Appendix D.   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.