Exchange Format Description

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Contents

CHAPTER 1

Introduction

This document will describe the WHP-Exchange formats used by the CCHDO for CTD and bottle. 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. WHP-exchange is a rigorously-described comma-delimited (csv) format designed to ease data exchange and simplify data import.

1.1 Overview

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

- UTF-8 Encoded
- 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
- Positions in decimal degrees
- Dates in ISO 8601 YYYYMMDD format

1.2 File Types and Names

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

Data Type	Filename Suffix	Description
CTD data	_ct1.csv	One CTD profile in WHP-exchange format
CTD data	_ct1.zip	Zip archive containing one or more _ct1.csv WHP-exchange CTD files
Bottle data	_hy1.csv	Data from one or more bottle profiles in WHP-exchange format

1.3 Requirement Levels

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in **RFC 2119**.

1.4 About Text Encodings and UTF-8

1.4.1 Text on Computers

As strange as it may seem, there is no such thing in computing as 'plain text'. Computers only understand binary, on or off, commonly represented by zeros and ones. For a series of zeros and ones to have meaning to humans, there needs to be an agreed upon standard for what any specific set of binary data represents. As an example, in 8-bit ASCII (ANSI X3.4-1986) the capital letter A is represented by the binary 01000001 (hex 41). 7-bit ASCII is limited to representing 127 characters, which is fine for most English speaking countries.

As the use of computers spread to non english speaking countries, it became nessessary to extend the encodings to support other characters needed. However, most systems still only supported 8-bit bytes, with a maximum of 255 different characters it could represent. With more charciters needing to be represented than space avaiable, a proliferation of incompatible encoding standards occured. There are at least 15 parts of ISO 8859, 6 JIS standards for Japanese, 3 for Chinese, 9 encodings specific to the Windows operating system, and 16 DOS code pages. Unicode was created to provide a unified way of representing all the chaircters which occur in most writing systems, including those of dead languages.

The unicode standard itself is not an encoding standard, but rather a list characters with a number assigned to each one, these numbers are what are called code points. For example, the capital letter A is the 65th letter in unicode, usually written in the hex 41. In the standard way of writing code points, this would be written as U+0041. You may notice that the unicode point for the calital letter A is the same as in ASCII, this feature was exploited to create the most common text encoding on the internet, UTF-8.

Character encodings were created to represent, in binary, all the code points allowed within unicode. One encoding in particular has become the dominant one for text on the internet [1], UTF-8. UTF-8 is a variable length encoding, meaning a character can take anywhere from 1 to 6 bytes to represent. In UTF-8 the first 127 characters of unicode are encoded with only byte. Since the first 127 code points in unicode are exactly the same as ASCII, the UTF-8 representation of any unicode character less than 128 is ASCII. This allows forward compatability of ASCII with UTF-8, and if containing only code points below 128, a UTF-8 file to be backwards compatable with ASCII.

1.4.2 Unicode Representation in this Document

Character in this document will be defined as unicode points in the format U+#### where the # symbols are hexidecimal numbers. Since exchange files are defined to be UTF-8 encoded, this unambigiously specifies the exact bits which must occur in a file.

[1] As of March 2015, 83.7% of the text on the internet is encoded with UTF-8.

CHAPTER 2

Common Format Features

Certain format specifications are shared between the bottle and CTD WHP-exchange files. Those common features are described in this section.

2.1 File Requirements

2.1.1 Encoding

WHP-exchange text files MUST be UTF-8 encoded.

Note: UTF-8 was chosen as the encoding for WHP-Exchange files because it is backwards compatable with ASCII. Valid ASCII files are also valid UTF-8 files. UTF-8 allows for the full range of unicode points to display non ASCII text.

Warning: Be careful if editing or creating files on Windows as the default text encoduing is UTF-16. UTF-16 is not compatable with UTF-8 or ASCII.

2.1.2 Byte Order Marks

The UTF-8 encoded files MUST NOT include a BYTE ORDER MARK (U+FEFF).

Note: Not including a byte order mark ensures backwards compatability with ASCII when the file contains only code points less than U+007F.

2.1.3 Line Endings

- Lines in an exchange text file SHOULD end with a LINE FEED (U+000A).
- Lines MAY also end with a CARRIAGE RETURN (U+000D) followed immediatly by a LINE FEED (U+00A).
- Lines MUST NOT use any other form of line ending.

2.2 File Identification Stamp

The first line of a WHP-exchange file MUST contain the file identifier and a creation stamp seperated by a COMMA (U+002C) `,`. The file itendifier will be either `BOTTLE` in the case of water samples or `CTD` in the case of a CTD profile. The creation stamp contains information on when the file was created and who created it.

A bottle file identifier will look like:

```
BOTTLE,20140716CCHSIOSCD
```

A CTD file identifier will look like:

```
CTD,20140716CCHSIOSCD
```

Note: If while attempting to read a WHP-exchange file and the first line does not start with `BOTTLE` or `CTD` an attempt to read the rest of the file will likely fail. When writing a WHP-exchange format reader, always check if this identification stamp is present and has a valid value.

The creation stamp contians the following information:

1. **20140716**CCHSIOSCD: A date stamp in the from of YYYYMMDD (ISO 8601)
2. 20140716**CCH**SIOSCD: The division (or group) of the instituion that wrote the file, typically three characters. The CCHDO uses CCH as the division.
3. 20140716CCH**SIO**SCD: The instituion that the group is associated with, typically three characters. The CCHDO is locaded at the Scripps Instituion of Oceanography, thus SIO is used.
4. 20140716CCHSIO**SCD**: The initials of the person who wrote the file, typically three characters. Use only code points U+0041 to U+005A and for the initials. In this example, SCD.

Warning: Do not rely on the creation stamp to be the same legnth in every WHP-exchange file. While all the same elemnts will be present, their lengths may vary.

2.3 Optional Comment Lines

After the *File Identification Stamp* any number of comment line, including none may appear. Comment lines start with a NUMBER SIGN (U+0023) `#`. Comment lines typically contain information about the file history and will often contain data citation information.

An example:

```
# This is one line of comments
# An additional line of comments
```

An example of the begining of a file, including the *File Identification Stamp*:

```
BOTTLE,20140716CCHSIOSCD
# This is a comment line
# BOTTLE,20130215CCHSIOSCD
```

Note: Notice that an older *File Identification Stamp* is in a comment line. This is a convention often used by the CCHDO to record when changes were made to files

---

Warning: Comments may contain UTF-8 encoded code points above U+007F, especially in proper names that may be present with data citation information. If writing your own WHP-exchange reader, ensure that it can handle code points above U+007F or have it skip comment lines without trying to read them.

2.4 Parameter and Unit Lines

Warning: There are additional headers specific to CTD WHP-exchange files. See the *Additional CTD Headers* section for details on these additional headers.

After any format specific headers, the parameter and unit lines are next. The parameter names are first, units are second.

Parameter names are COMMA (U+002C) `,` seperated values that define the columns the exchange file will contain. The names must be unique, capitalized, contain no empty fields, and not end with a trailing comma. The parameter names must contain only code points in the range U+0021 to U+007E except a COMMA (U+002C) `,`. A trailing comma, or a comma that occurs at the end of the line with nothing else after it, MUST NOT be included on the parameter line. Certain parameter names, or parameter combinations, are required to be present. See the respective sections on *Required Bottle Parameters* and *CTD required headers* for information specific to each format.

The unit line contains information for the units of each parameter listed in the parameter line. The unit line, like the parameters, are comma seperated values. Like the parameter names, units must contain only code points in the range U+0021 to U+007E except a COMMA (U+002C) `,`. A trailing comma MUST NOT be included in the unit line. Units may contain empty fields if the parameter has no units. Units for a paramter must be in the same column as that paramter, essentialy, the sname number of commas occur before the parameter name and its unit.

Warning: Parameter names and units MUST NOT contain commas as part of the name or unit. Commas are reserved for seperating the, names, units, and data into columns.

The parameter and unit lines of a CTD file might look like this:

```
CTDPRS,CTDPRS_FLAG_W,CTDTMP,CTDSAL,CTDOXY
DBAR,,ITS-90,PSS-78,UMOL/KG
```

Note the presence of quality flag column (suffixed with `_FLAG_W`) which has the corrisponding units of nothing denoted by two commas next to each other. For more information on quality flags, see the *Quality Codes* section. White space MUST have no meaning in the exchange format so it may be included for purly asthetic reasons. The parameter and units could very easially have looked like:

```
CTDPRS, CTDPRS_FLAG_W, CTDTMP, CTDSAL, CTDOXY
  DBAR,              , ITS-90, PSS-78, UMOL/KG
```

Note: Some technical details for formatting the whitespace.

While not strictly requiered, parameter, units, and data lines may contain whitespace matching the length of the print format of the paramter. This is a convention followed by the CCHDO to ease reading of files by humans. Quality flag columns usually have a 1 character width which will often cause the parameter/units and data to not be aligned into pretty columns.

2.5 Data Lines

The data lines occur directly after the unit line. Each line of data contains COMMA (U+002C) `,` seperated values of related data. Each data point of the data line may contain any combination of characters from U+0020 to U+007F except a COMMA (U+002C) `,`. Like the *Parameter and Unit Lines*, a trailing comma MUST NOT be included at the end of each line. Data points for each parameter of the *Parameter and Unit Lines* must be in the same column as that paratemer, i.e. the same number of commas occur before the parameter label and the datum.

Numeric data which occurs on the data lines MUST only contain numbers, spaces, an optional decimal marker, and an optional negative sign. All whitespace within data lines has no symantic meaning. Integers may be represented as bare numerals with no decimal marker. All real numeric data (i.e. data that are real numbers) MUST be decimal and MUST represent their decimal mark using a FULL STOP (U+002E) `.`. For both negative real numbers and integers, prepend a HYPHEN-MINUS (U+002D) − to the numeric portion, positive real numbers MUST NOT be prefixed by a PLUS SIGN (U+002B) +.

The validity of each datum is determined by the parameter column in which it occurs. For example, the *EXPOCODE* column may contain any combination of letter, numbers, or symbols (except a comma). A *CTDPRS* column may only contain real decimal numbers (U+0030 to U+0039) using a FULL STOP (U+002E) `.` as the decimal mark.

Note: Parameters may have a different precision depending on how the measurement was made. The CCHDO maintains a list of parameter names which includes precisions for historic reasons. Previous versions of the Exchange format specification stated the CCHDO would pad "meaningless" zeros to the end of any data without enough precision. Newer software allows the CCHDO to keep the precision as reported, both less and more precise. For these and other reasons, a mix of precisions may occur in a column of data.

Always report the precision as measured.

Warning: The exchange format currently has no support for quoted strings within the parameter, unit, and data lines. This means it is not possible for any meaningful whitespace to be included.

After all datalines, the end of the data is indicated by a line containing only `END_DATA`. Here is a short example of what exchange data might look like:

```
2.0,2,  19.1840,  34.6935,    220.8
4.0,2,  19.1992,  34.6924,    220.7
6.0,2,  19.2002,  34.6922,    220.5
8.0,2,  19.2022,  34.6920,    220.5
END_DATA
```

2.6 Post Data Content

After the `END_DATA` line, any additional content may be included without format restriction. Additional content after `END_DATA` MUST continue to be UTF-8 encoded.

2.7 Examples

Full examples of data in exchange format are presented in their speciifc sections:

- *Example Bottle Data*
- *Example CTD Data*

CHAPTER 3

Bottle Specific

Exchange Bottle files follow all the common format specifications for their strucutre. The *File Identification Stamp* of an exchange bottle file starts with `BOTTLE`. Each *data line* in an exchange bottle file represents a single bottle closure.

When ctd parameters are encountered within exchange bottle files (e.g. *CTDPRS*) they represent the corrected values being read by the CTD at the time of bottle closure, usually averaged over some interval.

In bottle files, specific parameters are REQUIRED to be present and have non fill values.

3.1 Required Bottle Parameters

The following parameters are REQUIRED to be present in exchange bottle files where the parameter name occurs witin the *Parameter and Unit Lines* and their values be present in the *Data Lines*.

- *EXPOCODE*
- *STNNBR*
- *CASTNO*
- *DATE*
- *LATITUDE*
- *LONGITUDE*
- *CTDPRS*

At least one or both of the following parameters MUST be present:

- *BTLNBR*
- *SAMPNO*

3.2 Unique Line Identification

Since each *data line* of an exchange bottle file represents a single bottle closure, enough information must be present on each line to uniquiely identify closure event. This is to allow the integration of all the measurements of samples taken from that bottle at a later time. The identification is done by requireing a combination of values from specific parameters to be unique throughout the file.

The following combination of parameters must have unique values:

- *EXPOCODE*

- *STNNBR*
- *CASTNO*
- *BTLNBR*

or

- *EXPOCODE*
- *STNNBR*
- *CASTNO*
- *SAMPNO*

3.2.1 Unique Line Identification Examples

In these examples, the long parameter, unit, and data lines truncated by `[...]`.

The following example exchange bottle data is all from the same cruise indicated by the expocode: `33RO20131223`, the same station: `1`, the same cast `2`, but the bottle number and sample numbers differ (`24` and `23`).

```
BOTTLE,20150327CCHSIORJL
# From submitted file a16s_2013_final_discrete_o2.csv:
# Merged parameters: OXYGEN_FLAG_W
EXPOCODE,STNNBR,CASTNO,SAMPNO,BTLNBR[...]
,,,,[...]
33RO20131223,       1,          2,          24,         24[...]
33RO20131223,       1,          2,          23,         23[...]
END_DATA
```

The following example shows an example of duplicated unique identification parameter values. More than one line contains the exact same values for *EXPOCODE*, *STNNBR*, *CASTNO*, *BTLNBR*, and *SAMPNO*.

```
BOTTLE,20150327CCHSIORJL
# From submitted file a16s_2013_final_discrete_o2.csv:
# Merged parameters: OXYGEN_FLAG_W
EXPOCODE,STNNBR,CASTNO,SAMPNO,BTLNBR[...]
,,,,[...]
33RO20131223,       1,          2,          24,         24[...]
33RO20131223,       1,          2,          24,         24[...]
END_DATA
```

3.3 Example Bottle Data

An example bottle exchange file is provided on the next page.

```
BOTTLE,20150327CCHSIORJL
# From submitted file a16s_2013_final_discrete_o2.csv:
# Merged parameters: OXYGEN_FLAG_W
#|
#|
#| Analysis                  Institution    Principal Investigator   email
#| ____________________________________________________________________________________
#| Chief Scientist           AOML           Rik Wanninkhof           rik.wanninkhof@noaa.gov
#| Co-Chief Scientist        AOML/CIMAS     Leticia Barbero          leticia.barbero@noaa.gov
#| CTDO                      NOAA/PMEL      Gregory Johnson          Gregory.C.Johnson@noaa.gov
#|                           NOAA/AOML      Molly Baringer           Molly.Baringer@noaa.gov
#| Salinity                  NOAA/AOML      Molly Baringer           Molly.Baringer@noaa.gov
#| UW & Discrete pCO2        NOAA/AOML      Rik Wanninkhof           Rik.Wanninkhof@noaa.gov
#| Total CO2 (DIC)           NOAA/PMEL      Richard Feely            Richard.A.Feely@noaa.gov
#|                           NOAA/AOML      Rik Wanninkhof           Rik.Wanninkhof@noaa.gov
#| Nutrients                 NOAA/AOML      Jia-Zhong Zhang          Jia-Zhong.Zhang@noaa.gov
#|                           NOAA/PMEL      Calvin Mordy             Calvin.W.Mordy@noaa.gov
#| Dissolved O2              NOAA/AOML      Molly Baringer           Molly.Baringer@noaa.gov
#|                           RSMAS          Chris Langdon            clangdon@rsmas.miami.edu
#| Total Alkalinity/pH       RSMAS          Frank Millero            fmillero@rsmas.miami.edu
#| CFCs/SF6                  NOAA/PMEL      John Bullister           John.L.Bullister@noaa.gov
#| 3He/Tritium               LDEO           Peter Schlosser          peters@ldeo.columbia.edu
#|                           WHOI           William Jenkins          wjenkins@whoi.edu
#| CDOM                      UCSB/MSI       Craig Carlson            carlson@lifesci.ucsb.edu
#| Chipod                    OSU            Jonathan Nash            nash@coas.oregonstate.edu
#| ADCP/Lowered ADCP         U Hawaii       Eric Firing              efiring@hawaii.edu
#| Trace Metals              FSU            William Landing          wlanding@fsu.edu
#|                           UH             Chris Measures           measures@hawaii.edu
#| 14C/DIC                   WHOI           Ann McNichols            amcnichol@whoi.edu
#|                           PU             Robert Key               key@princeton.edu
#| DOC                       RSMAS          Dennis Hansell           dhansell@rsmas.miami.edu
#| Data Management           SIO            James Swift              jswift@ucsd.edu
#|                           SIO            Susan Becker             sbecker@ucsd.edu
#|
#|  Following American Geophysical Union recommendations, the data should be
#|  cited as: "data provider(s), cruise name or cruise ID, data file name(s),
#|  CLIVAR and Carbon Hydrographic Data Office, La Jolla, CA, USA, and data
#|  file date." For further information, please contact one of the parties
#|  listed above or cchdo@ucsd.edu. Users are also requested to acknowledge
#|  the NSF/NOAA-funded U.S. Repeat Hydrography Program in publications resulting
#|  from their use.
#|
#
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
,,,,,,,,,,,METERS,DBAR,ITS-90,PSS-78,,PSS-78,,UMOL/KG,,UMOL/KG,
33RO20131223,       A16S,       1,          2,         24,        24,2,20131226,       0706,    -6.0016,   -24.9998,       5809,     3.9,  26.2239,  36.3097,2,  36.3082,2,     199.1,2,    201.2,2
33RO20131223,       A16S,       1,          2,         23,        23,2,20131226,       0704,    -6.0016,   -24.9998,       5809,    22.5,  26.2331,  36.3090,2,  36.3171,2,     199.4,2,    201.3,2
33RO20131223,       A16S,       1,          2,         22,        22,2,20131226,       0702,    -6.0016,   -24.9998,       5809,    47.4,  26.2335,  36.3078,2,  36.3080,2,       200,2,    201.9,2
33RO20131223,       A16S,       1,          2,         21,        21,2,20131226,       0700,    -6.0016,   -24.9998,       5809,    72.1,  26.2112,  36.3044,2,  36.3055,2,     200.6,2,      201,2
33RO20131223,       A16S,       1,          2,         20,        20,2,20131226,       0658,    -6.0016,   -24.9998,       5809,    97.5,  24.2160,  36.1165,2,  36.1258,2,     193.2,2,    190.1,2
33RO20131223,       A16S,       1,          2,         19,        19,2,20131226,       0656,    -6.0016,   -24.9998,       5809,   147.3,  15.5167,  35.6384,2,  35.6247,2,     104.9,2,    103.3,2
33RO20131223,       A16S,       1,          2,         18,        18,2,20131226,       0654,    -6.0016,   -24.9998,       5809,   222.8,  12.0808,  35.1686,2,  35.1586,2,     109.3,2,    108.6,2
33RO20131223,       A16S,       1,          2,         17,        17,2,20131226,       0651,    -6.0016,   -24.9998,       5809,   296.4,   9.8716,  34.8809,2,  34.8809,2,       124,2,      125,2
33RO20131223,       A16S,       1,          2,         16,        16,2,20131226,       0648,    -6.0016,   -24.9998,       5809,   406.5,   8.4675,  34.7567,2,  34.7520,2,      83.8,2,     81.4,2
33RO20131223,       A16S,       1,          2,         15,        15,2,20131226,       0645,    -6.0016,   -24.9998,       5809,   517.9,   7.1433,  34.6371,2,  34.6366,2,      93.8,2,     88.6,2
33RO20131223,       A16S,       1,          2,         14,        14,2,20131226,       0642,    -6.0016,   -24.9998,       5809,   647.7,   5.5545,  34.5066,2,  34.5046,2,     139.4,2,    130.5,2
33RO20131223,       A16S,       1,          2,         13,        13,2,20131226,       0638,    -6.0016,   -24.9998,       5809,   791.9,   4.6390,  34.4845,2,  34.4826,2,     158.6,2,    148.5,2
33RO20131223,       A16S,       1,          2,         12,        12,2,20131226,       0633,    -6.0016,   -24.9998,       5809,  1047.4,   4.2414,  34.6431,2,  34.6429,2,     163.9,2,    163.7,2
33RO20131223,       A16S,       1,          2,         11,        11,2,20131226,       0627,    -6.0016,   -24.9998,       5809,  1347.9,   4.3278,  34.8700,2,  34.8698,2,     197.4,2,    197.1,2
33RO20131223,       A16S,       1,          2,         10,        10,2,20131226,       0619,    -6.0016,   -24.9998,       5809,  1747.8,   3.8921,  34.9665,2,  34.9664,2,     238.6,2,    238.3,2
33RO20131223,       A16S,       1,          2,          9,         9,2,20131226,       0611,    -6.0016,   -24.9998,       5809,  2147.8,   3.2522,  34.9412,2,  34.9420,2,     242.7,2,    243.6,2
33RO20131223,       A16S,       1,          2,          8,         8,2,20131226,       0602,    -6.0016,   -24.9998,       5809,  2597.5,   2.8568,  34.9202,2,  34.9188,2,     242.6,2,    242.3,2
33RO20131223,       A16S,       1,          2,          7,         7,3,20131226,       0553,    -6.0016,   -24.9998,       5809,  3097.5,   2.6784,  34.9194,2,  34.9176,2,     251.1,2,    251.7,2
33RO20131223,       A16S,       1,          2,          6,         6,3,20131226,       0544,    -6.0016,   -24.9998,       5809,  3598.4,   2.4902,  34.9073,2,  34.9727,4,     255.1,2,    235.6,4
33RO20131223,       A16S,       1,          2,          5,         5,2,20131226,       0534,    -6.0016,   -24.9998,       5809,  4098.5,   1.8197,  34.8364,2,  34.8340,2,     242.3,2,    243.2,2
33RO20131223,       A16S,       1,          2,          4,         4,2,20131226,       0524,    -6.0016,   -24.9998,       5809,    4598,   0.9865,  34.7443,2,  34.7432,2,     225.6,2,    226.4,2
33RO20131223,       A16S,       1,          2,          3,         3,2,20131226,       0515,    -6.0016,   -24.9998,       5809,  5097.2,   0.7993,  34.7170,2,  34.7167,2,     220.1,2,    221.9,2
33RO20131223,       A16S,       1,          2,          2,         2,2,20131226,       0505,    -6.0016,   -24.9998,       5809,  5597.3,   0.7292,  34.7031,2,  34.7024,2,     219.8,2,    219.9,2
33RO20131223,       A16S,       1,          2,          1,         1,3,20131226,       0459,    -6.0016,   -24.9998,       5809,  5904.3,   0.7651,  34.7023,2,  34.7049,2,     219.9,2,    220.9,2
33RO20131223,       A16S,       2,          1,         24,        24,2,20131226,       1421,    -6.4977,   -24.9999,       5628,     3.1,  26.2387,  36.2430,2,  36.2424,2,     201.5,2,    202.1,2
33RO20131223,       A16S,       2,          1,         23,        23,2,20131226,       1419,    -6.4977,   -24.9999,       5628,    27.9,  26.1705,  36.2402,2,  36.2394,2,     202.2,2,    202.2,2
33RO20131223,       A16S,       2,          1,         22,        22,3,20131226,       1417,    -6.4977,   -24.9999,       5628,    67.9,  26.1326,  36.2369,2,  36.2353,2,     201.5,2,    202.3,2
33RO20131223,       A16S,       2,          1,         21,        21,2,20131226,       1415,    -6.4977,   -24.9999,       5628,   107.1,  22.8199,  36.1452,2,  36.1454,2,     168.2,2,    170.3,2
33RO20131223,       A16S,       2,          1,         20,        20,2,20131226,       1412,    -6.4977,   -24.9999,       5628,   172.4,  15.2580,  35.6092,2,  35.6393,4,       112,2,    112.6,2
33RO20131223,       A16S,       2,          1,         19,        19,2,20131226,       1410,    -6.4977,   -24.9999,       5628,   257.5,  10.8796,  35.0258,2,  35.0261,2,      92.4,2,     92.3,2
33RO20131223,       A16S,       2,          1,         18,        18,2,20131226,       1407,    -6.4977,   -24.9999,       5628,   367.8,   9.2106,  34.8337,2,  34.8338,2,      75.2,2,     75.6,2
END_DATA
```

The basic strucutre is:

- Line 1: *File Identification Stamp* starting with `BOTTLE`
- Line 2, 3: *Optional Comment Lines*
- Lines 3, 4: *Parameter and Unit Lines*
- Lines 6-11: *Data Lines*.

CHAPTER 4

CTD Specific

Exchange CTD files follow all the common format specifications with the addition of some header information. They MUST only contain one profile per file.

4.1 Additional CTD Headers

Rather than encode information which would remain constant throughout the cast with the *Data Lines*, Exchange CTD files store this information in headers that appear after the *Optional Comment Lines*, but before the *Parameter and Unit Lines*. These headers follow the basic form:

```
PARAM = VALUE
```

Where the `PARAM` is some parameter name (e.g. `DEPTH`) and the `VALUE` is the value for that parameter (e.g. `4523`). The `PARAM`, with the exception of *NUMBER_HEADERS*, must be listed in the *Parameters* section. The format of `VALUE` must conform to the data type listed for the parameter in the *Parameters* section. The `PARAM` and `VALUE` are seperated by a EQUALS SIGN (U+003D) =, there is no meaning to any whitespace. Each param-value pair ends end with a line-ending character. Here is an example of a complete set of CTD headers (note that we have included line numbers, these are not part of the header):

```
1  NUMBER_HEADERS = 10
2  EXPOCODE = 318M20130321
3  SECT_ID = P02W
4  STNNBR = 1
5  CASTNO = 2
6  DATE = 20130322
7  TIME = 2205
8  LATITUDE =  32.5068
9  LONGITUDE =  133.0297
10 DEPTH =   166
```

Notice three things: the special `NUMBER_HEADERS` parameter, the parameter names are all caps, and none of the parameters have units.

The units for each parameter are defined by convention rather than explicitly stated in each file, see the *CTD required headers* for information on which headers are required.

4.2 CTD required headers

The following CTD headers are REQUIRED, see the *Parameters* section for the description of each, except for the *NUMBER_HEADERS* which is described below:

- *NUMBER_HEADERS*
- *EXPOCODE*
- *STNNBR*
- *CASTNO*
- *DATE*
- *LATITUDE*
- *LONGITUDE*

Note: *TIME* is not a required parameter, this is not an omission from the list above.

Warning: There is no support for including units in the CTD headers it is not reccomended that any parameters which could have multiple units be included in the CTD headers.
Usually the optional *DEPTH* parameter is the only one with units commonly found in CTD headers, it MUST be in meters when included in the CTD headers.

4.2.1 NUMBER_HEADERS

The `NUMBER_HEADERS` parameter is an integer describing how many lines the headers will be before the parameter and unit lines. The value of `NUMBER_HEADERS` includes itself it is REQUIRED and MUST be the first line after any *Optional Comment Lines*.

Warning: The most common mistake with Exchange CTD Headers is not including the `NUMBER_HEADERS` line in the calculation of the number of lines the headers occupy. It would be incorrect in the above example to have `NUMBER_HEADERS = 9`.

4.3 CTD Optional Headers

The following CTD headers are optional, but encountered frequently within ctd exchange files:

- *SECT_ID*
- *TIME*
- *DEPTH*

4.4 Preferred Header Order

The only header which must come first is `NUMBER_HEADERS`. Other header parameters may come in any order, however, there is a preferred order. The preferred order after `NUMBER_HEADERS` is:

```
EXPOCODE
SECT_ID
STNNBR
CASTNO
DATE
TIME
LATITUDE
```

```
LONGITUDE
DEPTH
```

4.5 Example CTD Data

Here is an example of a complete exchange CTD file (though a very shallow profile):

```
CTD,20130709ODF
# REPORTED CAST DEPTH IS CTD_DEPTH + DISTANCE_ABOVE_BOTTOM AT MAX PRESSURE
NUMBER_HEADERS = 10
EXPOCODE = 318M20130321
SECT_ID = P02W
STNNBR = 1
CASTNO = 2
DATE = 20130322
TIME = 2205
LATITUDE =  32.5068
LONGITUDE =  133.0297
DEPTH =   166
CTDPRS,CTDPRS_FLAG_W,CTDTMP,CTDTMP_FLAG_W,CTDSAL,CTDSAL_FLAG_W,CTDOXY,CTDOXY_FLAG_W
DBAR,,ITS-90,,PSS-78,,UMOL/KG,
      2.0,2,  19.1840,2,  34.6935,2,    220.8,2
      4.0,2,  19.1992,2,  34.6924,2,    220.7,2
      6.0,2,  19.2002,2,  34.6922,2,    220.5,2
      8.0,2,  19.2022,2,  34.6919,2,    220.5,2
     10.0,2,  19.2033,2,  34.6918,2,    220.6,2
     12.0,2,  19.2039,2,  34.6919,2,    220.8,2
     14.0,2,  19.2033,2,  34.6919,2,    220.9,2
     16.0,2,  19.2029,2,  34.6916,2,    220.6,2
END_DATA
```

The structure is:

- Line 1: *File Identification Stamp*
- Line 2: *Optional Comment Lines*
- Lines 3-12: *Additional CTD Headers*
- Lines 13, 14: *Parameter and Unit Lines*
- Lines 15-23: *Data Lines*.

4.6 Structure of ZIP CTD Archives

Since exchange CTD files only contain one profile, it is convient to package them into entire an archive containing an entire cruise. The archve format exchange uses is zip, specifically PKZIP 2.0. The zip archive allows for a large varity of structure so it is nessessary to define the structure here.

Exchange CTD zip files MUST contain a flattened structure, that is, only files with no directory paths. The files within the zip SHOULD be in the same order in which the stations were done. Usually this means the filenames contain numerical information reguarding the station order. All the files within the zip MUST have the `_ct1.csv` file extention.

Here is an example a correct ctd exchange zip archive (the output of `unzip -l`):

```
Archive:  33RO20131223_ct1.zip
  Length      Date    Time    Name
 --------    ----    ----    ----
   401802  04-10-14 17:27   33RO20131223_00001_00002_ct1.csv
   388950  04-10-14 17:27   33RO20131223_00002_00001_ct1.csv
   385278  04-10-14 17:27   33RO20131223_00003_00002_ct1.csv
   400573  04-10-14 17:27   33RO20131223_00004_00001_ct1.csv
   395069  04-10-14 17:27   33RO20131223_00005_00002_ct1.csv
 --------                   -------
  1971672                   5 files
```

Notice the lack of directory paths in the archive names, it is simply filenames. The following is an example of an incorrectly packaged archive, which has archive names containing directory structure (notice the / in the names):

```
Archive:  33RO20131223_ct1.zip
  Length      Date    Time    Name
 --------    ----    ----    ----
   401802  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00001_00002_ct1.csv
   388950  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00002_00001_ct1.csv
   385278  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00003_00002_ct1.csv
   400573  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00004_00001_ct1.csv
   395069  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00005_00002_ct1.csv
 --------                   -------
  1971672                   5 files
```

Note: Currently, the bahavior when other files or directories are present is undefined. The reccomended bahavior when encountering directories or other (non _ct1.csv) files is to ignore the extra files while warning the user of their presence.

CHAPTER 5

Quality Codes

Most parameters may also have an associated column of numeric quality flags. Quality flag columns appear as a normal parameter in the *Parameter and Unit Lines*, they MUST NOT have any associated units. The quality flag parameter name are constructed and require parsing to determine which parameter they need to be associated with.

The basic formula for constructing a quality flag parameter name is:

```
<PARAMETER_NAME>_FLAG_W
```

where `<PARAMETER_NAME>` is the parameter for which the quality flags are for.

For example, the quality column for the parameter *CTDOXY* would be `CTDOXY_FLAG_W`.

The meaning of the flags is determined by the type of measurement it is. Bottles have *Bottle Quality Codes*, measurements from CTD based instruments use the *CTD Quality Codes*, and discrete measurements from bottle use the *Water Quality Codes*. The quality codes to use for any specific parameter is also *listed with each parameter* in the parameters section.

All quality flag codes are single digit integers.

The following descriptions of each quality code is taken from the WOCE manual.

5.1 WOCE Bottle Quality Codes

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.

5.2 WOCE Water Sample Quality Codes

1 Sample for this measurement was drawn from water bottle but analysis not received.

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.

Note: 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.

5.3 WOCE CTD Quality Codes

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.

CHAPTER 6

Parameters

6.1 About Paramters

The CCHDO works frequently with many parameters common in hydrography. Provided here is a description of many common parameters encountered in exchange files.

Warning: This list may not contain every parameter which may be encountered in an exchange file. CCHDO is working on providing a machine readable list of ALL parameters which may be encountered in all files. This list will include parameters which CCHDO lacks a descirption for (known unknown parameters). When this list becomes available, we intend to tie the generation of this parameter list with the machine readable list of parameters.
Until that time, parameters may appear in exchange formats from the CCHDO which are not documented here. No undocumented parameter or field will cause data integrity or usefulness issues (i.e. all undocumented parameters may be safely ignored).

6.1.1 Definitions

Provided with each parameter is a set of information in a table, the information included in that table should be interpreted as follows:

- **Units:** These are the common units encountered for this parameter as it will appear in the exchange document itself. The special units of "None" means the field will be either blank or contain only whitespace.
- **Data Type:** Specifies the allowed type of data in the data records for this parameter. There are three types of data, string (str), integers (int), and decimal. String data types may be any printing character except a comma `,` which is the field seperator. Integer data types may only contain numbers without a decimal point, quality flags are usually integers. Decimal data types may be any real number (including an integer) and may include decimal point, the precision is not specified.
- **Quality Flags:** Specifies which set of quality flag definitions should be used to interpret a quality flag column for this parameter (if present). Current quality flags are: *bottle*, *water*, *ctd*. See the *Quality Codes* section for more information

6.2 Parameters with Unknown Units

Sometimes data may have units which are not known. For this reason, any parameter, including ones not yet listed in the table bellow, MAY have the unit of `ARBITRARY` in the unit line.

Warning: Parameters with `ARBITRARY` units are NOT compareable with other `ARBITRARY` parameters, including those with the same parameter name.

6.3 Common Parameters

This section was generated automatically from a `machine readable list of parameters`.

- *EXPOCODE*
- *SECT_ID*
- *STNNBR*
- *CASTNO*
- *SAMPNO*
- *BIONBR*
- *BTLNBR*
- *DATE*
- *TIME*
- *LATITUDE*
- *LONGITUDE*
- *DEPTH (METERS)*
- *CTDPRS (DBAR)*
- *CTDTMP (ITS-90)*
- *CTDSAL (PSS-78)*
- *SALNTY (PSS-78)*
- *CTDOXY (UMOL/KG)*
- *OXYGEN (UMOL/KG)*
- *SILCAT (UMOL/KG)*
- *NH4 (UMOL/KG)*
- *NITRAT (UMOL/KG)*
- *NITRIT (UMOL/KG)*
- *PHSPHT (UMOL/KG)*
- *CFC-11 (PMOL/KG)*
- *CFC-12 (PMOL/KG)*
- *CFC113 (PMOL/KG)*
- *SF6 (FMOL/KG)*
- *TCARBN (UMOL/KG)*
- *ALKALI (UMOL/KG)*
- *FCO2 (UATM)*
- *FCO2TMP (DEG C)*
- *PCO2 (UATM)*
- *PCO2TMP (DEG C)*
- *PH_TOT*
- *PH_SWS*
- *PH_TMP (DEG C)*
- *DOC (UMOL/KG)*
- *TRITUM (TU)*
- *TRITER (TU)*
- *HELIUM (NMOL/KG)*
- *DELHE3 (PERCNT)*
- *REFTMP (DEG C)*
- *REVPRS (DBAR)*
- *REVTMP (ITS-90)*
- *DELC13 (/MILLE)*

- *C13ERR (/MILLE)*
- *DELC14 (/MILLE)*
- *C14ERR (/MILLE)*
- *DON (UMOL/KG)*
- *TOC*
- *POC (UG/KG)*
- *PON (UG/KG)*
- *TDN (UMOL/KG)*
- *TON*
- *NEON (NMOL/KG)*
- *NEONER (NMOL/KG)*
- *DELO18 (/MILLE)*
- *CCL4 (PMOL/KG)*
- *CCL4ER*
- *NI*
- *ALUMIN (NMOL/L)*
- *BARIUM (NMOL/KG)*
- *CU*
- *FE (NMOL/L)*
- *MN (NMOL/L)*
- *FLUOR (MG/M^3)*
- *PAR*
- *I-129*
- *RA-226 (DM/.1MG)*
- *RA-228 (DM/.1MG)*
- *XMISS (%TRANS)*
- *AR-39 (PCTMOD)*
- *CS-137 (DM/.1MG)*
- *KR-85 (DM/MG)*
- *SR-90 (DM/.1MG)*
- *N2O (NMOL/KG)*
- *RA-8/6 (DM/.1MG)*
- *RA-8/6E (DM/.1MG)*
- *QUALT2*
- *QUALT1*
- *CTDRAW (DBAR)*
- *I129ER*
- *MCHFRM (PMOL/KG)*
- *IODATE (NMOL/KG)*
- *IODIDE (NMOL/KG)*
- *CHLORA (UG/KG)*
- *PPHYTN (UG/KG)*
- *CH3CL (PMOL/KG)*
- *CH4 (NMOL/KG)*
- *DMS*
- *AZOTE*
- *CALCIUM*
- *ARGON (UMOL/KG)*
- *14C-DOC (/MILLE)*
- *D15N_NO3*
- *TOT_CHL_A (MG/M^3)*
- *TOT_CHL_B (MG/M^3)*
- *TOT_CHL_C (MG/M^3)*
- *ALPHA-BETA-CAR (MG/M^3)*

- *BUT-FUCO (MG/M^3)*
- *HEX-FUCO (MG/M^3)*
- *ALLO (MG/M^3)*
- *DIADINO (MG/M^3)*
- *DIATO (MG/M^3)*
- *HFUCO (MG/M^3)*
- *PERID (MG/M^3)*
- *ZEA (MG/M^3)*
- *MV_CHL_A (MG/M^3)*
- *DV_CHL_A (MG/M^3)*
- *CHLIDE_A (MG/M^3)*
- *MV_CHL_B (MG/M^3)*
- *DV_CHL_B (MG/M^3)*
- *CHL_C1C2 (MG/M^3)*
- *CHL_C3 (MG/M^3)*
- *LUT (MG/M^3)*
- *NEO (MG/M^3)*
- *VIOLA (MG/M^3)*
- *PHYTIN_A (MG/M^3)*
- *PHIDE_A (MG/M^3)*
- *PRAS (MG/M^3)*
- *GYRO (MG/M^3)*
- *BTL_DATE*
- *BTL_TIME*
- *BTL_LAT*
- *CTDNOBS*
- *CTDETIME (SECONDS)*
- *BTL_LON*

6.3.1 EXPOCODE

Units	None
Data Type	string

The expedition code, assigned by the CCHDO or generated by the user. Used as the unique identifier for the cruise. Usual generation formula is ICES 4 character platform code then the cruise depature date in YYYYMMDD format. The underscore _ character may also be present.

Warning: `EXPOCODE` does not have woce quality codes. `EXPOCODE_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

6.3.2 SECT_ID

Units	None
Data Type	string

If a repeat of a WOCE section, this is the WHP section identifier. Examples include: `A12`, `A13.5`, `P02`.

Warning: `SECT_ID` does not have woce quality codes. `SECT_ID_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

Note: There may be inconsisntency in the how line numbers are represented. For example, `P02` might be present as

P2, these represent the same SECT_ID. Two digit zero padded line numbers are the canonical representation, please inform the CCHDO if non zero padded line numbers are encountered.

6.3.3 STNNBR

Units	None
Data Type	string

The originator's station identifier. Allowed characters are U+0041 to U+005A, U+0061 to U+007A, and U+005F (a-z, A-Z, and _)

Warning: STNNBR does not have woce quality codes. STNNBR_FLAG_W should not appear in data file *Parameter and Unit Lines*.

Note: Numeric-only station identifiers are preferred by many data users, but provision for non numeric station identifiers is retained to maintain compatibility with WOCE records.

6.3.4 CASTNO

Units	None
Data Type	integer

The originator's cast number.

Warning: CASTNO does not have woce quality codes. CASTNO_FLAG_W should not appear in data file *Parameter and Unit Lines*.

Note: Where cast number is unknown a default value of 1 MAY be inserted by data processors.

6.3.5 SAMPNO

Units	None
Data Type	string

The sample number. Often it is the rosette position, however, groups may use their own sampling identification scheme. Allowed characters are U+0041 to U+005A, U+0061 to U+007A, and U+005F (a-z, A-Z, and _)

Warning: SAMPNO does not have woce quality codes. SAMPNO_FLAG_W should not appear in data file *Parameter and Unit Lines*.

Warning: The value may not be numeric, ensure that any software reading the file can handle UTF-8 data of the specified allowed code points.

6.3.6 BIONBR

Units	None
Data Type	string

Warning: BIONBR does not have woce quality codes. BIONBR_FLAG_W should not appear in data file *Parameter and Unit Lines*.

6.3.7 BTLNBR

Units	None
Data Type	string
BTLNBR_FLAG_W Definitions	*WOCE Bottle Quality Codes*

The bottle identification number. This is intended to be a permanent, unique serial number fixed to the sampling device. It may also be the an identifier fixed for the duration of a single expedition. Allowed characters are U+0041 to U+005A, U+0061 to U+007A, and U+005F (a-z, A-Z, and _)

Note: The bottle number MAY have quality flags.

Warning: The value may not be numeric, ensure that any software reading the file can handle UTF-8 data of the specified allowed code points.

6.3.8 DATE

Units	None
Data Type	string

The UTC date in zero padded YYYYMMDD format. The date reported is usually cast bottom for Bottle files and cast start for CTD files. Valid range for YYYY: 0001-9999. Valid range for MM: 01-12. Valid range for DD: 01-31 (depends on month and year). The format of dates corresponds to the C-strftime format of %Y%m%d.

The date should be read as a string, but be able to be cast unambiguously to an integer. To convert from integer representation, left pad zeros to match the date format description. For example, the integer 8020202 is the date 08020202 or Feb 2nd, 802. This is a very unlikely situation.

Warning: DATE does not have woce quality codes. DATE_FLAG_W should not appear in data file *Parameter and Unit Lines*.

6.3.9 TIME

Units	None
Data Type	string

The UTC time in zero padded hhmm format. A single time should be reported for each cast, usually the time at cast bottom (deepest) is used. The order of preference for the reported time is: cast bottom, cast start, cast end (i.e if cast bottom is not available, the cast start time should be used).

Valid range for hh: 00-24 Valid range for mm: 00-59 The format of times corresponds to the C-strftime format of %H%M.

The time should be read as a string, but be able to be cast unambiguously into an integer. To convert from an integer, left pad zeros to match the time format description.

Warning: `TIME` does not have woce quality codes. `TIME_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

Note: Times represented as integers will be present in netcdf files. Times in netcdf files will be anywhere from 1 to 4 digits. E.g. a time of 6 as in integer represents 6 minutes after midnight or 0006

Midnight is a special case in that it has two valid representations: `0000` and `2400`. The date `20140202` at time `0000` is the same instant as the date `20140201` at time `2400`. This corresponds to times allowed by ISO 8601.

Use *BTL_TIME* to report the time of individual bottle closures.

Warning: Time is not a required parameter! If time is not present, then the temporal resolution of the data is reduced to a 24 hour period. It is the responsibility of the user of the data to omit files/casts which do not meet their temporal resolution requirements.

6.3.10 LATITUDE

Units	None
Data Type	decimal

The latitude as a signed decimal number. By convention, is positive in the northern hemisphere and negative in the southern hemisphere. Positive values do not include a + character (U+002B), negative values are prefixed with a − character (U+002D).

Warning: `LATITUDE` does not have woce quality codes. `LATITUDE_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

Note: Only one latitude SHOULD be reported for a cast, typically this is the ship possition when the cast is at the bottom (deepest), but this is not guaranteed.

Use *BTL_LAT* to include positions of individual bottle closures.

Warning: Since this parameter has no units, the positive in the northern hemisphere and negative in the southern hemisphere MUST be strcitly adhered to.
The geographic coordinate system is not currently reported.

6.3.11 LONGITUDE

Units	None
Data Type	string

The longitude as a signed decimal number. By convention, is positive in the eastern hemisphere and negative in the western hemisphere. Positive values do not include a + character (U+002B), negative values are prefixed with a − character (U+002D).

Warning: `LONGITUDE` does not have woce quality codes. `LONGITUDE_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

Note: Only one longitude SHOULD be reported for a cast, typically this is the ship possition when the cast is at the bottom (deepest), but this is not guaranteed.

Use *BTL_LON* to include positions of individual bottle closures.

The longitudes of -180 and 180 describe the same meridian.

Warning: Since this parameter has no units, the positive in the eastern hemisphere and negative in the western hemisphere convention MUST be strcitly adhered to.
The geographic coordinate system is not currently reported.

6.3.12 DEPTH

Units	METERS
Data Type	decimal

The reported depth to the bottom. Corrected depths are preferred to uncorrected depths.

Warning: `DEPTH` does not have woce quality codes. `DEPTH_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

Note: Documentation should be provided describing how the depth was calculated/corrected, typically in the comment fields.

Warning: This is NOT the depth of bottle closures.

6.3.13 CTDPRS

Units	DBAR
Data Type	decimal
CTDPRS_FLAG_W Definitions	*WOCE CTD Quality Codes*

The corrected pressure as measured by the CTD.

Note: Typically does not have quality flags.

6.3.14 CTDTMP

Units	ITS-90
Data Type	decimal
CTDTMP_FLAG_W Definitions	*WOCE CTD Quality Codes*
Alternate Units	IPTS-68

The corrected temperature as measured by the CTD.

Note: Typically does not have quality flags.

6.3.15 CTDSAL

Units	PSS-78
Data Type	decimal
CTDSAL_FLAG_W Definitions	*WOCE CTD Quality Codes*

The corrected salinity as measured (calculated) by the CTD.

6.3.16 SALNTY

Units	PSS-78
Data Type	decimal
SALNTY_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

The salinity measured from a bottle sample.

6.3.17 CTDOXY

Units	UMOL/KG
Data Type	decimal
CTDOXY_FLAG_W Definitions	*WOCE CTD Quality Codes*
Alternate Units	ML/L

The corrected oxygen measured by the CTD.

6.3.18 OXYGEN

Units	UMOL/KG
Data Type	decimal
OXYGEN_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.19 SILCAT

Units	UMOL/KG
Data Type	decimal
SILCAT_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.20 NH4

Units	UMOL/KG
Data Type	decimal
NH4_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.21 NITRAT

Units	UMOL/KG
Data Type	decimal
NITRAT_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.22 NITRIT

Units	UMOL/KG
Data Type	decimal
NITRIT_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.23 PHSPHT

Units	UMOL/KG
Data Type	decimal
PHSPHT_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.24 CFC-11

Units	PMOL/KG
Data Type	decimal
CFC-11_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.25 CFC-12

Units	PMOL/KG
Data Type	decimal
CFC-12_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.26 CFC113

Units	PMOL/KG
Data Type	decimal
CFC113_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.27 SF6

Units	FMOL/KG
Data Type	decimal
SF6_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.28 TCARBN

Units	UMOL/KG
Data Type	decimal
TCARBN_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.29 ALKALI

Units	UMOL/KG
Data Type	decimal
ALKALI_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.30 FCO2

Units	UATM
Data Type	decimal
FCO2_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.31 FCO2TMP

Units	DEG C
Data Type	decimal
FCO2TMP_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.32 PCO2

Units	UATM
Data Type	decimal
PCO2_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.33 PCO2TMP

Units	DEG C
Data Type	decimal
PCO2TMP_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.34 PH_TOT

Units	None
Data Type	decimal
PH_TOT_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.35 PH_SWS

Units	None
Data Type	decimal
PH_SWS_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.36 PH_TMP

Units	DEG C
Data Type	decimal
PH_TMP_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.37 DOC

Units	UMOL/KG
Data Type	decimal
DOC_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.38 TRITUM

Units	TU
Data Type	decimal
TRITUM_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.39 TRITER

Units	TU
Data Type	decimal
TRITER_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.40 HELIUM

Units	NMOL/KG
Data Type	decimal
HELIUM_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.41 DELHE3

Units	PERCNT
Data Type	decimal
DELHE3_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.42 REFTMP

Units	DEG C
Data Type	decimal
REFTMP_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.43 REVPRS

Units	DBAR
Data Type	decimal
REVPRS_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.44 REVTMP

Units	ITS-90
Data Type	decimal
REVTMP_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.45 DELC13

Units	/MILLE
Data Type	decimal
DELC13_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.46 C13ERR

Units	/MILLE
Data Type	decimal
C13ERR_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.47 DELC14

Units	/MILLE
Data Type	decimal
DELC14_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.48 C14ERR

Units	/MILLE
Data Type	decimal
C14ERR_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.49 DON

Units	UMOL/KG
Data Type	decimal
DON_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.50 TOC

Units	None
Data Type	string
TOC_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.51 POC

Units	UG/KG
Data Type	decimal
POC_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.52 PON

Units	UG/KG
Data Type	decimal
PON_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.53 TDN

Units	UMOL/KG
Data Type	decimal
TDN_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.54 TON

Units	None
Data Type	string
TON_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.55 NEON

Units	NMOL/KG
Data Type	decimal
NEON_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.56 NEONER

Units	NMOL/KG
Data Type	decimal
NEONER_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.57 DELO18

Units	/MILLE
Data Type	decimal
DELO18_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.58 CCL4

Units	PMOL/KG
Data Type	decimal
CCL4_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.59 CCL4ER

Units	None
Data Type	string
CCL4ER_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.60 NI

Units	None
Data Type	string
NI_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.61 ALUMIN

Units	NMOL/L
Data Type	decimal
ALUMIN_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.62 BARIUM

Units	NMOL/KG
Data Type	decimal
BARIUM_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.63 CU

Units	None
Data Type	string
CU_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.64 FE

Units	NMOL/L
Data Type	decimal
FE_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.65 MN

Units	NMOL/L
Data Type	decimal
MN_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.66 FLUOR

Units	MG/M^3
Data Type	decimal
FLUOR_FLAG_W Definitions	*WOCE Water Sample Quality Codes*
Alternate Units	0-5VDC

6.3.67 PAR

Units	None
Data Type	decimal
PAR_FLAG_W Definitions	*WOCE CTD Quality Codes*

PAR/Irradiance, Biospherical/Licor

Note: From SBE .cnv files, no units

6.3.68 I-129

Units	None
Data Type	string
I-129_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.69 RA-226

Units	DM/.1MG
Data Type	decimal
RA-226_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.70 RA-228

Units	DM/.1MG
Data Type	decimal
RA-228_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.71 XMISS

Units	%TRANS
Data Type	decimal
XMISS_FLAG_W Definitions	*WOCE CTD Quality Codes*
Alternate Units	0-5VDC

6.3.72 AR-39

Units	PCTMOD
Data Type	decimal
AR-39_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.73 CS-137

Units	DM/.1MG
Data Type	decimal
CS-137_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.74 KR-85

Units	DM/MG
Data Type	decimal
KR-85_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.75 SR-90

Units	DM/.1MG
Data Type	decimal
SR-90_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.76 N2O

Units	NMOL/KG
Data Type	string
N2O_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.77 RA-8/6

Units	DM/.1MG
Data Type	string
RA-8/6_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.78 RA-8/6E

Units	DM/.1MG
Data Type	string
RA-8/6E_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.79 QUALT2

Units	None
Data Type	string
QUALT2_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.80 QUALT1

Units	None
Data Type	string
QUALT1_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.81 CTDRAW

Units	DBAR
Data Type	decimal
CTDRAW_FLAG_W Definitions	*WOCE CTD Quality Codes*

6.3.82 I129ER

Units	None
Data Type	string
I129ER_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.83 MCHFRM

Units	PMOL/KG
Data Type	decimal
MCHFRM_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.84 IODATE

Units	NMOL/KG
Data Type	string
IODATE_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.85 IODIDE

Units	NMOL/KG
Data Type	string
IODIDE_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.86 CHLORA

Units	UG/KG
Data Type	decimal
CHLORA_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.87 PPHYTN

Units	UG/KG
Data Type	decimal
PPHYTN_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.88 CH3CL

Units	PMOL/KG
Data Type	decimal
CH3CL_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.89 CH4

Units	NMOL/KG
Data Type	string
CH4_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.90 DMS

Units	None
Data Type	string
DMS_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.91 AZOTE

Units	None
Data Type	string
AZOTE_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.92 CALCIUM

Units	None
Data Type	string
CALCIUM_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.93 ARGON

Units	UMOL/KG
Data Type	decimal
ARGON_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.94 14C-DOC

Units	/MILLE
Data Type	decimal
14C-DOC_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.95 D15N_NO3

Units	None
Data Type	decimal
D15N_NO3_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.96 TOT_CHL_A

Units	MG/M^3
Data Type	decimal
TOT_CHL_A_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

Total chlorophyll a measured using HPLC

SeaBass Description:HPLC DV_Chl_a + MV_Chl_a + Chlide_a + Chl_a_allom + Chl_a_prime

Note: A different measurement than *CHLORA*

6.3.97 TOT_CHL_B

Units	MG/M^3
Data Type	decimal
TOT_CHL_B_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC DV_Chl_b + MV_Chl_b

6.3.98 TOT_CHL_C

Units	MG/M^3
Data Type	decimal
TOT_CHL_C_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC chl_c1 + chl_c2 (chl_c1c2) + chl_c3

6.3.99 ALPHA-BETA-CAR

Units	MG/M^3
Data Type	decimal
ALPHA-BETA-CAR_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Alpha (Beta,epsilon) + Beta (Beta,beta) Carotenes

6.3.100 BUT-FUCO

Units	MG/M^3
Data Type	decimal
BUT-FUCO_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC 19'-Butanoyloxyfucoxanthin

6.3.101 HEX-FUCO

Units	MG/M^3
Data Type	decimal
HEX-FUCO_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC 19'-Hexanoyloxyfucoxanthin

6.3.102 ALLO

Units	MG/M^3
Data Type	decimal
ALLO_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Alloxanthin

6.3.103 DIADINO

Units	MG/M^3
Data Type	decimal
DIADINO_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Diadinoxanthin

6.3.104 DIATO

Units	MG/M^3
Data Type	decimal
DIATO_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Diatoxanthin

6.3.105 HFUCO

Units	MG/M^3
Data Type	decimal
HFUCO_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Fucoxanthin

6.3.106 PERID

Units	MG/M^3
Data Type	decimal
PERID_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Peridinin

6.3.107 ZEA

Units	MG/M^3
Data Type	decimal
ZEA_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Zeaxanthin

6.3.108 MV_CHL_A

Units	MG/M^3
Data Type	decimal
MV_CHL_A_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Monovinyl Chlorophyll a

6.3.109 DV_CHL_A

Units	MG/M^3
Data Type	decimal
DV_CHL_A_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Divinyl Chlorophyll a

6.3.110 CHLIDE_A

Units	MG/M^3
Data Type	decimal
CHLIDE_A_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Chlorophyllide a

6.3.111 MV_CHL_B

Units	MG/M^3
Data Type	decimal
MV_CHL_B_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Monovinyl Chlorophyll b

6.3.112 DV_CHL_B

Units	MG/M^3
Data Type	decimal
DV_CHL_B_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Divinyl Chlorophyll B

6.3.113 CHL_C1C2

Units	MG/M^3
Data Type	decimal
CHL_C1C2_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Chlorophyll c1 + c2

6.3.114 CHL_C3

Units	MG/M^3
Data Type	decimal
CHL_C3_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Chlorophyll c3

6.3.115 LUT

Units	MG/M^3
Data Type	decimal
LUT_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Lutein

6.3.116 NEO

Units	MG/M^3
Data Type	decimal
NEO_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Neoxanthin

6.3.117 VIOLA

Units	MG/M^3
Data Type	decimal
VIOLA_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Violaxanthin

6.3.118 PHYTIN_A

Units	MG/M^3
Data Type	decimal
PHYTIN_A_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Pheophytin a

6.3.119 PHIDE_A

Units	MG/M^3
Data Type	decimal
PHIDE_A_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Pheophorbide a

6.3.120 PRAS

Units	MG/M^3
Data Type	decimal
PRAS_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Prasinoxanthin

6.3.121 GYRO

Units	MG/M^3
Data Type	decimal
GYRO_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

HPLC Gyroxanthin-Diester

6.3.122 BTL_DATE

Units	None
Data Type	decimal
BTL_DATE_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.123 BTL_TIME

Units	None
Data Type	decimal
BTL_TIME_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

6.3.124 BTL_LAT

Units	None
Data Type	decimal

Warning: `BTL_LAT` does not have woce quality codes. `BTL_LAT_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

6.3.125 CTDNOBS

Units	None
Data Type	integer

The number of discrete observations from which the values of another data variable have been derived

Warning: `CTDNOBS` does not have woce quality codes. `CTDNOBS_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

6.3.126 CTDETIME

Units	SECONDS
Data Type	decimal

The elapsed time of CTD pressure bin

Warning: `CTDETIME` does not have woce quality codes. `CTDETIME_FLAG_W` should not appear in data file *Parameter and Unit Lines*.

6.3.127 BTL_LON

Units	None
Data Type	decimal
BTL_LON_FLAG_W Definitions	*WOCE Water Sample Quality Codes*

CHAPTER 7

Changelog

7.1 2016-01-06 (1.1)

- Add an `ARBITRARY` unit that any parameter MAY use.

7.2 2015-11-16 (1.0.1)

- Added Parameters
  - XMISS [0-5VDC]
  - FLUOR [0-5VDC]
  - CTDNOBS
  - CTDETIME [SECONDS]

7.3 2015-10-29

- Organized the text encoding requirements better.
- Added note about requirement levels following RFC 2119.

7.4 2015-04-27

- Define the structure of a `_ctl.zip` archive.

7.5 2015-01-21

- Paramters no longer will have a print format, now will just have a data type

7.6 2014-08-18

- Less restrictive parameter names and units.
- Specify how numerical data should appear.
- CCHDO now keeps numerical precsion of data found in files

7.7 2014-07-24

- Require parameter names in an exchange file to be unique.

7.8 2014-07-16

- Changed stated file encoding to UTF-8 rather than ASCII. Some of the WHP-exchange bottle files have non-ASCII in the citations.

R