Description of WHP-Exchange Format for CTD/Hydrographic Data

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Summary

Exchange formats for the CCHDO CTD and bottle data are described. The WHP-exchange formats provide simplified exchange and improved readability of hydrographic data. WHP-exchange data files carry the essential information from CTD and water sample profiles in rigorously-described comma-delimited (csv) ASCII formats designed to ease data exchange and simplify data import.

1. Overview of WHP-exchange file formats

The WHP-exchange bottle and CTD data formats include these features:

ASCII, spreadsheet-like
comma-delimited values (csv)
no special meaning to blank/empty spaces
station information in every line in the file (bottle) or in the top lines in each file (CTD)
only one missing data value defined for all parameters
missing data value format defined in the format for each parameter
WHP quality flag, when provided, associated directly with its parameter
positions in decimal degrees
dates in YYYYMMDD format.

There are three types of WHP-exchange format files, each with a unique **8-character** suffix:

data type	8-character suffix	description
CTD data	_ct1.csv	one CTD profile in WHP-exchange format
	_ct1.zip	zipped directory holding one or more _ct1.csv WHP-exchange CTD profiles
bottle data	_hy1.csv	data from one or more bottle profiles in WHP-exchange format

2. Format description for WHP-exchange bottle data (8-character suffix _hy1.csv)

[Note: To better understand this section please refer to one of the WHP-Exchange bottle data files available from the CCHDO. The file "a24_hy1.csv" from the CCHDO from <http://cchdo.ucsd.edu/data/onetime/atlantic/a24/a24_hy1.csv> is a good example. It is recommended that the reader examine "a24_hy1.csv" both in a text editor application - in order to see all characters - and also in a spreadsheet application - in order to view overall layout.]

The overall layout of a _hy1.csv bottle data file is described in Table 1.

The first line ("line" = "row") of a WHP-exchange format file is a single word which describes the file type, in this case "BOTTLE", followed by a comma and a date/time stamp.

The format next provides for 0-N optional information lines, each beginning with a "#" character, near the beginning of a _hy1.csv file. The CCHDO uses "#" lines to hold file history and data citation information referring to the data originators.

A description of the station information columns of a _hy1.csv file is in Table 2.

A description of the remaining data columns and preferred parameter names is in Table 3.

A line with "END_DATA" signals the end of the data lines.

After that line, a bottle data file may hold other file-specific documentation. The primary documentation for WHP data will, however, remain in the ".doc" file (or zipped directory).

General rules for WHP-exchange_hy1.csv data files:

Each line must end with a carriage return or end-of-line.

With the exception of (1) the file type line, (2) lines starting with a "#" character, or (2) including and following a line which reads "END_DATA", each line in a _hy1.csv file must have exactly the same number of commas as do all other lines in that file.

The number and names of the parameters in a _hy1.csv file is not specifically addressed, except that for WHP data certain parameters are noted as REQUIRED. For example, it is not necessary that a bottle data file contain columns for CFC measurements when there are no CFC data.

The order of the header and bottle data parameters in a _hy1.csv file is preferred to be similar to that shown in the example "a24_hy1.csv", especially for the first 13 columns, but is not strictly required. Although the _hy1.csv files should be as consistent as feasible in this regard, data users are urged to use "read" statements that are sensitive to parameter names rather than position of the parameter in the data files. Here is the order used in " a24_hy1.csv":

EXPOCODE, SECT_ID, STNNBR, CASTNO, SAMPNO, BTLNBR, BTLNBR_FLAG_W, DATE, TIME, LATITUDE, LONGITUDE, DEPTH, CTDPRS, CTDTMP, CTDSAL, CTDSAL_FLAG_W, SALNTY, SALNTY_FLAG_W, CTDOXY, CTDOXY_FLAG_W, OXYGEN, OXYGEN_FLAG_W, SILCAT, SILCAT_FLAG_W, NITRAT, NITRAT_FLAG_W, NITRIT, NITRIT_FLAG_W, PHSPHT, PHSPHT_FLAG_W, CFC-11, CFC-11_FLAG_W, CFC-12, CFC-12_FLAG_W, TRITUM, TRITUM_FLAG_W, HELIUM, HELIUM_FLAG_W, DELHE3, DELHE3_FLAG_W, TCARBN, TCARBN_FLAG_W, PCO2, PCO2_FLAG_W, ALKALI, ALKALI_FLAG_W, PH, PH_FLAG_W, PCO2TMP, CTDRAW, HELIER, DELHER, THETA, TRITER

All parameters defined as alphanumeric (e.g.,"A14") and integer (e.g., "I4") will be shown in the full defined width and will be right-justified, meaning that entries shorter than the defined width will be padded with meaningless spaces to the left of the first character (for example, EXPOCODEs are usually shorter than the defined maximum of 14 alphanumeric characters).

The bottle data parameter names should follow those listed in Table 3 when feasible. Data providers are urged to use caution, however, and list their actual parameter name rather than a WHP parameter name whenever there is any question on this matter.

Each data parameter listed in Table 3 - except for all flags, which are "I1" - will be listed in "F9.x" floating point format, where "x" indicates the number of decimal places. For each parameter, the CCHDO will pad with meaningless zeros data received with fewer decimal places and round data received with extra decimal places to the number of decimal places specified in Table 3.

When a quality flag is available for a parameter, that quality flag shall be placed in the column immediately to the right of the parameter. The name of a quality flag always begins with the name of the parameter with which it is associated, followed by an underscore character, followed by "FLAG", followed by an underscore, and then followed by an alphanumeric character indicating the flag type. (Also see **Appendix**, "Parameter Quality Codes".)

The "missing value" for a data value is always defined as -999, but written in the decimal place format of the parameter in question. For example, a missing salinity would be written -999.0000 or a missing phosphate -999.00. The value -999 was chosen because it is out of range for all WOCE-era parameters.

Table 1. General description of _hy1.csv file layout.

1st line	File type, here BOTTLE, followed by a comma and a DATE_TIME stamp YYYYMMDDdivINSwho YYYY 4 digit year MM 2 digit month DD 2 digit day div division of Institution INS Institution name who initials of responsible person example: 20000711CCHSIOSCD
#lines	A file may include 0-N optional lines, typically at the start of a data file, but after the file type line, each beginning with a "#" character and each ending with carriage return or end-of-line. Information relevant to file change/update history of the file itself may be included here, for example.
2nd line	Column headings. A list of column headings approved and used by the CCHDO is found in Table 2. A list of parameter headings approved and used by the CCHDO

	is found in Table 3. Data originators are urged, however, to be careful to supply their **correct** column headings rather than to simply copy 'approved' column headings into their files.
3rd line	Units. A list of parameter units used by the CCHDO is found in Tables 2 and 3. Data originators are urged, however, to be careful to supply their **correct** units rather than to simply copy the units used by the CCHDO.
data lines	As many data lines may be included in a single file as is convenient for the user, with the proviso that the number and order of parameters, parameter order, headings, units, and commas remain absolutely consistent throughout a single file. Thus a single data file may contain data lines for as little as one bottle from one cruise to as much as many bottles from many cruises.
note	Within a _hy1.csv file it is very strongly preferred that data from each station be contiguous, it is recommended that data from each cast at a station be contiguous, and it is preferred that the data from each cast be sorted from lowest pressure to highest pressure.
END_DATA	The line after the last data line must read END_DATA, and be followed by a carriage return or end of line.
other lines	Users may include any information they wish in 0-N optional lines at the end of a data file, after the END_DATA line.

Table 2. _hy1.csv header columns

Parameter	Format	Description notes
EXPOCODE	A14	The expedition code, assigned by the CCHDO or generated by the user. A single alphanumeric word, without spaces, commas, or "/" characters (but "_" underscore characters are OK) which is unique cruise identifier code. REQUIRED.

note		The convention the CCHDO uses to create the EXPOCODE is:
		`ExpoCode Syntax: NODCShipCodeYearMonthDay`
		`Example:`
		`Ship Name: Roger Revelle`
		`Cruise start date: March 29, 2009`
		`EXPOCODE: 33RR20090329`

SECT	A6	If a repeat of a WOCE section, this is the WHP section identifier. Optional.
STNNBR	A6	The originator's station number. This column is used for a single alphanumeric word, without spaces, commas, or "/" characters (but "_" underscore characters are OK) which is unique station identifier. Numeric-only STATION identifiers are preferred by many data users, but provision for alphanumeric identifiers is retained to maintain compatibility with WOCE records. REQUIRED.
CASTNO	I3	The originator's cast number. This column is used for a single integer cast number. Where cast number is unknown a default value of 1 is used or written in by the CCHDO. REQUIRED.
note		No "cast type" designator is used.
SAMPNO	A7	The sample number as described in this report, Section 5. It is very strongly recommended that at least one, preferably both, of the

		parameters SAMPNO and BTLNBR be reported for bottle data files. Where neither SAMPNO or BTLNBR are available, the CCHDO will add a SAMPNO column containing consecutive integers for each station/cast.
BTLNBR	A7	The bottle identification number as described in this report, Section 5. It is very strongly suggested that at least one, preferably both, of the parameters SAMPNO and BTLNBR be reported for bottle data files. It is preferred that one of these, preferably BTLNBR, include a quality flag in the column immediately to its right. This is the primary index to a water sample. [Pressure - or depth - is a measured parameter. The pressure value can change during processing, and so pressure (or sample depth) should never be used to index water sample data.]
BTLNBR_FLAG_W	I1	The parameter name of a data quality flag should be identical to the actual parameter name, followed by "FLAG" and then by a character indicating the type of quality flag, with underscores between each word. W = WHP quality flag; I = IGOSS quality flag; U = quality flag from user-defined table.
DATE	I8	Cast date in YYYYMMDD integer format. REQUIRED
TIME	I4	Cast time (UT) as HHMM. Optional. Must have all four digits. The CCHDO prefers only one TIME value per cast, usually the time the rosette was at its deepest depth (i.e. when the first bottle is closed). Users who wish to record the time each bottle closes are urged to add a second time-related column, BTL_TIME, where the closure time for each bottle can be recorded.
LATITUDE	F8.4	Latitude as SDD.dddd where "S" is sign (blank or missing is positive), DD are degrees, and dddd are decimal degrees. Sign is positive in northern hemisphere, negative in southern hemisphere. Spaces to left of leftmost digit are ignored. Data with positions not reliable to ten-thousandths of a degree should be padded with meaningless zeros. The "BO" or "bottom" position (ship position when cast is at deepest level) should be used if available, with "BE" (ship position at cast start) or "EN" (ship position at cast end) used in that priority order when "BO" position is not available. REQUIRED The CCHDO prefers only one LATITUDE per cast, usually the ship's position when the rosette was at its deepest depth (i.e. when the first bottle is closed). Users who wish to record the position each bottle closes are urged to add a second latitude-related column, BTL_LAT, where the position at time of closure for each bottle can be recorded.
LONGITUDE	F9.4	Longitude as SDDD.dddd where "S" is sign (blank or missing is positive), DDD are degrees, and dddd are decimal degrees. Sign is positive for "east" longitude, negative for "west" longitude. Spaces to left of leftmost digit are ignored. Data with positions not reliable to ten-thousandths of a degree should be padded with meaningless zeros.

		The "BO" or "bottom" position (ship position when cast is at deepest level) should be used if available, with "BE" (ship position at cast start) or "EN" (ship position at cast end) used in that priority order when "BO" position is not available. REQUIRED The CCHDO prefers only one LONGITUDE per cast, usually the ship's position when the rosette was at its deepest depth (i.e. when the first bottle is closed). Users who wish to record the position each bottle closes are urged to add a second longitude-related column, BTL_LONG, where the position at time of closure for each bottle can be recorded.
DEPTH	I5	Reported depth to bottom. Preferred units are "meters" and should be specified in Line 2. In general, corrected depths are preferred to uncorrected depths. Documentation accompanying data should include notes on methodology of correction. When no depth-to-bottom is supplied by the data originator for one or more rows of data in a _hy1.csv file which contains a "DEPTH" column, -999 may be written in by the CCHDO. Optional but strongly preferred.

Table 3. WHP-Exchange bottle file parameter names, units, and comments.

Parameter	Format	Suggested Units	Comments
CTDPRS	F9.1	decibars	corrected CTD pressure (in a _hy1.csv file the value accompanying closure of the rosette bottle); normally no data quality flag is needed when reported in the bottle file; sometimes reported as CTDP or PRES
CTDTMP	F9.4	degrees C (specify ITS-90 or IPTS-68 if known)	corrected CTD temperature (in a _hy1.csv file the value accompanying closure of the rosette bottle); normally no data quality flag is needed when reported in the bottle file; sometimes reported as CTDT or TEMP
CTDSAL	F9.4		corrected CTD salinity (in a _hy1.csv file the value accompanying closure of the rosette bottle); sometimes reported as CTDS
CTDSAL_ FLAG_a	I1	a = W for WHP quality flags; a = I for IGOSS quality flag; U = quality flag from user-defined table (table to be supplied in comment lines)	The parameter name of a data flag should be identical to the actual parameter name, followed by "FLAG" and then by a character indicating the type of quality flag, with underscores between each word. [A FLAG value can follow any data value, and should follow almost every data value. FLAG is shown here only for CTDSAL for simplicity. Typically a data file will have FLAG_W values following most parameters in this table except for CTDPRS and CTDTMP.]

SALNTY	F9.4		bottle salinity; sometimes reported as SALT
CTDOXY	F9.1	μmol/kg	corrected CTD oxygen (in a _hy1.csv file the value accompanying closure of the rosette bottle; may not be available in some _hy1.csv files); sometimes reported as CTDO or CTDO2
OXYGEN	F9.1	μmol/kg	bottle oxygen (must specify actual units, not simply copy the suggested units); sometimes reported as O2 or OXY
SILCAT	F9.2	μmol/kg	silicate (values in μmol/kg units are only 3% different than values in μmol/l units; so one must specify actual units reported, not simply copy the suggested units); sometimes reported as SIO3
NITRAT	F9.2	μmol/kg	nitrate (values in μmol/kg units are only 3% different than values in μmol/l units; so one must specify actual units reported, not simply copy the suggested units); sometimes reported as NO3
NO2+NO3 (shown only if separate NITRAT and NITRIT are not available)	F9.2	μmol/kg	nitrate plus nitrite (values in μmol/kg units are only 3% different than values in μmol/l units; so one must specify actual units reported, not simply copy the suggested units) [Most modern techniques for determining dissolved nitrate return a value of nitrate (NO3) plus nitrite (NO2). A separate determination is then done for nitrite and the result subtracted by the data originator to obtain nitrate. If no separate nitrite determination was carried out - or in rare cases the nitrite number was not subtracted - data providers should list the result as NO2+NO3. Because nitrite values are in most regions small compared to nitrate, most data users will not adversely affect their results by relabeling NO2+NO3 as NITRAT.]
NITRIT	F9.2	μmol/kg	nitrite (see NO2+NO3) (values in μmol/kg units are only 3% different than values in μmol/l units; so one must specify actual units reported, not simply copy the suggested units); sometimes reported as NO2
PHSPHT	F9.2	μmol/kg	phosphate (values in μmol/kg units are only 3% different than values in μmol/l units; so one must specify actual units reported, not simply copy the suggested units); sometimes reported as PO4
CFC-11	F9.3	μmol/kg	sometimes reported as CFC11 or F11 (must specify actual units, not simply copy the suggested units)
CFC-12	F9.3	pmol/kg	sometimes reported as CFC12 or F12 (must specify actual units, not simply copy the suggested

			units)
CFC113	F9.3	pmol/kg	sometimes reported as CFC113 or F113 (must specify actual units, not simply copy the suggested units)
CCL4	F9.3	pmol/kg	carbon tetrachloride
TRITUM	F9.3	TU	tritium (must specify actual units)
HELIUM	F9.4	nmol/kg	dissolved helium
DELHE3	F9.2	%	
DELC14	F9.1	0/00	
DELC13	F9.1	0/00	
O18O16	F9.2	per mille	$\delta^{18}O$; oxygen isotope ratio
ALKALI	F9.1	μmol/kg	total alkalinity AT (sometimes reported as ALK or TALK)
TCARBN	F9.1	μmol/kg	total carbon (sometimes reported at TIC or DIC)
PCO2	F9.1	μatm	partial pressure of CO2
PCO2_TMP		degrees C	PCO2 temperature, reported if PCO2 is reported
FCO2	F9.1	μatm	fugacity of CO2
FCO2_TMP		degrees C	FCO2 temperature, reported if FCO2 is reported
PH	F9.2		pH
PH_TMP		degrees C	PH temperature, reported if PH is reported
PH_SCALE	A3	"TS" or "SWS"	total scale (TS) or seawater scale (SWS), reported if PH is reported
DOC	F9.1	μmol/kg	dissolved organic carbon
DTN	F9.1	μmol/kg	dissolved total nitrogen

Table 3.b Other bottle parameters which have been submitted to the WHPO or CCHDO

Column Heading		Units		Reporting Precision	
Parameter	Mnemonic	Scientific	Mnemonic	Range	FORTRAN Format
39Argon	AR-39	% modern	PCTMOD	0,100	F9.1
Argon	ARGON	µmol/kg	UMOL/KG	5,25	F9.2
Abundance of bacteria	BACT	cells´108/kg	CELL/KG		
Barium	BARIUM				
Methane	CH4	nmol/kg	NMOL/KG	1,20	F9.2
Chlorophyll a	CHLORA	µg/kg	UG/KG	0,9	F9.2
Carbon monoxide	COMON	µmol/kg	UMOL/KG		
137Cesium	CS-137	dpm/100 kg	DM/.1MG	0,100	F9.2
Nitrogen (dissolved organic)	DON	µumol/kg	UMOL/KG	200,900	F9.1
Iodate	IODATE	nmol/kg	NMOL/KG	200,600	F9.3
Iodide	IODIDE	nmol/kg	NMOL/KG	0,300	F9.3
85Krypton	KR-85	dpm/1000 kg	DM/MG	0,5	F9.2
Nitrous oxide	N2O	nmol/kg	NMOL/KG	1,200	F9.2
Neon	NEON	nmol/kg	NMOL/KG	0,10	F9.3

Ammonium	NH4	µmol/kg	UMOL/KG		
Particulate organic carbon	POC	µg/kg	UG/KG		
Particulate organic nitrogen	PON	µg/kg	UG/KG		
Phaeophytin	PPHYTN	µg/kg	UG/KG	0,9	F9.2
226Radium	RA-226	dpm/100 kg	DM/.1MG	3,80	F9.2
228Radium	RA-228	dpm/100 kg	DM/.1MG	–1,10	F9.2
90Strontium	SR-90	dpm/100 kg	DM/.1MG	0,100	F9.2
Aluminum	ALUMIN				
Apparent Oxygen Utilization	AOU				
concentration of arabanose after hydrolysis	ARAB				
Calcium	CALCIUM				
Copper	CU				
Dissolved Combined Neutral Sugars	DCNS		(a20_2003)		
Dissolved Inorganic Nitrogen	DIN				
Biogenic sulfur compounds (DMS or DMSP)	DMS				
Fluorescence (total chlorophyll & phaeopigments)	FLUOR	mg/m3	MG/CUM	0,50	
concentration of fucose after hydrolyses	FUC				
concentration of galactose after hydrolysis	GAL				
concentration of glucose after hydrolysis	GLU				
Iodine 129	I-129				
concentration of Mannose after hydrolysis	MAN				
methyl chloroform	MCHFRM				
Nickel	NI				
pigmented picoeukaryotes	PEUK		(cell /L)		
Prochlorophytes	PRO				
concentration of	RHAM				

rhamnose after hydrolysis					
Sulfur Hexafluoride	SF6				
Synechococcus	SYN		(cell /L)		
Total Organic Carbon	TOC				
Transmissometer	XMISS	%light transmitted	%TRANS	0,100	

Also see <http://cchdo.ucsd.edu/parameter_descriptions> for a current list of CCHDO parameter names.

3. Format description for WHP-exchange CTD data (8-character suffix _ct1.csv for single CTD profiles and _ct1.zip for a zipped directory containing one or more _ct1.csv files)

[Note: To better understand this section please refer to document "example_ct1.csv" available from < http://cchdo.ucsd.edu/formats/exchange/example_ct1.csv >. It is recommended that the reader examine "example_ct1.csv" in a text editor application in order to see all characters and also in a spreadsheet application in order to view overall layout.]

The overall layout of a _ct1.csv CTD data file is described in Table 4.

The first line of a WHP-exchange format file is a single word which describes the file type, in this case "CTD", followed by a comma and a date/time stamp.

The format next provides for 0-N optional information lines, each beginning with a "#" character, near the beginning of a _ct1.csv file. The CCHDO intends to use the "#" lines to hold file history information.

Next is a line indicating the number of header lines (counting the present line and those following), usually 10 in WHP CTD data in WHP-exchange format.

Next are the remaining 9 lines (usually) of header information. These mostly match the description of the similar information in a _hy1.csv file.

Next are the remaining 9 lines (usually) of header information. These mostly match the description of the similar information in a _hy1.csv file.

A line with "END_DATA" signals the end of the data lines.

After that line, a CTD data file may hold other file-specific documentation. The primary documentation for WHP data will, however, remain in the ".doc" file (or zipped directory).

General rules for WHP-exchange _ct1.csv data files:

Each line must end with a carriage return or end-of-line.

With the exception of the file type line, lines starting with a "#" character, the 10 header lines, or including and following a line which reads "END_DATA", each line in a _ct1.csv file must have exactly the same number of commas as do all other lines in that file.

The order of the parameters in the header lines in a _ct1.csv file should follow the order listed (and in "example_ct1.csv") to make it simplest for users to import files. All _ct1.csv files prepared by the CCHDO will adhere to the header parameter line order shown in "example_ct1.csv". Still, CTD data users are urged to use "read" statements that are sensitive to parameter names rather than position of the parameter in the data files.

It is not necessary that a CTD data file contain a column for CTD oxygen probe measurements (CTDOXY) when there are no CTD oxygen probe data.

If other parameters are included in the CTD data stream, they, and their quality flags, can be included in the _ct1.csv data file, following the overall protocols.

When a quality flag is available for a CTD parameter, that quality flag shall be placed in the column immediately to the right of the parameter.

The name of a quality flag always begins with the name of the parameter with which it is associated, followed by an underscore character, followed by "FLAG", followed by an underscore, and then followed by an alphanumeric character indicating the flag type. (Also see **Appendix**, "Parameter Quality Codes".)

The "missing value" for a data value is always defined as -999, but written in the decimal place format of the parameter in question. For example, a missing salinity would be written -999.0000.

The value -999 was chosen because it is out of range for all WHP parameters.

Each data parameter listed in Table 5 - except for all flags, which are "I1" - will be listed in "F9.x" floating point format, where "x" indicates the number of decimal places. For each parameter, the CCHDO will pad with meaningless zeros data received with fewer decimal places and round data received with extra decimal places to the number of decimal places specified in Table 5.

Appendix. Parameter Quality Codes (Quality Flags)

Below we discuss "WOCE" quality codes (quality flags) for sample bottles, water samples, and CTD data. We end with a discussion of IGOSS quality flags, including translation of "WOCE" to "IGOSS" quality codes.

1. Sample bottle quality codes

The bottles on a rosette water sampler can leak, the control mechanism may fail to release the lanyard, or there can be other problems with the water bottles. It is therefore recommended that each sampling bottle on a cast be accompanied by a quality code as defined in Table D.1. (The CCHDO does not, however, *require* that data providers include bottle quality codes.)

TABLE D.1: "WOCE" quality code definitions for water bottles.

Flag Value	Definition
1	Bottle information unavailable.
2	No problems noted.
3	Leaking.
4	Did not trip correctly.
5	Not reported.
(6)	(Significant discrepancy in measured values between Gerard and Niskin bottles.)
(7)	(Unknown problem.)
(8)	(Pair did not trip correctly. Note that the Niskin bottle can trip at an unplanned depth while the Gerard trips correctly and vice versa.)
9	Samples not drawn from this bottle.

Use of code 1 is generally limited to cruises where bottle information is not available. ***BTLNBR*** is sometimes set equal –9 in older data sets. Present-day cruises should use code 5 if bottle information is not reported.

Flags 6, 7, and 8 apply primarily to large volume samplers, which are not currently in use.

Note: It is critical that questionable bottles (**especially leaking bottles**) be flagged at the earliest possible time.

2. Water sample (measured parameter) quality codes

Each water sample measurement should be accompanied by a data quality code. (The CCHDO does not, however, *require* that data providers include parameter quality codes.) Water sample quality code definitions are given in Table D.2.

TABLE D.2: "WOCE" quality code definitions for water sample measurements.

Flag Value	Definition
1	Sample for this measurement was drawn from water bottle but analysis not received. *Note that if water is drawn for any measurement from a water bottle, the quality code for that parameter should be set equal to 1 initially to help ensure that all water samples are accounted for.*
2	Acceptable measurement.
3	Questionable measurement.
4	Bad measurement.
5	Not reported.
6	Mean of replicate measurements (Number of replicates should be specified in the .DOC file and the replicate data tabulated there).
7	Manual chromatographic peak measurement.
8	Irregular digital chromatographic peak integration.
9	Sample not drawn for this measurement from this bottle.

The definitions in this table apply to quality codes in a bottle data file, but not to the CTD (***CTDSAL*** or ***CTDOXY***) parameters or the bottle number (***BTLNBR***) in that file. See the separate tables for the bottle quality code and CTD quality codes.

If water is drawn for any quality-coded measurement from a bottle, the CCHDO recommends that the data team at sea set the quality code for that parameter equal 1 initially, next to the otherwise empty data column, to ensure that all water samples are accounted for later when the data are received and merged. If the parameter is not sampled on a given station, cast, or level the quality code for that parameter is instead set to 9.

All measured values should be reported, including bad values, in data files which contain quality codes. In other words, questionable or bad values due to sampling, analytical or other problems are coded appropriately, but not removed from the data file. Whenever data were expected to be measured from a water sample drawn from a bottle (quality flag = 1), but the observation is missing due to sample loss, contamination, etc., the numerical "missing value" (e.g., -999) is placed in the measurement field in the data file and the respective quality code is reset to 5.

It is not possible to define what is meant by an “acceptable” measurement (quality code = 2) for all cruises or even all measurements from the same bottle. What may be a questionable, or even bad, measurement on a one cruise may be quite acceptable on another cruise. Water from the same bottle may be quite adequate for one parameter, for example, salinity, but badly contaminated for another, for example, CFCs. Also, investigators should be certain that their quality code assignments for their water samples are consistent with the quality code for the water bottle itself.

3. CTDO data quality codes

The CTDO quality codes are defined in Table D.3. Each measured CTDO parameter may have one quality code associated with it. CTDO data quality codes are optional but recommended.

A CTDO quality code of 1, *not calibrated*, applies to salinity and oxygen measurements only when water samples are collected from the present cast, or a nearby cast, but corrections have not yet been applied to the CTD data. For pressure and temperature, a quality code of 1 would indicate final CTD calibrations have not been applied.

TABLE D.3: "WOCE" Quality code definitions for CTD data.

Flag Value	Definition
1	Not calibrated.
2	Acceptable measurement.
3	Questionable measurement.
4	Bad measurement.
5	Not reported.
6	Interpolated over a pressure interval larger than 2 dbar.
7	Despiked.
(8)	(Not used for CTD data.)
9	Not sampled.

4. IGOSS Quality Codes

It may be advantageous for some users to translate the WOCE quality codes into the more widely recognized IGOSS quality codes. The table below list the translation recommended by the CCHDO.

The WMO IGOSS observation quality codes are:

0	No quality control yet assigned to this element
1	The element appears to be correct
2	The element is probably good
3	The element is probably bad
4	The element appears erroneous
5	The element has been changed
6 to 8	Reserved for future use
9	The element is missing

A perfect translation is probably not feasible, but we suggest the following WHP-to-IGOSS (not IGOSS-to-WHP) translation rules as reasonable:

	WOCE	IGOSS
bottle		
	1	0
	2	1
	3	3 (see note #1)
	4	4
	5	0
	6	4
	7	4
	8	4
	9	9
water sample		
	1	0
	2	1
	3	2 (see note #2)
	4	4
	5	0
	6	2
	7	2
	8	2
	9	9
ctd		
	1	0
	2	1
	3	2 (see note #2)
	4	4
	5	0
	6	2
	7	2
	9	9

Note #1: The CCHDO, in the interest of being conservative, has chosen to translate the WOCE bottle quality code 3 into IGOSS quality code 3. A leaking water sample bottle typically results in a discrepancy or error in gas samples, such as oxygen and CFCs, but less often results in data discrepancies for salinity and nutrients. It is suggested that data users who wish to import only "good" data not import any water sample data from bottles with a WOCE code 3 or IGOSS code 3. A data user who is willing to entertain slightly greater risk might choose to import non-gas sample data (e.g., salinity and nutrients) from a WOCE code 3 or IGOSS code 3 water sample bottle, and allow import of gas sample data (e.g. oxygens and CFCs) for bottles with IGOSS Code 2. (The CCHDO is not, however, currently assigning IGOSS code 2 to water sample bottles; but future data

	originators or data centers may wish to use code 2.)
Note #2:	The CCHDO has noted that in general, data originators tend to be conservative and so some WHP-code-3 ("questionable") water sample parameter data may be deemed WHP-code-2 ("good") by a data user. The IGOSS code 2 ("probably good") seems to be a reasonable interpretation. The CCHDO is not currently assigning IGOSS code 3 ("probably bad") to WHP water sample data values.

Table 4. General description of _ct1.csv file layout.

1st line	File type, here CTD, followed by a comma and a DATE_TIME stamp YYYYMMDDdivINSwho YYYY 4 digit year MM 2 digit month DD 2 digit day div division of Institution INS Institution name who initials of responsible person example: 20000711WHPSIOSCD ORIGINAL_DEPTH_HEADER=
#lines	A file may include 0-N optional lines at the start of a data file, each beginning with a "#" character and each ending with carriage return or end-of-line. Information relevant to file change/update history may be included here, for example.
2nd line	NUMBER_HEADERS = n (n = 10 in this table and the example_ct1.csv file.)
3rd line	EXPOCODE = [expocode] (see Table 2 for definition)
4th line	SECT = [section] (see Table 2 for definition)
5th line	STNNBR = [station] (see Table 2 for definition)
6th line	CASTNO = [cast] (see Table 2 for definition)
7th line	DATE = [date] (see Table 2 for definition)
8th line	TIME = [time] (see Table 2 for definition)
9th line	LATITUDE = [latitude] (see Table 2 for definition)
10th line	LONGITUDE = [longitude] (see Table 2 for definition)
11th line	DEPTH = [bottom] (see Table 2 for definition)
next lines	Parameter headings. A list of CTD parameter headings approved and used by the CCHDO is found in Table 5. Data originators are urged, however, to be careful to supply their **correct** column headings rather than to simply copy 'approved' column headings into their files.
next lines	Units. A list of parameter units used by the CCHDO is found in Table 5. Data originators are urged, however, to be careful to supply their **correct** units rather than to simply copy the units used by the WHP.
data lines	A single _ct1.csv CTD data file will normally contain data lines for one CTD cast. Generally these will be what is called a "2 decibar" file, i.e. there will be a 2-decibar interval between data lines, and each line will lay at either even or odd whole decibars. Other pressure intervals are accepted; for example, the CCHDO has many CTDO data reported at 1-decibar pressure intervals.
END_DATA	The line after the last data line must read END_DATA, and be followed by a carriage return or end of line.
other lines	Users may include any information they wish in 0-N optional lines at the end of a data file, after the END_DATA line.

Table 5. _ct1.csv common parameter names, units, and comments.

Parameter	Format	Suggested Units	Comments
CTDPRS	F9.1	decibars	corrected CTD pressure; sometimes reported as CTDP or PRES
PARAMETER_NAME_FLAG_a	I1	W = WHP quality flag. I = IGOSS quality flag. [U = quality flag from user-defined table]	The parameter name of a data flag should be identical to the actual parameter name, followed by "FLAG" and then by a character indicating the type of quality flag, with underscores between each word. [A FLAG value can follow any data value in this table. FLAG is shown here only for CTDPRS for simplicity. Typically a WHP data file will have FLAG_W values following every parameter in this table.]
CTDTMP	F9.4	degrees C (specify ITS-90 or IPTS-68 if known)	corrected CTD temperature; sometimes reported as CTDT or TEMP
CTDSAL	F9.4		corrected CTD salinity; sometimes reported as CTDS
CTDOXY	F9.1	μmol/kg	corrected CTD oxygen (must specify actual units, not simply copy the suggested units); sometimes reported as CTDO or CTDO2
Other parameters embedded in the CTD data stream, and their associated quality flags, may be included in the _ct1.csv data file following the general protocols listed here. Some examples:			
CTDNOBS	F9.0 (or I2 or I3)		number of CTD observations (scans) averaged for the CTD data reported at this pressure interval (no quality flag needed); sometimes reported as NUMOBS
TRANSM	F9.3	volts DC	transmissometer voltage; sometimes reported as XMISS or TRANS
FLUORM	F9.3	volts DC	fluorometer voltage; sometimes reported as FLUOR