical

winch with a stainless steel wire rope of about Smm (3/16")

?ameter of varying lengths with a lead weight on the end.

This wire is fed through a motering block about 3m (10 Ft.) off the deck and down over the side of the ship. Sampling Cquipment is then clamped to the wire and lowered to the slesired depth. The sampling equipment is usually handled by the scientific crew, while the operation of the hydro-winch lalis to mombors of the ship's crew. ?The meter wheel is calibrated periodically by measuring a segment of wire passing

through the meter wheel. The depth of the sample is determined

mathenaticatly using the wire angle and the meter wheel cor~

Fection fictor. The sample depth 1s also calculated from

roversing thermoneter data,

gto

Water samples are collected by loworing # ?bottle

epen at the end, to the desired depth, then closing thé end

plugs or valves 'with a "messenger" and returning the hottle

to the deck of the ship

Several types of sampling bottles have been devised.

A wolT known oceanographic sampler is the Nansen hot

leis clamped on the hydro-wire by oneend, then tho entire

hottie ix averted and clipped into place.? This bottle has

Connected, rotating valves, onc at cach end, and a rack

which holds two to four thermometers. \A-nuaber of other

types of water samplers have heen developed and sone are

---Page Break---

available commercially, One such bottle, the Niskin bottle,

is made of PVC which minimizes metal contamination. The

model commonly used at the Puerto Rico Nuclear Center (PRNC)

holds five liters and is sufficient for most sampling (twelve

and thirty liter bottles are used also). ?The five liter

bottles are equipped with thernoneter racks holiing_ three

thermometers each. These bottles differ trom the Nansen

bottles in that they are clamped to the hydro-wire with two

Bolts, the ends are closed at depth by tripping two end

plugs which are pulled together by a spring or elastic
Passing through the middle of the bottle, and the thermometers
are reversed by a rotating rack on the side of the bottle.

When sampling in series on a cast, each bottle above
the bottom one has a messenger attached to it. The messenger
is a brass weight which clamps freely around the wire and is
\ttached to the bottic by a short lanyard. The bottles are
placed on the hydro-wire at predetermined intervals, recorded
bn the station sheet, and ona card used by the winch operator
as shown below:

Table 2. Example of information recorded on the Station Lo

vnd Winch Cand.

Eetinated Meter Bottle

cast Bepth Weel Slippage __Kember

303

1 ° 100 1

1 25 7s 2

1 50 so 3

1 100 ° "

Since all bottles are on the same cast (column 1), all

are nunbered the same under "Cast." If a second or third

cast is necessary, cither for samples at different depths

a malfunction in the cast, or additional samples at the same

dopth, the casts are so numbered, e.g., Cast 2,3.

The desired depth of the sample is entered (column 2)

in descending order with depth being measured in meters posi-

tively down from the surface. The bottles are hung on the

hydro-wire in reverse order with the meter wheel reading,

shown in column 3, corresponding to the bottle numbers shown

in column 5. The?meter wheel reading is determined by sub-

tracting the estimated depth of each bottle from the deepest

depth sampled on the cast. The additional three meters,

---Page Break---

(column 3, supra) on the ship, are needed to get the last

bottle tothe water fron the evel of the "Hero's Platform."

The "Hero's Platform" is a cage which extends from the side or stern of the ship in which a person stands while attaching the sampling equipment to the hydro-wire. The platform is usually equipped with a snap on a short rope, which sccures the hydro-wire while attaching the equiprent, ands tray to hold messengers and tools,

Times are recorded on the station log sheet for the Start of the cast, the time the bottles are down, and when the messenger is dropped. A mininum of three minutes is lowed for the bottles to equilibrate before being tripped. This allows time for the thermometers to come to equilibrium and for the bottles to be flushed. The times for the start of the haul, completion of the cast and the initials of all scientific personnel active in the work at the station are also recorded. When the bottles are removed from the hydro-Wire the winch operator notes the meter wheel reading and notifies the scientific crew of any difference between the "down" and "up" readings. He also writes the difference down on the winch card as "slippage" (column 4).

Set-up for Cast

The scientific crow sets out bottles for the individual samples in the bottle rack before or during the lowering of the cast. Samples usually include salinity, dissolved oxygen, phosphate and nitrate. The bottle numbers and the thermometer numbers corresponding to the sampling bottle number are re- corded on the station log sheet. Great care is used to ensure that no mix-up occurs with respect to bottle and thermometer numbers

The person setting out the bottles checks to see that the cases are arranged with the smallest numbers in the upper left-hand corner and bottle numbers increasing from left to right and top to bottom (top=away from; botton= toward the reader). The order of the bottle numbers is checked, 1) as the bottles are placed in the rack, 2) as the numbers are recorded on the station log sheet when the bottles are filled, and 3) again when they are returned to their respective cases. Thermometer numbers are recorded directly from the bottie (not from another sheet!) and checked with each reading.

The initial set-up includes the strategic location of oxygen reagents, tools, messengers, magnifiers for reading tnermoneters, flashlight and wire angle gauge.

---Page Break---

HYDRO TEAM

Hydro Area

The hydro area is a working area. No horseplay, unnecessary shouting, nor radios should be permitted. The winch man is not to be distracted nor his line of sight to the "a" ?frame blocked. Persons not active in the sampling should be encouraged to avoid interfering with the hydrowerk,

The hydro team on deck at any one tine usually consists of two to Five persons. The person in charge nay Ye ehe chief scientist, cruise leader, of a team (eaten toate,

A nunber of duties may be assigned to spect Tic mombene te the team, and shared or rotated:

hanging botties*

fiUling out station tog sheets

setting up for sample bottles

drawing and treating oxygen samples

@rawing other samples

reading thermometers

carrying bottles

*NOTE: One person is responsible for hanging and retrieving Sample bottles. The care of the bottles, thermometers, messengers, and directions to the bridge are h responsibility only!

Bottle Hanger

The ?bottle hanger" has the winch man lower the lead weight over the side, attaches tho wire to the ship with

the snap, and "zeros" the meter wheel, The ?bottle carrier? Garries the sample bottle, hands the ?bottle hanger" one bottle for the deepest measurement first, and then watches to see that no details are overlooked. Especially, the condition of the reversing thermometers prior to descent

is checked. He then fetches the next bottle and the pro-cedure is repeated. The "bottle hanger" attaches the bottles fo the wire and tightens the clamps Securely. The following items ure then prepared and checked.

end plugs cocked

air vent closed

discharge cock closed

thermometers reversed

mercury bulb checked to sce that all mercury

has dropped

messenger attached

---Page Break---

Next, the wire is released from the snap hook. The

winch man?is signalled to lower the bottles to the next

edited depth. The "bottle hanger? may at any tine request

wee Delage officer to maneuver the ship during the lowering

or raising of the cast to redues the wire ?angle, reduce roll,

Protect the equipment fron hitting On The oes to prevent

Rigage to the ship by having the wire drawn against it. Tt

Ganpee {esponsibility to watch the wire and sampling equipment

at all Eines the wire is in the waters including the three

minute "soak" period, and to be especially vigilant while

the ship's propeller is turning. ?Ske Bridge should be reninded to keep an eye on the depth indicator when sampling

fear is down and kept advised of the various stages in sampling.

Drawing Samples

Ié three or more people are on the hydro team, sample drawing should commence as soon as the "bottle carrier" has Glaced'the first bottle in the rack. All bottles are rinsed piw\east three times. Special care should be given to rinsing dry bottles especially if they contain salt crystals. These bottles should be soaked or washed with acid prior to use.

The dissolved oxygen samples are dravn first followed by

The dibeand nutrients. (The order may be changed, but dis- Solved oxygen is usually first.)

Dissolved Oxygen,

Dissolved oxygen samples are drawn through a tube which extends to the orton of the bottle. Two regular rinses of extends tei ?tach are made. The stopper is rinsed cach time.

spout ova 'rinse is made by inverting the bottle with the tube

The vine to'the bottom, rinsing the walls and allowing any

TUBRISE [2 the tube to escapes The stopper, is held in the

meptenater during this operation. After about 100 ml have

saree eaeTehe bottle is righted and allowed to fi11 to over-

eon weeds che tube is withdrawn from the water only at the

sag oF the Filling and while still flowing, Innediatel

ond, of the si11in5 and yhlls eh While placing the tip oF" the

dsdhenser a few millimeters below the surface. One milli-

Tee" whr-Naolt solution is added in the same fashion.

The stopper is then dropped into place and the bottle in

ree ea gh veral times to thoroughly mix the sampic, | Tf a

HoERIS is?present at this point, the sample should be dumped

and re-drawn.

After 1§ to 30 minutes the oxygen bottles are reversed

slowly several times to re-suspend the precipitate, then

fioatea with 1 ml of M12S0g approximately 45 minutes after

being drawn. The samples should be titrated within 24 hours.

---Page Break---

The method is similar to that found in Strickland and Parsons, 1968. The oxygen titer is calculated from the standardization Process and entered om the station log sheet. The results

are reported as mil? liters per liter (ml/1), milligrams

Per liter (mg/1) and percent saturation (1 sat.)«

Salinity

Salinity samples are collected in 250 al polycarbonate bottles with good-fitting screw caps. Care is taken not to

use dry bottles unless they have been rinsed previously with fresh water. The bottles are triple rinsed and filled to

the round. ?A check is made, when putting the cases away,

to see that all caps are secure. Salinity samples can be analyzed on shipboard or returned to the laboratory. Salinity is determined by an induction salinometer using standard (Copenhagen) water and a substandard collected from the open Sea, The techniques used in the analyses are those recom: mended by the salinoneter manufacturer. Results are reported

5 parts per thousand (*/oo). (Beckman, 1965 and Plessey, 1962).

Nutrients

Nutrients commonly measured in sea water are phosphate (PO.'), nitrate (NOs) and silicate (Si02) because they are usually the limiting factors for phytoplankton in the surface waters. ?The analysis of silicate is sometimes deleted because S02 is only limiting to those plankton, such as radiolarians, which use it in their skeletons. High concentrations of these complexes in surface waters are of interest because of their effect on biological communities. A moderate supply of nutrients is usually beneficial whereas an overabundance degrades the system. High nutrient concentration can be caused by upwelling of deep water from agricultural, industrial and municipal run-off. ?The latter is ?more likely around Puerto Rico. ?Nutrient concentrations generally increase with depeh. The nutrients measured are qualified with the word "reactive? because it is recognized that there is more of a particular nutrient present in the water than measured. However, it is assuned that the nutrient concentration measured represents the amount available to the plants at that particular time. Appreciable productivity is possible with low nutrients if the turnover rate of "bound" to "free" nutrient is rapid.

Samples for the various nutrient analyses can be stored
in a common bottle or in separate bottles. These bottles
are usually plastic and not fully filled as they are generally
frozen until the samples can be analyzed. Samples left ex-
posed to light or heat will be altered by plankton growth
and/or degradation of organic matter. Ammonia and nitrite
(degradation products of nitrate) are usua:ly not detected

---Page Break---

in open ocean samples. Therefore, their presence would
{Indicate improper sample handling, The samples are analyzed
by standard colorimetric methods as described in Strickland
and Parsons, 1968, The data are reported a> microgram atoms
per liter (ig-at./1).

Temperature

Reversing Thermometers

Oceanographic temperatures are measured in a nunber
of ways. The most conmon and most accurate is with the use
OE the reversing thermometer. These thermometers are con-
Structed in such a fashion that after equilibration at a
desired depth, the mercury columa is interrupted when the

thermoneter is turned end-for-end, thereby ?fixing? the Temperature so that it can be read on deck. These thermo- meters can be read to 0.01°C. Tdeally, at least three re- Vorsing thermoneters are used on each Sampling bottle. Two have thei mercury reservoir bulbs protected against pressure by an outer jacket of mercury. The third is unprotected. The pressure, and therefore the depth, can be determined by the"diftetence in readings from the provected anc unpro- tected thermometers, In addition to the main thermometer Of each reversing thermometer, there is a small, or auxiliary, Ghermoneter used to measure the temperature of the thermometer On deck so that the glass expansion effect can be determined.

?These thermoneters must be handled with great caret They are never allowed to Te horizontal. , When preparing a bottie for sampling, the "bottle hanger" and the ?bottle tarrier" both check to see that the mercury has dropped Elouniy. If the thernoneter gives problons it may have to be tapped or removed fron the rack and reversed several tines with gentle tapping.

?The thermometers are usually allowed to equilibrate with the deck temperature (out of direct suniight) for 5 to 80 ninutes before being read. A magnifying lens is used to

ead the thermometer to make sure they are lined up on the horizontal. One person reads the thermometers and a second person records the data on the station log sheet. The practice YSifor the reader to call out the sanpling bottle nunber, followed by the left thermometer nunber, then the readings. For example, "Main (or Big T), twenty-one point four-six, Auxiliary (or little t), twenty-eight point seven.? The ?person recording data reads hack the data as he records then. | The process is then repeated for the middle and right thermometers, and on to the remaining bottles. The persons then change roles and go through the whole procedure again, This provides two

---Page Break---

complete and independent readings for each thermometer, The initials of those reading thermometers and the times that the readings were taken is also recorded on the station log sheet.

The temperature data are computer processed upon return to the laboratory, They are inspected for errors and combined with other hydrographic paraneters for the standard Calculations and initial data print-out and plotting. Temperature is expressed in degrees Celsius (*C). (Equations are in the Appendix.)

hy thermograph

The bathythermograph (BT) is also commonly used to record temperature. The BT is a torpedo-shaped mechanical device, sensitive to both temperature and depth. A pen scribes an X-Y plot of the two parameters on a gold-coated slide. The slide has the following information scratched on the upper left corner:

J. cruise and station numbers

2. station nane

3. date

4. time

5. depth

6: BT nunber

The BT can be lowered with a hydrocast or by itself. Tt was actually designed to be used while the ship is underway. BT slides are connonly read by placing them into a calibrated viewer and recording depth and temperature where breaks in

the profile occur. The points are then connected. The method We use at PRNC is?to project the slide onto a two-sided screen with a 35 mm slide projector. The temperature profile is then traced on a lined sheet of paper. The slide image is adjusted to fit the scale on the paper using reversing thermometer data for the surface and deep temperature corresponding to the BT. ?The paper scale has been checked previously by lowering the

BT to known depths with reversing thermometers.

Other Sampling

Many other types of sampling may occur in conjunction with a hydrographic cruise. ?The basic data aay be determined using other methods. Also STD records, salinity, temperature and depth in profile, and oxygens can be determined using a polarographic probe éither in situ or on samples brought to

the deck. Special chemistry may Inciude: pil, alkalinity, sulfide, trace metals, radionuclides, etc. fn addition, sediment samples nay be taken by core, grab or dredge. "PLankton or fish nets may be towed, or the vessel may support small

craft or be engaged in current measurements while hydrographic work is being carried on.

---Page Break---

Data Processing

?The chief scientist is responsible for assembling all data sheets and samples at the end of a cruise and for having then delivered to the proper people for the analyses.

The thernoneter readings are handled by a computer progran which corrects for calibration errors and deck temperature. The program "REVTHR" (Appendix) also computes averaged pro: tected thermometer values and the sampling depth where pro- toeted and unprotected readings are available.

When all of the values are available, the data are put on punch cards, following the form of? the oceanographic Station log, and processed by a program called "OCNSTN" (Appendix). This program provides punch cards to be run by another program NocNst2", to plot the depth profiles of the paraneters: temper- ature, salinity, sigma-t, oxygen and phosphate. The data

fron ne station can be Compared with the data from another Station better if they are converted to standard depths.

This is accomplished by a program, "AVOCN", (Appendix) which

also averages the duta.

The data are continually scanned for errors and incon-

sistencies. The print-outs are then ready for distribution

to participating Scientists and reports to funding agencies

as Shown in Table T

w

---Page Break---

APPENDIX

15

---Page Break---

STEPS FOR USE OF STATION L0G SHEET

wake carbon copy - Sample sheet, Table 15

14. Use penett

164, Woite neatty ~ nunbers ake exarptes: B12 3456789

fv. cruise and Station Mo. = From Bridge Log, e.g-+ "PA-GOL-O10 ~ Table 26

vy. Station - Nane or Nunber designated by Chief Scientist, estes MIB=A0"

+ Palunbo

vi, Vescel Mame, 0.8.) RVR

vEt. Local Date = Use Ronan numeral month, e.g. 5-¥-71

aster card

ten Instructions

country USA fe Nunber "32"

ship Palubo not yet Listed

tats

3 attitude From Bride tog sheet "a0 aIr3t

tong.

sos tengitude rom Bride Log Sheet "780 44.2) *

se-8 Maredon Squares

jell igen ai So

| $ |

izle aoe

tate 3 i

ea ls, fu .

MARSDEN SQUARES ue 30"

isk 12} oralarr,orejor9 20°

ee oan ir o+

lou : oe

\ col gies oslo end 0

a 03204] 3) 339} 10°

| t

s4cis42 laa feaopsa..338, 18,371] 20%

w rad radhadhnct dod aC 70 eT a ad 2d 1 PSS

10-4 bate ont om 19 gst

25.27 Tine GMT in hours and tenths of hr. e.g.) "14.6"

Tor Puerto Rico, ade hours to the messenger

tine of the firet cast and round off to nearest

tenth of an hour

---Page Break---

me

Station Nane

37 Depth in meters

38-38 Max. Sample Depth

Bank

wang Water color

Table 4

FOREL WATER COLOR SCALE

ues Transparency

6-47 Waves. Din.

Table §

?COMPASS DIRECTION CODE

?True Direction From Which Surface Wind

is Blowing or From Which Kave System

is Approaching, in 10°intervals,. (WHO-

Code 23),

Instructions

& spaces available for chief Scientists

Station designation. "JB-@14"

Sonic (or chart) Depth "#161"

Fathons to meters, Table 12

Meters to fathces, Table 13

Drop last tie digits on deepest sampling

depth. For 1880 m write "35"

Ese

Grease or eroh be),

HiSatten or Bae

| Vf

Gimeno

?Greendyiiow

Yeon

seezee:

Secchi disc depth (meters) "22"

Direction waves coming from,

el

1s: be ol gew,

fon

---Page Break---

space

48

49

50-51

52-59

57-62

63-08

8s

68

67

Item

wave height

?Table

?STATE OF

WIND wav

Wave period

Wind Dir.

Wind Speed

Table 7

Air temperature

Weather

cloud type

Cloud cover

Vieibinity

6

SEA

eS

Height

Deseription Meters

g

calm-glassy- °

Caln-rippies: o-1/10

Snooth-wavelets~ 3/10-1/2

- 1/201 1/8

21/62 1/2

21/24

46

69

rary

over 14

Number of seconds crest to crest.

Sane as for waves - use Table 5.

In weters per second

VELOCITY CONVERSION-KNOTS TO METERS PER SECOND

1

3 = wt

Ht Re

H at ite

|

Barceetric Pressure in miliibars using only

?tuo digits to the left of the decimal and

one to the ri 1021.6 becomes "21.6"

997.8 becones "97.4", Table 19

Wet and dry bulb in °C to one decimal place

(Relative humidity and temperature con-

version tables are in H.0. 607).

By code, Table #

By code, Table 9

By code, Table 10

By code, Table 11

---Page Break---

Space Iten Instructions

88-70 Relative humidity in # (Rain = 1008) From Bridge Log Sheet

or calculated fron wet/dry temperatures ,

76 cruise Number Fron ridge Log Sheet - Table 16

79 Station Number From Bridge Log Sheet - Table 26

% Bank

Chronological Record of Events

In the upper right commen of the Oceanographic Station Log (Table 15) is

space to record the number of pages required for the particular station and

Each cast is numbered sequentially with the times for each part of @ cast.

and the wire angle at the tine the massenger was dropped. The tine the cast

was down and the messenger times are eritical, All spaces should be filled

in here including the initials of the sefentific crew (observers)

Parameter Cand

Space ite Instruction

1 Cast Number Taken from the tined events recorded

in the upper right

as Local Messenger ?Taken fron the tined events reconded

Tee in the upper right

6-9 Last Applicable Deepest dopth sampled on this cast

Depta

10-12 Wire Angle In degrees

3245, Final Down Reading Deepest depth plus the distance from

the Hero's platform to the water

surfas

16-19 oxygen titer Concentration factor to determine

oxygen values (From titration

standardization - Table 17.)

Repeat of 1-19 for cast 2

Repeat of 20-38 for Cast 3

(the ocean station program ie

Limited to 3 casts per station.)

19

---Page Break---

Item

hak

88-69 veter theel Factor catibration of Heter Wheel

0-71 Tine Zone tones from the Greenwich Meridian.

a7 card No. of age No, of total pages for

the station:

ram Reference hunber crutse and statdon misters

0 tiank

pata cand

one cand is punched for each sample depth, however, two lines are used for

each depth to allow space for two readings of each thermoneter and extra samples.

pace Item Instructions

1 cast cast Nunber

Estimated Depth Arrange numbers in their respective

Colunns to avold confusion.

6-8 Meter Wheel Meter wheel reading is the deepest

Sampling depth minus the estinated

depth.

rot stip No. Avount @ bottle slips on the wire

during the cast, i.e., the down reading

minus the up reading of the meter wheel.

s213 Revers ing Bottle ?The number of the particular sample

No. bottle.

19 ?Thermoneter No. Serial mumber of the left deep sea

reversing thermonet

Big "T" ?The reading of the main thermoneter

to one hundredth of a degree C.

23-95 Little " ?The reading of the auxiliary thermoneter

?to one tench of a degree C.

26-97 Repeat of 1-25 for the middie thermometer.

---Page Break---

50-52

53-57

58-60

61-64

65-67

cen

m73

79

80

Item

Bridge

Titra

Phos.

Nitra

Reference No.

Control No.

2a

Instructions

Repeat of 26-37 for the right
?thermoneter (usually an unprotected
?thermoseter).

Salinity bottie number.

Salinity as determined by the
induction salinoneter to a thousandth
of a part per thousand.

Onygen bottle number.
(After the oxygen values have been
recorded, the spaces 52-60 can be
used to enter the thernonetric depths).

The anount of titer required to
titrate the oxygen eanples toa
hundredth of a milliiter.

(Nutrient bottle numbers are recordee

(on the right side on shipboard, later

(covered with the nutrient concentration

(values for key punching.

Cruise and station numbers

3 for continued data, 5 for and of

station and § for end of data.

---Page Break---

S3uvNDS = N3GSYVH

---Page Break---

PART II

OCEANOGRAPHIC CODES AND TABLES

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---Page Break---

?Table @ (continued)

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i Tov wien Wray fie

8 Ral bot fcxing eostinaoak

Bale teese signe

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---Page Break---

Panda

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Table Scroun Tire cove

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* Sates tr eteennton (?

re Paci Snags

GNTFICANT loud layer,

cLouD TYPES

Compiled hy the U.S. Werther Butea to aid inthe in

ation atl ending of loud observations.

Family ?A? High Clouds: Cirrus (C1), Clerocumulus (Ce). Mean tower level, 6,000 me

20,000 fet

Covet cms > honeteneenaetel 7

(Nore Further ithutotinns and seseriptions

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iewlar § Secon! Faltian. "Auneh of Choad

Forme and Cater for Sts of the Sy" The

ion ?may ?aeparotig

Imarine obververs at U.'S."Weathe? Hunted Peat

Ofices end Blarine vvvtees

Cove 1 CIRRUS» [~

t

HA: Filaments or strands of cirrus scattered

?tnd not increasing (often ?Mares? Tails

?

tne aca

- f comrres Cove 1

{12 Dense cites in patch ot tite heaven

+ wsually ?nat incressings pssbly. bat not

sla, he etna the woe pa ot

---Page Break---

?Table 9 (continued)

la © CIRRUS Covet

H9; Cirrus, often anvilshaped; either the

Temains of the upper portions of eumulo-

?imbue or part of & distant cumulonimbus,

the ree of which ia not viable

Sco notes on 1.3 for coding requirements

svhen cumulonimbus is present)

«creas Cove 1

Tt: Cirrus (often ook-shaped), gradual

Spresdng ox heap nad ols thicker.

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"pe ti tare

- 1 eudig ne he

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sins ftom ?which thoy wre advancing

4 where owing to the effect of perspeetive they

{My ane the appre of eorstats

?aida _???

Cones 1&2 CIRRUS &CIRROSTRATUS

oe

HS: Cirrus und cirzosteatus, often. in bands

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stone te gemaly sprenditg War

fhe sky aud wouallythickeninye ns. 8h

Dat tie continuous layer not reaching 432

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resent, the angular altitude

ig edge of the eirosteutus

Cooest &2 CIRRUS CIRROSTATUS =) peer wernamam wren ea

Ho; Cirrus and cirrostrats often in. bands

sen tte

lec aky and melting as

aunt the continnons layer exceeding

refers to the leading cge of the eirostratus

ftyer

---Page Break---

Table 9 (continued)

Cone 2 CIRROSTRATUS + f er eens

ng the entire sky.

During the day, when the sun issulcienty

hove ie Hiraon, the sheets never

titel enough to prevent shadows of objects

?on the ground

a

© cinnosr Ratu: Cove 2

Us: Cierostratus not incrensing and not cover

ing the whole sky; cirrus and rrocumuts

may bo present

TT cirocumulus is present, the ciroatratus

inch dominate totaly the requirements

ofGore 2. Ifthe estocumulve predominates,

the sky would be coded as Code

© crRKocUMULUS, Cove 3

9: Cirrocumulus alone or eirrocumulus with

Smee Gtenanan, Bath rr

presents (Carooumutin maybe pres t

Cade't to Code 2

Lo

Family ?BY Middle Clouds: Atvocumul

20,000 feet me

(Ac), Altostratus (As). Mean upper Level, 6,000 meters,

lower level, 2,000 meters, 6,500 feet,

- © ALrosrRares Cone 5

M1; Thin altostratus (semitransparent every=

sper) through whit the sun of moon cas bo

himly seen. A sheet of thin cloud resembles

{HEN cetsteats from sehich its often ee

sived without any break; but halo phenotn-

a, gam pil te ant sen a

vis, "and the sin ?cr ?moon app

w Hf Teel

: fot tas hind

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---Page Break---

Table 9 (continued)

ALTOSTRATUS OR NIMBOSTRATUS >

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portions o te slice the

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or Tach and moon ate enpletey widen 1

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EGAN mag Be nts in opnenraner. Thick

eRStemtos en he Yorn tr thick

sree atontatas. oF by tbe tasng together

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?Mamtrats as derseed ster by a change

from thick nlontratis the fang,

rates nf ihe cid sls in a sheet oF

Spa ali arcs ren

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in Whe form of continuoi Fai Ur Sto

Simbestatus usually has dank gray color

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Beara Wich aney or ne MoU rear the

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Cone 4 al

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Cove 4 ALTOCUMULL

Md: Thin. Gemitransparcnt)_altocumulus in

dio often almnids or Reehaped); cloud

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iat hana ve

se tines sl ee om

Somewhat discontiauous sheets

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pot ~ © ALTOCUMULUS Come 4

. Ms: ?Thin (semitranspareat) altocumulus in

Bande or ine layer gradually spreasing over

Reeskyand usdally thickening as « whole;

bec ary ope os Ube

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"M5 designates one or perhaps two ads

ing layer of eliocumalun, wally of i

?Bade the amount ad tek of which

---Page Break---

Table 9 (continued) ;

ALTOCUMULUS Cones

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Core 445

MT: Any ofthe following exes

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Table 9 (continued)

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Family ?D? Clouds With Vertical Development:

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CUMULUS 9 0 Seen

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?See 18 for 1s of eummalis of cone

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?sith bases at different levels)

30

---Page Break---

?Tabla 9 (continued)

boos © CUMULONIMBUS Cor 9

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Sgt te | see 4: Stratocurmutos formed by the sprog ont

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© STRATOCUMULLS Coon 6

1: Steatucumulie not formed by the spreading

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ingle level with sniitransparent part ot

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?Table 9 (continued)

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ERACTOSTRATUSOR FRACTOCEMULL'S

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cesta darks receive te ithe so

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(Gee Li for deerpton of rurtocunales

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SS & STRATOCUMULUS

18: Caml

those formed br the spreading out of eurnulas

with bases. at diferent levels. The heer

Cunmulus choids muy ne say not, estend up

through the upper stratocumolus layer

---Page Break---

© CUMULONIMBUS Covn 9

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AR GASES S885 S525

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---Page Break---

Table 13 DEPTH CONVERSION?METERS TO FATHOMS

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?Table 1WA -RAROMETRIC PUESSUIEE CONVERSION?INCHES TO MILLIBARS

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Table 148 BAROMETIUC PRESSURE CONVERSION?-MILLIMETERS TO MILLIBARS

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table 17.

Oceanographic Stat fon Log

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---Page Break---

COMPUTER PROGRAMS

---Page Break---

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THERMOMETES CORKEGTION PROGRAM (24/4/73 = UK) - 48

SPFCIFICAT {Oy INFORMATION a8

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Cat Ck EXISTENCE OF PROTECTED READINGS

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CORRECT PANTFCTEN READINGS AND OUTPUT

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TWTERPOLATE Foe wrk cORRECTINS AND ¥RITE

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Cae Gk EXISTENCE OF UNPROTECTED READINGS

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CHAPTER 3

TEMPERATURE AND DEPTH CALCULATIONS

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Fre formula to correct the tmprotected ther.

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?S-4 Correcting the PROTECTED Ther- rmometer The protected thermometer is cor- feted to give. the true temperature of the water by the following formula:

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tuts aren ped on every boil but ony

Masected det

?There ave two methods in general use for de-

termining thermonnetric depth Althouzh simic

fae, nge mivelves direct use of « formula, while

IE Ser int revoir rain Pane 08

the formulas Ech unprotected reversing thtr-

seeder hg evunique? graph called edepth

?Toomely (22) graph fom whieh the depth cor-

fection 1s read direedy

S10. ?Determining Thermometric Depth by

Fora. ?The thermometrie depth ray be de~

termined diteely by the following formula:

aolk

wheres

"Z=The thermometric depth in motes

ed rewing of the wipro

net.

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ALCL ON

?CALCULATION

WHERE: Pw 16.40"

3

K Delo

ners

?Fiowe 8-8. Two drvwings of reversing thersomoter Hie rule with protected an

?= The mean density of the water column

above the level of reversal. ?This

nay be obtained from graphs, tables,

or the computed ?denties of. the

?tation. ?Graphs of these values for

several areas are show's in figure 3-3

?and in table 17

Q=The pressure coeticient of the unpro-

tected thermometer, expressed i de-n

protected tpl calculations.

res Celsius cree inthe reading

Ber. kglem increase in premont

Balch Gans mecttae

Thermometer calforsion certeat

An eaniple of the cledation of thesms

atic depth shown a alos

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sheet (055) and determine the AZ (200

Bate ts value im the Correction column, Be

to indiate i the correc i 0 br added

{o the diference times 100 and entcr this

(Gilg) in the Thermometric Depth (2) eal

Fe A Se ene

12 Constructing a Depth Anomaly (a

Graph, 1 ? tin wad

rote thermometer will register an ineeease

SFOOIC? pormeter of drpairanaca water, th

108 times tr dere tn

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fe glns> ard other act

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{he unproteriedthermomn

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then solving

?above. for tepth 7)

?Thediference beuween the computed oF thee

metic depth und the ideal or assurned depth

depth asiomaly (82). For rvample. the

?Wales ed to constfuct the 82 gph showin in

?igure 3-4 are given below:

a) at

8

?The values of a7 are plottel atthe values of

Ue curve draw through the points

A akuld?be noted vats the sample these are

patie erry tat te Mnamerie dpi

han the assumed or heal dept and @

the corrections obtained from this graph must

be rat trom. 1007.) to ?obtain the

31a ACCEPTED DEPTH DETRRMINA-

TIONS. ?There are, two thethode. in general

se for dete, the seep dept

the best pomble determination of

Aepuh?ot Pach Nansen bottle at the time of

everal. ?Thege are the depth-aifereiee method

Grier lengthy minus theemometrse depth, 2)

find thes deptheraio. tthod"(Ueemometrie

depth, Z, divided by wire leyeth, 2). In the

Firat, reasonably arcurate picture of the trae

trire shepe during ?cust = reproduced graphic

Cally and in the arcond the ratio of the teetno-

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