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GTSPP REAL-TIME QUALITY CONTROL MANUAL

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GTSPP REAL-TIME QUALITY CONTROL MANUAL

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1.0 INTRODUCTION

This Manual has been produced within the context of the Global Temperature-Salinity Pilot Project (GTSPP). Because the work- of assuring the quality of data handled by the Project is shared amongst data centres, it is important to have both consistent and well documented procedures. This Manual describes the means by which data quality is assessed and the actions taken as a result of the procedures.

The GTSPP handles all temperature and salinity profile data. This includes observations collected using water samplers, continuous profiling instruments such as CTDs, thermistor chain data and observations acquired using thermosalinographs. These data will reach data processing centres of the Project through the real-time channels of the IGOSS program or in delayed mode through the IODE system.

The procedures described here are intended to cover only the above-mentioned data types and specifically for data sent through the IGOSS system. However, there are obvious generalizations that can be made to other data types. Because of this, it is expected that this Manual will serve as a base on which to build more extensive procedures for the aforementioned data types and to broaden to other types, as well. Indeed, in sonic cases, tests of data types that are not strictly part of this Project are incorporated into this Manual simply because they are of obvious use and because these data types are often associated with the data of interest to the GTSPP

Updates to this Manual are carried out as new procedures are recommended to the (GTSPP). and as these are accepted by the project Steering Group. Readers are encouraged to make suggestions on both how to improve existing tests, and of new tests that should be considered. In both cases, it is important to explain how the suggestion improves or expands upon the existing suite of tests. Suggestions may be forwarded to any participants of the GTSPP and these will be directed to the Steering Group. As tests are suggested but before incorporation, they will be documented in a section of the Manual. This will provide a means to accumulate suggestions, to disseminate them and solicit comments.

This Manual describes procedures that make extensive use of flags to indicate data quality. To make full use of this effort, participants of the (GTSPP). have agreed that data access based on quality flags will be available. That is, (GTSPP). participants will permit the selection of data from their archives based on quality flags as well as other criteria. These flags are always included with any data transfers that take place. Because the flags are always included, and because of the policy regarding changes to data, as described later, a user can expect the participants to disseminate data at any stage of processing. Furthermore, (GTSPP). participants have agreed to retain copies of the data as originally received and to make these available to the user if requested.

The implementation of the tests in this Manual requires interactive software to be written. The operator is consulted in the setting of flags or possibly in changing data values. In each case, information is provided to the operator to help them decide what action to take. In the descriptions of the tests, certain specific items of information and data displays are included. So, for example, when a station position fails a test of platform speed, a track chart of the platform is used The amount of information displayed and the presentation technique is dependent upon the hardware and software capabilities at the implementation site. For this reason, the information to be displayed, and the method of presentation should be treated as recommendations

2.0 QUALITY FLAGGING

The purpose of this Manual is to set standards for quality control of real-time data and to describe exactly the screening process that is employed. By reading this document, users may assess the applicability of the procedures to their requirements and thereby judge whether they need do further work before using the data.

Attached to every profile is a number indicating the version of the Quality Control Manual which describes the tests employed. As the procedures documented by this Manual are expanded to include others or to refine the older tests, a new version flag will be assigned. It is recognized that the suite of tests performed will undergo modifications with time. For this reason it is necessary to record which version of quality control

procedures have been applied to the data. This version number is associated with updates to this Manual. The version applied is to be to each profile as it is processed and to be carried thereafter with the data. This document constitutes version 1.0.

Also attached to every profile is a number that indicates which tests have been employed. This number is constructed as follows. Each test of the Quality Control Manual is assigned an index number to base 2. The number that describes the suite of tests employed against a profile is the sum of the index numbers of the tests used. The index number is given with every test documented in this Manual. This number is then written in base 16. So the digits 0 through 9 represent numbers from 0 through 9, A=10 through to F=15. As an example, if there are 10 tests, and all are employed, the Test Number is then 3FF

If a participating Data Center applies tests other than those described in this Manual, it should supply documentation with the data to explain the other tests. The use of other tests is indicated by a version number for the Manual that has a digit in the hundredths place. So, for example, a Version of 1.02 indicates that a Data Center has used the tests described in version 1.0 of the QC Manual but have also applied other tests (indicated by the digit 2) of their own. Each Data Centre may assign this last digit in a fashion suitable to their own operations.

The second type of flag is used to indicate the quality of the data. It is considered unproductive to attach a flag describing the result of each test performed to every observation since this may result in numerous flags that generally would not be used. Instead, it is deemed necessary to be able to assign flags to individual or groups of data values to indicate the confidence in the value. Participants of the GTSPP have agreed that the following rules shall apply.

1. Both independent and dependent variables can have a flag assignment.

2. Data aggregations (in the case here these are entire profiles) can also be assigned a flag. So the word element used later implies aggregations as well.

3. The flags indicating data quality are those currently used in IGOSS processing with one extension.

    0 = No quality control has been assigned to this element
    1 = The element appears to be correct
    2 = The element appears to be inconsistent with other elements
    3 = The element appears doubtful
    4 = The element appears erroneous
    5 = The element has been changed
    6 to 8 = Reserved for future use
    9 = The element is missing

The general philosophy for flag assignment adopted by this Manual is that it is generally inadvisable to change data. Changes should only be instrumentation knowledge if available. It is expected that subsequent made when it is clear what the change should be and that if a change versions of the Manual will improve on this. were not made the data would be unusable.

The test descriptions allow for inferring values for those that have failed the test procedures. The inference of a correct value is done at the discretion of the person doing the quality control. It should be based on information which is not available to the test procedure but which the operator has at hand and assists in knowing what the correct value should be. Values should be changed only when there is certainty what is the correct value. In the instance where data values are changed, the original value is also preserved and is available to users or to other tests if needed.

Finally, because quality assessment is shared over processing centres, it is possible that data flagged as doubtful by one centre will be considered acceptable by another or vice versa. Flags can be changed by any processing centre as long as a record is kept of what the changes are.

The use of the flagging scheme described here will meet the stated requirements of the (GTSPP). It is recognized that as new testing procedures are developed, it will be necessary to re-examine data. With version

flags preserved with the data, it will be possible to identify what has been done, and therefore how best to approach the task of passing data through newer quality control procedures.

3.0 INSTRUMENTATION KNOWLEDGE

It is recognized that knowledge of the instrumentation used to make an observation can be useful in the assessment of the quality of the data. Likewise, knowledge of the platform from which the data were collected can also be used. Where available, this instrumentation knowledge should be sent with the data to the GTSPP participants. The present version of this Manual suggests tests that make use of instrumentation knowledge if available. It is expected that subsequent versions of the Manual will improve on this.

4.0 TEST MONITORING

All processing centers should monitor the performance of their quality control tests. In this way, deficiencies can be identified and recommendations made to improve procedures. These recommend a tions should be sent to the Steering Group designated to maintain this Manual. They will be discussed and included as appropriate in subsequent versions of the Manual.

5.0 PRE AND POST PROCESSING

The quality control tests described in the appendix assume a basic scrutiny has been applied to the data. Explicitly, the data have passed a format checking procedure which ensures that alphanumerics occur where expected and no illegal characters are present. It does not assume that values of variables have been checked to see if the are physically possible.

None of the tests described here automatically assigns a quality flag without the approval of the person doing the quality assessment. When a value or element fails a test, a recommendation of the flag to be assigned is made. The person doing the quality assessment then must decide the appropriate flag to use from a list of recommendations. The tests do restrict the flags that may be assigned in that a user is not permitted to assign any flag to a value or element failing a test.

There is a need to find and remove data duplications. A check for duplicate reports is necessary to eliminate statistical biases which would arise in products incorporating the same data more than once. In searching, the distinction between exact and inexact duplicates should be kept in mind. An exact duplicate is a report in which all the physical variable groups (including space-time coordinates) are identical to those of a previous report of the same type from the same platform. An inexact duplicate will have at least one difference.

Annex A contains the algorithm proposed by the Marine Environmental Data Service for the identification of duplicates. It discusses the implementation of the technique for data received in both real-time and delayed mode. In the context of this Manual, only the discussions of the handling of realtime data is relevant. The algorithm is based on near coincidences of position, and time. This means that tests 1.1 to 1.4 and test 2.1 of this Manual must be applied before duplications are sought. The basic criteria for a possible duplication is based on the experience of the TOGA Subsurface Data Centre. So, if stations are collected within 15 minutes or 5 km of each other, they may be duplicates. The identification of the stations of potential duplicates are then examined as well as the data to resolve whether or not a duplication exists. Then, other tests of the quality control are run on the output of the duplicates test. In this way, as little as possible is done before duplications are tested for.

There also be a need for assessment of the data- quality. This would involve subjecting the data to a different set of tests by applying knowledge of the characteristics of the processes from which observations have been collected. It may also be that more data may be gathered together so that more sophisticated statistical tests can be applied-. As such tests become generally accepted and an established application procedure developed,

they could be incorporated into the context of this Manual and become part of the regular screening process conducted by participants of this project.

6.0 QUALITY CONTROL TESTS

The complete set of tests is included in Annex B. Each description has a number of sections that are always present. A description of the information that each contains follows:

Test Name: This is the short name of the test. Each test is numbered for case of reference.

Prerequisites: This describes what tests are assumed to have applied before and what preparation of the data set is suggested before application of the test. If will also describe what information files are required.

Description: This section describes how the test is implemented and what actions are taken based on the results of the test.

History: This records any changes that have taken place in the test procedure and the date on which they were recorded. This section will record the evolution of a test procedure through the various versions of the Manual.

Rules: This section lists the rules that are applied to effect the various tests. Their numbering is for reference value only since they have been written so that they may be implemented in any order.

The tests have been grouped according to stages. The first stage is concerned with determining that the position, the time, and the identification of a profile are sensible. The second stage is concerned with resolving impossible values for variables. The next stage examines the consistency of the incoming data with respect to references such as climatologies. The next section looks at the internal consistency within the data set.

The grouping of the tests suggests a logical order of implementation in that the simpler, more basic tests occur before more complicated ones. The order of presentation of tests within a stage does not imply an order in implementation. In fact, should a value be changed as a result of a test, the new value should be retested by all of the tests within the stage. Indeed, since data values can be changed, the implementation of these tests cannot take place in a strictly sequential fashion.

The tests detailed by this Manual cannot be mutually exclusive in examining the various properties and characteristics of the data. As much as possible, each test should focus on a particular property to test if the data value or profile conforms to expectations. Modifications to old tests will be incorporated as they refine the focus of the test. New tests will be added to examine properties of data that are not adequately covered by this version.

Each of the tests has been written from the point of view that the data being examined have not been before. The difference this makes is that quality flag assignments do not check if the flag has already been set to something other than 0 (meaning no quality control has been performed). If this is not the case, the rules as written will need modifications to check if the flag has previously been set. If this is the case, and a flag indicates the value was changed, the user should be informed of the original value of the data before another change is performed. Then, if the flag is reset, the changed value should be preserved in the history of the station if the flag is set to be anything else. In other cases, where a flag is changed but the observation is untouched, it is not necessary to record the old flag, but simply to record that data have passed through a second organization and the quality tests done there.

The tests described in stage 5 represent a visual Inspection of the data as received and after ill other tests have been completed. This stage is necessary to ensure that no questionable data values pass through the suite of tests employed without being detected. The testing and flagging procedure of this stage relies upon the experience and knowledge of the person conducting the test. As experience is gained with the tests contained within this Manual, the processes used in the visual inspection of stage 5 will be converted to objective tests

included in other sections of the Manual. However, there will always be a need to conduct this visual inspection as the final judgement of the validity of the data.

7.0 SUGGESTED ADDITIONAL TESTS

Other tests that have been suggested are listed in Annex C. These have not yet reached the stage of being incorporated into the Manual but have been suggested as worthy of consideration. They are noted here so that participants may record their experiences with their use and so that they may be considered for future versions.

8.0 ACKNOWLEDGEMENTS

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ANNEX A: DUPLICATES MANAGEMENT SYSTEM

The first step is to prepare the input file for the program. This involves a prescan of the input file to identify the date/time range covered by the data to be processed through the duplicates management system and loaded into the database.

Once the prescan has identified the date/time range, a retrieval of data from all ocean vertical profile type databases for that time range is submitted. The data from the databases and the input file are sort/merged by date/time and the resulting file serves as input to the duplicates management program.

This process enables the duplicates management system to deal with duplicates in the input file, and between the input file and the databases. It provides for the identification, for example, of a CTD observation duplicating an IGOSS TESAC received earlier and will specify the de-activation of the TESAC so that requests for temperature and salinity data will not result in duplicate observations being given to the user.

Potential duplicates are reviewed with respect to a target message. The review is forward in time for a window of At. There is no need to go backwards as the target message would already have been reviewed with respect to a previous target.

The list of potential duplicates is established by examining each message in the Δt window with respect to the target message in terms of

i) coincidences of platform identification, date and time; and

ii) both observations occurring in a delta time, delta position window (15 minutes and 5 km in the initial implementation of the system).

Once the list of potential duplicates is established with respect to the target observation and all observations within the At window forward, more detailed analysis of the list occurs.

The first step is to attempt to remove entries from the list according to two criteria. Each observation is examined once more relative to the target. If the position is different from the position of the target by more than Δd (5 km) the observation is removed from the list. This can occur in the case of an identification/ time duplicate.

The second check examines the subsurface information for the target and each other observation on the duplicates list.

At this point it becomes necessary to consider an additional factor, the source of the observation which is carried in the databases as a variable named STREAM_IDENT.

The STREAM - IDENT identifies the observation source and a MEDS BATHY, delayed mode XBT, an observation from the scientific QC stream, etc. It is relatively easy to compare sub-surface profiles from two IGOSS BATHY messages because a duplicate observation should have the same depths and temperatures, or very nearly so. However, a comparison of a BATHY trace to a delayed mode XBT trace is not straight forward. MEDS does not yet have a sufficiently reliable algorithm for this purpose.

This means that the subsurface test can at this time only be carried out automatically on observations from the same or similar streams. Similar streams would include the delayed mode XBT and scientific QC streams as the sub-surface variables are not changed in this step.

At this time, the concept of reviewable and non-reviewable decisions by the duplicates checking program is introduced. Once the duplicates checking program has produced an output file containing all data and the database update decision, a post processor is run to permit review and alteration of "reviewable" decisions by an operator. At the post processor stage, non-reviewable decisions are accepted and are not referred to the operator.

As implied above, there are "reviewable- and "non-reviewable" decisions. The following are the tests and types of decisions (i.e. reviewable or non-reviewable) that are included in the sub-surface checking algorithm. Note that the algorithm must deal cases of different profiles attached to the two messages. This would occur for a CTD reporting salinity as well as temperature when the IGOSS message included only temperature.

1. If the observations are from non-similar streams, the profiles are assumed to be duplicates and the decision is reviewable.

2. If for all profiles, the depths and variables are the same, the profiles are assumed to be duplicates and the decision is non-reviewable.

3. If for all profiles, the depths and variables to some level involving more than n levels or X% of the maximum depth range are the same, the profiles are assumed to be duplicates and the decision is reviewable.

4. If more than 80% of depths and variables are different for all profiles the observation is assumed not to be a duplicate and is removed from the duplicates list. The decision is non-reviewable.

The goal of this strategy is to refer all grey area decisions to the operator in the post-processor phase. As the AI capabilities in MEDS improve, attempts will be made to implement software to reduce the requirements for operator review.

After completion of the final duplicates list, further processing becomes a question of making decisions on the action to be taken with each observation on the final duplicates list. These decisions are based on a priorization of the STREAM_IDENTs occurring in the input file (which now contains the data from the database as well) stream and whether the observations conic from the original input stream or the database.

The next group of decisions regarding the duplicates list is to decide the actions necessary in regard to updating the observations into the database, removing them from the database, or altering their "active status". The principles are as follows.

1 . Duplicates from the same or similar input stream are not entered into the database. If such a duplicate occurs, then the decision depends on a control parameter set for the run. This control parameter specifies either "database priority" or "input stream priority". If the control parameter specifies "database priority", then the database copy and the duplicate in the input stream are marked to be "ignored" at database update which leaves the existing copy in the database. If the control parameter specifies "input stream priority" then the database copy is marked to be "deleted" from the database and the input stream copy is marked to be "updated" into the database which replaces the copy in the database with the input stream copy.

   This facility provides the ability to correct data in the database by reprocessing the data and then updating in back into the database

2. If there are duplicates from two different input streams, then the observation with the highest priority in the STREAM_IDENT priority list is chosen to be the active copy. The observation(s) in the database with the lower priority will be marked to be "flagged inactive" during the update. The highest priority will be flagged to be "updated" if it is not already in the database or it will be flagged to be in the update if it is already in there and is to be left there.

Thus all observations in the input stream to the duplicates management system (including the ones that have been extracted from the databases following the prescan) are written to an output file with flags to indicate the appropriate action to be taken at update time This output file is passed to the post processor.

The post processor is an interactive program that presents textual and graphic information to the operator in a form that allows him or her to judge whether the decision made by the duplicates management system was appropriate. If the operator disagrees with the decision, the decision can be altered at this stage relative to the observations that were on the final duplicates list. The final product of the post processor program is a data file that is ready for input to the database update system.

Note that in the MEDS implementation of the duplicates management system, there will be several separate databases including (present thinking) a BATHY database, a TESAC database, a bottle database, an MBT/XBT database, a foreign BT database, and a CTD database. The processing systems described here open and deal with all these databases during duplicates checking and update phases of the data, management system as if they were in fact one database.

ANNEX B: GTSPP QUALITY CONTROL TESTS

This Annex lists the tests names with their index number in parentheses after each. They are grouped by stages, and within Stage 1 they are presented in order of application. Tests in other Stages may be applied in any order, but generally, stage 2 tests should be done before stage 3 and so on.

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TEST NAME: 1.1 PLATFORM IDENTIFICATION

Prerequisites: A list of known platform identifiers Sort the file by identifier

Description:

This test is the very first to be done. It takes a data file and compares the station identifiers to a list of known identifiers. If the incoming identifier is not known, the user can either keep the station or try to infer the correct identifier.

The test starts by checking the identifier of the first station in the incoming file against a list of known identifiers to see if there is an exact match. If there is, the station is checked to determine if it is the last in the file. If it is, the test is complete. If it is not, the identifier is set to be the next in the file and this is checked against the list of known identifiers.

If the identifier was not in the list of known identifiers, the file is checked to determine if there is another identifier exactly the same in the incoming file. If so, it is added to a list of known identifiers and the identifier checked to see if it is the last in the file. If there is only one of the identifier in the file, it is assumed to be wrong.

The user can choose to infer the correct identifier. If this is not chosen, the identifier is added to the list of known identifiers. Then, the identifier is checked to see if it is the last in the file and processing continues as already described.

If the user chooses to infer the correct identifier, a corrected value may be supplied. Then a track chart is displayed of the stations in the file with the supplied identifier.

The user can then choose to accept the inferred identifier. If accepted, the identifier is changed and then checked to see if it is the last in the file and actions continue as described previously. If all choices are rejected the results from the second rule are presented and so on. If all possible inferences are rejected, the user may choose to preserve the identifier as already described.

History: None

Rules:

1.1.1 : Set the ID to be the first identifier in the file
: 1.1.2

1.1.2 IF: The identifier exists in the list of known identifiers
THEN : 1.1.3
ELSE : 1.1.5

1.1.3 IF: The ID is the last in the file
THEN : Next test
ELSE : 1.1.4

1.1.4 : Set the ID to be the next in the file
: 1.1.2

1.1.5 IF: There is more than one identifier in the incoming file
THEN : 1.1.6
ELSE : 1.1.7

1.1.6 : Notify the user that the ID was added to the list of known identifiers
: Add the ID to the list of known identifiers
: 1.1.3

1.1.7 IF: The user chooses to infer the correct identifier
THEN : 1.1.8
ELSE : 1.1.9

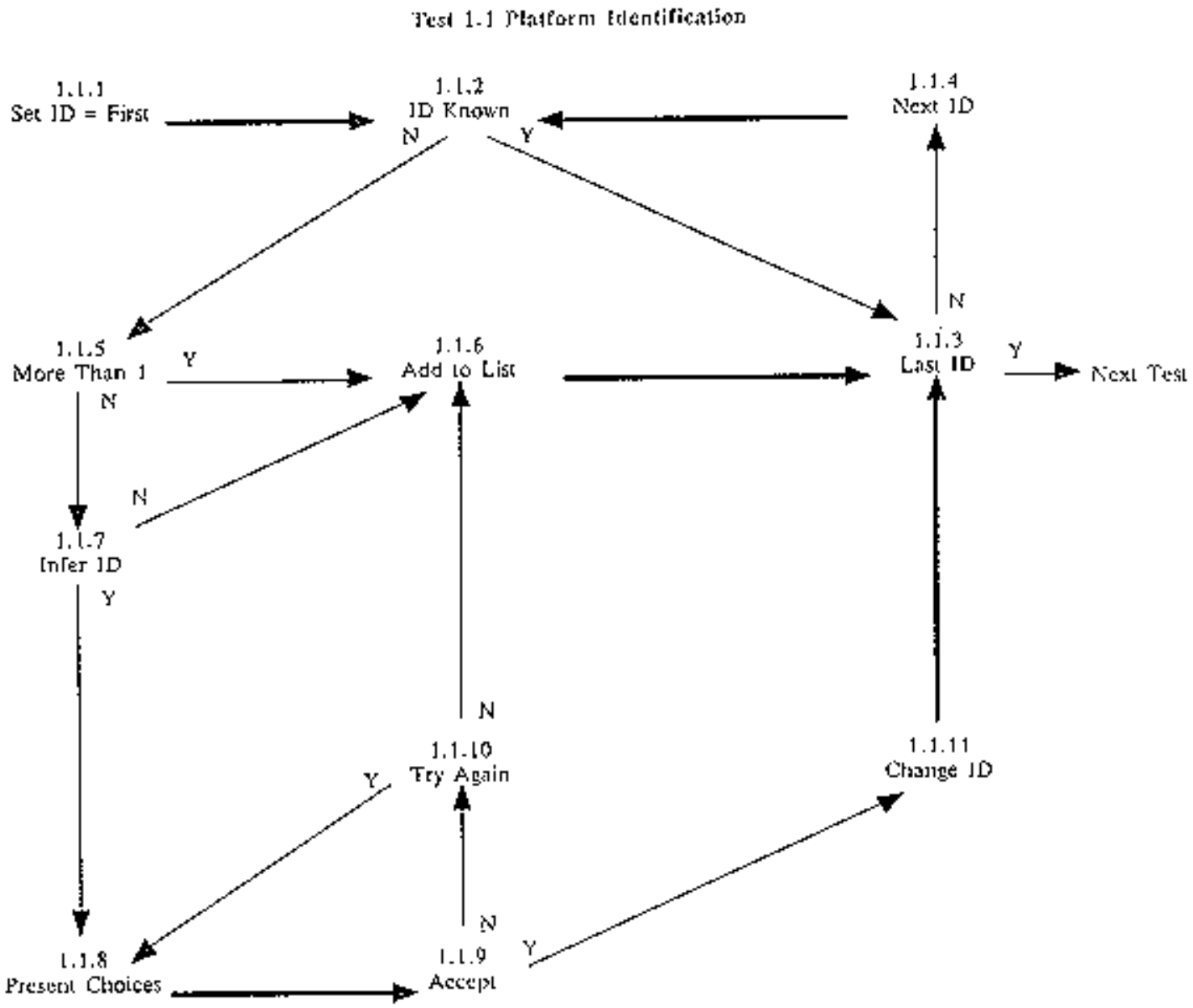
1.1.8 : Accept the user supplied new identifier
: Display the track chart of the new identifier;
: 1.1.9

1.1.9 IF: The user chooses to accept the inferred identifier
THEN : 1.1.11
ELSE : 1.1.10

1.1.10 IF: The user chooses to try another inference
THEN : 1.1.8
ELSE : 1.1.6

1.1.11 : Preserve the original identifier
: Substitute the identifier
: Set the quality flag on the identifier to be "5" changed

Test 1.1 Platform Identification



TEST NAME: 1.2 IMPOSSIBLE DATE AND TIME

Prerequisites: Platform Identification Test
Sort the file chronologically by identifier

Description:

This tests if the date and time of the observation is sensible. It does so by breaking the test into a number of parts. So, the year, month, day, hour and minutes are tested separately. Each part has a capability to infer a correct value if the given one fails the testing. The rules for the inferencing are listed in each part.

The first part tests if the year is in the past. If it is not, the user can flag the year as wrong or try to infer the correct year. The quality flag on the year is set appropriately.

The second part tests if the month is a value between 1 and 12 and if the date is not greater than the present. If any of these fail, the User can choose to flag the month, or to try to infer the correct value. The quality flag is set based on the user's choice.

The third part tests if the day is a value permitted for the given month and year, if the year or month have not already been flagged as erroneous, and if the year, month, day are not greater than the present. If any of these fail, the user can choose to flag the day, or to try to infer the correct value. The quality flag is set based on the user's choice. This test allows for real-time data by ensuring data derived from this source must have a date that is within 30 days of the present.

The fourth part tests if the hour is a value between 0 and 23 and if the time is greater than the present. If any of these fail, the user can choose to flag the hour, or to try to infer the correct value. The quality flag is set based on the user's choice.

The last part tests if the minutes are a value between 0 and 59 and if the time is greater than the present. If any of these fail, the user can choose to flag the minutes, or to try to infer the correct value. The quality flag is set based on the user's choice.

PART 1: This part begins by setting the station to be the first in the file. It then checks if the year is greater than the present year. If not, a marker is tested (this is set if a change has been made to the year as a result of an inference). If set, it is cleared, and processing passes to Part 2. If the marker was not set, the quality flag is set to be good and processing goes to Part 2. If the year is greater than the present year, it is in error. The identifier of the station is examined to see if it is unique (i.e. there is only one station with this identifier). If not unique the identifier, position, date and time of the station under consideration is displayed. As well, the same information for all of the other stations with the same identifier is also displayed. A track chart is also displayed. If the identifier is not known, the same information as described above is displayed for the station under consideration. As well, the same information for other stations in the same neighbourhood is displayed. Then the user can choose to set the quality flag on the year to be erroneous.

If the user chooses to flag the year as erroneous, the quality flag is set appropriately and testing proceeds to Part 2. If not, the user can choose to try to infer the correct year.

The identifier, position, date and time Of the station Under consideration is displayed. As well, the same information for all of the other stations inferred to he the same is also displayed. The user can choose to accept the inferred value. If so, the original value of the year is preserved, the value is changed and the quality flag set to be changed. Processing proceeds to Part 2.

If the user rejects all of the inferences, the year is flagged as erroneous and processing continues as already described.

PART 2 begins by testing if the month is a value between 1 and 12. If it is, the quality flag on the year is tested to see if it is set to be erroneous. If not set to be erroneous, the year and month are tested to determine if they are greater than the present. If not, a marker is tested (this is set if a change has been made to the month as a result of an inference). If set, it is cleared, and processing passes to Part 3. If the marker was not set the

quality flag on the month is set to be good and testing continues in Part 3. If the date is greater than the present, or if the quality flag on the year is set to be erroneous, or if the month is not between 1 and 12, then the identifier is checked.

If not unique, the identifier, position, date and time of the station under consideration is displayed. As well, the same information for all of the other stations with the same identifier is also displayed. Also a track chart is displayed. If the identifier is unique, the same information as described above is displayed for the station under consideration. As well, the same information for other stations in the same neighbourhood is displayed. Then the user can choose to set the quality flag on the month to be doubtful.

If the user chooses to flag the month as doubtful, the quality flag is set appropriately and testing proceeds to Part 3. If riot, the user can choose to set the quality flag to be erroneous. If the user chooses to flag the month as erroneous, the quality flag is set appropriately and testing proceeds to Part 3. If not, the user can choose to try to infer the correct month.

If an inference can be made the identifier, position, date and time of the station under consideration is displayed. Along with this is shown the track chart of the station. As well, the same information for all of the other stations inferred to be the same is also displayed. The user can choose to accept the inferred value. If so, and only the month is inferred to be different, the original value of the month is preserved, the value is change(-] and the quality flag set to be changed. The new value is then tested to ensure it is not greater than the present and processing proceeds as already described. If the month and year are inferred to be different, the original values are preserved, the quality flags on both are set to be changed, the marker is set and processing passes back to Part 1 to check that the year is not greater than present and processing proceeds as described before.

If an inference cannot be made the quality flag on the month is set to be erroneous and processing continues with Part 3.

PART 3 begins by testing if the day is valid given the year and month. If it is, the quality flag on the year and month are tested to see if either is set to be erroneous. If not set to be erroneous, the year, month, day is tested to determine if they are greater than the present. If not, a marker is tested (this is set if a change has been made to the day as a result of an inference). If set, it is cleared, and processing passes to Part 4. If the marker was riot set the quality flag on the day is set to be good and testing continues in Part 4. If the data did arrive in real-time, the date is checked that it is within 30 days of the present. If it is, the marker is checked as already described.

If the real-time data are older than 30 days, or if the date is greater than the present, or if the quality flag on the year or month is set to be erroneous, or if the day is riot valid then the identifier is checked.

If the identifier is riot unique, the identifier, position, date and time of the station under consideration is displayed. As well, the same information for all of the other stations with the same identifier is also displayed. Along with this is shown the track chart of the stations. If the identifier is unique, the same information as described above is displayed for the station under consideration. As well, the same information for other stations in the same neighbourhood is displayed. Then the user can choose to set the quality flag on the day to be doubtful.

If the user chooses to flag the day as doubtful, the quality flag is set appropriately and testing proceeds to Part 4. If not, the user can choose to set the quality flag to be erroneous. If the user chooses to flag the day as erroneous, the quality flag is set appropriately and testing proceeds to Part 4. If not, the user can choose to try to infer the correct day.

If an inference can be made the identifier, position, date and time of the station under consideration is displayed. Along with this is shown the track chart of the station. As well, the same information for all of the other stations inferred to be the same is also displayed. The user can choose to accept the inferred value. If so, and only the day is inferred to be different, the original value of the day is preserved, the value is changed and the quality flag set to be changed. The new value is then tested to ensure it is not greater than the present and processing proceeds as already described. If the day and month are inferred to be different, the original values are preserved, the quality flags are set to be changed, the marker is set and processing passes back to Part 2 to

check that the month and year are not greater than present and processing proceeds as described before. If the day, month and year are inferred to be different, the original values are preserved, the quality flags are set to be changed, the marker is set and processing passes back to Part 1 to check that the day, month and year are not greater than present and processing proceeds as described before.

If an inference cannot be made, the quality flag on the day is set to be erroneous and processing continues with Part 4.

PART 4 begins by testing if the hour is valid, that is between 0 and 23. If it is, the quality flag on the year, month and day are tested to see if either is set to be erroneous. If not set to be erroneous, the year, month, day and hour are tested to determine if they are greater than the present. If not, a marker is tested (this is set if a change has been made to the hour as a result of an inference). If set, it is cleared, and processing passes to Part 5. If the marker was not set the quality flag on the hour is set to be good and testing continues in Part 5.

If the date is greater than the present, or if the quality flag on the year, month or day is set to be erroneous then the identifier is checked.

If the hour was not between 0 and 23, it is tested to be the value of 24. If not, the identifier is tested. If the hour was set to 24, the hour is reset to 0, and the day incremental by one. Months and years may have to be incremented as well. Then the quality flags on the day, month and year are tested as described above.

If the identifier is not unique, the identifier, position, date and time of the station under consideration is displayed. As well, the same information for all of the other stations with the same identifier is also displayed. Along with this is shown the track chart of the station. If the identifier is unique, the same information as described above is displayed for the station under consideration. As well, the same information for other stations in the same neighbourhood is displayed. Then the user can choose to set the quality flag on the hour to be doubtful.

If the user chooses to flag the hour as doubtful, the quality flag is set appropriately and testing proceeds to Part 5. If not, the user can choose to set the quality flag to be erroneous. If the user chooses to flag the hour as erroneous, the quality flag is set appropriately and testing proceeds to Part 5. If not, the user can choose to try to infer the correct hour.

If an inference can be made, the identifier, position, date and time of the station under consideration is displayed. As well, the same information for all of the other stations inferred to be the same is also displayed. Along with this is shown the track chart of the station. The user can choose to accept the inferred value. If so, and only the hour is inferred to be different, the original value of the hour is preserved, the value is changed and the quality flag set to be changed. The new value is then tested to ensure it is not greater than the present and processing proceeds as already described. If the hour and day are inferred to be different, the original values are preserved, the quality flags are set to be changed, the marker is set and processing passes back to Part 3 to check that the day, month and year are greater than present and processing proceeds as described before. If the hour, day and month are inferred to be different, the original values are preserved, the quality flags are set to be changed, the marker is set and processing passes back to Part 2 to check that the month and year are not greater than present and processing proceeds as described before. If the hour, day, month and year are inferred to be different, the original values are preserved, the quality flags are set to be changed, the marker is set and processing passes back to Part 1 to check that the year is not greater than present and processing proceeds as described before.

If an inference cannot be, made, the quality flag on the hour is set to be erroneous and processing continues with Part 5.

PART 5 begins by testing if the minute is valid, that is between 0 and 59. If it is, the quality flag on the year, month, day and hour are tested to see if any are set to be erroneous. If not set to be erroneous, the year, month, day, hour and minute are tested to determine if they are greater than the present. If not, a marker is tested (this is set if a change has been made to the minute as a result of an inference). If set, it is cleared, and the next station is tested. If the marker was not set the quality flag on the hour is set to be good and a test is made to see if there is another station.

If the date is greater than the present, or if the quality flag on the year, month, day or minute is set to be erroneous then the identifier is checked.

If the minute was not between 0 and 59, it is tested to be the value of 60. If not, the identifier is tested. If the minute was set to 60, the minute is reset to 0, and the hour incremented by one. Days, months and years may have to be incremented as well. Then the quality flags on the hour, day, month and year are tested as described above.

If the identifier is not unique, the identifier, position, date and time of the station under consideration is displayed. As well, the same information for all of the other stations with the same identifier is also displayed. Along with this is shown the track chart of the station. If the identifier is unique, the same information as described above is displayed for the station under consideration. As well, the same information for other stations in the same neighbourhood is displayed. Then the user can choose to set the quality flag on the minute to be doubtful.

If the user chooses to flag the minute as doubtful, the quality flag is set appropriately and testing proceeds to a next station. If not, the, user can choose to set the quality flag to be erroneous. If the user chooses to flag the minute as erroneous, the quality flag is set appropriately and testing proceeds to the next station. If not, the user can choose to try to infer the correct minute. At this time there are no rules for inferring the correct minute. However, the logic has been built into the rules below to permit inclusion of such rules when they are available. Since an inference, cannot be made, the quality flag is set to be erroneous and processing continues with a next station.

History: None

Rules:

Part 1:

1.2.1 : Set the station to be the first in the file
: 1.2.2

1.2.2 IF: The observed year is greater then the present year
THEN : 1.2.5
ELSE : 1.2.3

1.2.3 IF: MARK has been set
THEN : Clear MARK
: 1.2.18
ELSE : 1.2.4

1.2.4 : Set the quality flag on the year to be "I", good
: 1.2.18

1.2.5 IF: The platform identifier is unique
THEN : 1.2.7
ELSE : 1.2.6

1.2.6 : Display the ID, position and date of the ID in question
: Display the same information for any other identifiers with the same ID
: Display the track chart
: 1.2.8

1.2.7 ; Display the ID, position and date of the ID in question
: Display the same information for any other identifiers in
the neighbourhood of the ID under consideration
: 1.2.8

1.2.8 IF: The user chooses to flag the year as erroneous
THEN : 1.2.9
ELSE : 1.2.10

1.2.9 : Set the quality flag on the year to be "4", erroneous
: 1.2.18

1.2.10 IF: The user chooses to infer a value
THEN : 1.2.12
ELSE : 1.2.11

1.2.11 : Notify the user that the quality flag on the year will be set to be erroneous
: 1.2.9

1.2.12 : Display the ID, position and date of the ID in question
: Display the same information for the other stations with the inferred identifier
: Display the track chart
: 1.2.13

1.2.13 IF: The user accepts an inferred year
THEN : 1.2.15
ELSE : 1.2.14

1.2.14 IF: The user chooses to try another inference
THEN : 1.2.10
ELSE : 1.2.9

1.2.15 : Preserve the original value of the year
: Change the year to the inferred value
: Set the quality flag on the year to be '5', changed
: Set MARK
: 1.2.18

Part 2:

1.2.18 IF: The month is between 1 and 12
THEN : 1.2.19
ELSE : 1.2.23

1.2.19 IF: The quality flag on the year is set to be erroneous
THEN : 1.2.23
ELSE : 1.2.20

1.2.20 IF: The year and month are greater thin the present
THEN : 1.2.23
ELSE : 1.2.21

1.2.21 IF: MARK is set
THEN : Clear MARK
: 1.2.38
ELSE : 1.2.22

1.2.22 : Set the quality flag on the month to be "Y good
: 1.2.38

1.2.23 IF: The identifier of the station is unique
THEN : 1.2.25
ELSE : 1.2.24

1.2.24 : Display the ID, position and date of the ID in question
: Display the samE information for any other identifiers with the same ID
: Display the track chart
: 1.2.26

1.2.25 : Display the ID, position and date of the ID in question
: Display the same information for any other identifiers in
the neighbourhood of the ID under consideration
: 1.2.26

1.2.26 IF: The user chooses to flag the month as doubtful
THEN : 1.2.27
ELSE : 1.2.28

1.2.27 : Set the quality flag on the month to be "Y, doubtful
: 1.2.38

1.2.28 IF: The user chooses to flag the month as erroneous
THEN : 1.2.29
ELSE : 1.2.30

1.2.29 : Set the quality flag on the month to be 'A", erroneous
: 1.2.28

1.2.30 IF: An inference can be made of the correct month
THEN : 1.2.32
ELSE : 1.2.31

1.2.31 : Notify the user that no inferences can be made
: Notify the user that the quality flag on the month will be set to be erroneous
: 1.2.29

1.2.32 : Display the ID, position and date of the ID in question
: Display the samE information for the other stations with the inferred identifier
: Display the track chart
: 1.2.33

1.2.33 IF: The user accepts the inferred month
THEN : 1.2.35
ELSE : 1.2.34

1.2.34 IF: The user chooses to try another inference
THEN : 1.2.30
ELSE : Notify the user that the month will be flagged as erroneous
: 1.2.29

1.2.35 IF: Only the month should be changed
THEN : 1.2.36
ELSE : 1.2.37

1.2.36 : Preserve the original value Of the month
: Change the month to the inferred value
: Set the quality flag on the month to be "5", changed
: Set MARK
: 1.2.20

1.2.37 : Preserve the original value of the month

: Change the month to the inferred value
: Set the quality flag on the month to be "5", changed
: Preserve the original value of the year
: Change the year to the inferred value
: Set the quality flag on the year to be '5', changed
: Set MARK
: 1.2.2

Part 3:

1.2.38 IF: The day is possible for the given month and year
THEN : 1.2.39
ELSE : 1.2.45

1.2.39 IF: Either the quality flag on the month or year is set to be erroneous
THEN : 1.2.45
ELSE ; 1.2.40

1.2.40 IF: The year, month, day is greater than the present
THEN : 1.2.44
ELSE : 1.2.42

1.2.41 IF: MARK is set
THEN : Clear MARK
: 1.2.62
ELSE : 1.2.43

1.2.42 IF: The year, month, day is older than 30 days from the present
THEN : 1.2.44
ELSE : 1.2.41

1.2.43 : Set the quality flag on the day to be good
: 1.2.62

1.2.44 IF: The identifier of the station is not unique
THEN : 1.2.45
ELSE : 1.2.46

1.2.45 : Display the ID, position and date of the ID in question
: Display the same information for any other identifiers in
the neighbourhood of the ID under consideration
: Display the track chart
: 1.2.47

1.2.46 : Display the ID, position and date of the ID in question
: Display the same information for any other identifiers with the same ID
: 1.2.47

1.2.47 IF: The user chooses to flag the day as doubtful
THEN : 1.2.48
ELSE : 1.2.49

1.2.48 : Set the quality flag on the day to be "Y, doubtful
: 1.2.62

1.2.49 IF: The user chooses to flag the day as erroneous
THEN : 1.2.50
ELSE : 1.2.51

1.2.50 : Set the quality flag on the day to be "4", erroneous
: 1.2.62

1.2.51 IF: An inference can be made of the correct day
THEN : 1.2.53
ELSE : 1.2.52

1.2.52 : Notify the user that the quality flag on the day will be set to be erroneous
: 1.2.50

1.2.53 ; Display the ID, position and date of the ID in question
: Display the same information for the other stations with the inferred identifier
: Display the track chart
: 1.2.54

1.2.54 IF: The user accepts the inferred day
THEN : 1.2.56
ELSE : 1.2.55

1.2.55 IF: The user chooses to try another inference
THEN : 1.2.51
ELSE : Notify the user that the day will be flagged as erroneous
: 1.2.50

1.2.56 IF: Only the day should be changed
THEN : 1.2.57
ELSE : 1.2.58

1.2.57 : Preserve the original value of the day
: Change the day to the inferred value
: Set the quality flag on the day to be "5", changed
: Set MARK
: 1.2.40

1.2.58 IF: Only the day and month should be changed
THEN : 1.2.59
ELSE : 1.2.60

1.2.59 : Preserve the original value of the day
: Change the day to the inferred value
: Set the quality flag on the clay to be "5", changed
: Preserve the original value of the month
: Change the month to the inferred value
: Set the quality flag on the month to be '5', changed
: Set MARK
: 1.2.20

1.2.60 : Preserve the original value of the day
: Change the day to the inferred value
: Set the quality flag on the day to be "S", changed
: Preserve the original value of the month
: Change the month to the inferred value
: Set the quality flag on the month to be "5", changed
: Preserve the original value of the year
: Change the year to the inferred value
: Set the quality flag on the year to be "5", changed
: Set MARK

: 1.2.2

Part 4:

1.2.62 IF: The hour is a number between 0 and 23 inclusive
THEN : 1.2.63
ELSE : 1.2.67

1.2.63 IF: Any of the year, month or day have a quality flag set to be erroneous
THEN : 1.2.69
ELSE : 1.2.64

1.2.64 IF: The year, Month, day, hour is greater than the present
THEN : 1.2.69
ELSE : 1.2.65

1.2.65 IF: The marker is set
THEN : 1.2.88
ELSE : 1.2.66

1.2.66 : Set the quality flag on the hour to be 1 good
: 1.2.88

1.2.67 IF: The hour is equal to 24
THEN : 1.2.68
ELSE : 1.2.69

1.2.68 : Preserve the original value of the hour
: Set the hour to be 0
: Set the quality flag on the hour to be "5", changed
: Preserve the original value of the clay
: Set the day to be 1 greater than the original value
: Set the quality flag on the day to be "5", changed
: 1.2.63

1.2.69 IF: The identifier of the station is not unique
THEN : 1.2.70
ELSE : 1.2.71

1.2.70 : Display the ID, position and date of the ID in question
: Display the same information for any other identifiers with the same ID
: Display the track chart
: 1.2.72

1.2.71 : Display the ID, position and date of the ID in question
: Display the same information for any other identifiers in
the neighbourhood of the ID under consideration
: 1.2.72

1.2.72 IF: The user chooses to flag the hour as doubtful
THEN : 1.2.73
ELSE : 1.2.74

1.2.73 : Set the quality flag on the hour to be "Y, doubtful
: 1.2.88

1.2.74 IF: The user chooses to flag the hour as erroneous
THEN : 1.2.75

ELSE : 1.2.76

1.2.75 : Set the quality flag on the hour to be "4", erroneous
: 1.2.88

1.2.76 IF: An inference can be made of the correct hour
THEN : 1.2.77
ELSE : 1.2.78

1.2.77 : Display the ID, position and date of the ID in question
: Display the same information for the other stations with the inferred identifier
: 1.2.78

1.2.78 IF: The user accepts the inferred hour
THEN : 1.2.80
ELSE : 1.2.79

1.2.79 IF: The user chooses to try another inference
THEN : 1.2.76
ELSE : Notify the user that the hour will be flagged as erroneous
1.2.75

1.2.80 IF: Only the hour should be changed
THEN : 1.2.81
ELSE : 1.2.82

1.2.81 : Preserve the original value of the hour
: Change the hour to the inferred value
: Set the quality flag on the hour to be "5", changed
: Set MARK
: 1.2.64

1.2.82 IF: Only the hour and day should be changed
THEN : 1.2.83
ELSE : 1.2.84

1.2.83 :Preserve the original value of the hour
: Change the hour to the inferred value
: Set the quality flag on the hour to be "5", changed
: Preserve the original value of the day
: Change the day to the inferred value
: Set the quality flag on the day to be '5', changed
: Set MARK
: 1.2.40

1.2.84 IF: Only the hour, clay and month should be changed
THEN : 1.2.85
ELSE : 1.2.86

1.2.85 : Preserve the original value of the hour
: Change the hour to the inferred value
: Set the quality flag on the hour to be "5", changed
: Preserve the original value of the day
: Change the clay to the inferred Value
: Set the quality flag on the day to be "5", changed
: Preserve the original value of the month
: Change the month to the inferred value
: Set the quality flag on the month to be "5", changed

: Set MARK
: 1.2.20

1.2.86 : Preserve the original value of the, hour
: Change the hour to the inferred value
: Set the quality flag on the hour to be "5", changed
: Preserve the original value of the day
: Change the day to the inferred value
: Set the quality flag on the day to be "5", changed
: Preserve the original value of the month
: Change the month to the inferred value
: Set the quality flag on the month to be "5", changed
: Preserve the original value of the year
: Change the year to the inferred value
: Set the quality flag on the year to be "5", changed
: Set MARK
: 1.2.2

Part 5:

1.2.88 IF: The minute is a value between 0 and 59
THEN : 1.2.89
ELSE : 1.2.93

1.2.89 IF: Any of the quality flags on the hour, day, month or year is set to be erroneous
THEN : 1.2.95
ELSE : 1.2.90

1.2.90 IF: The year, month, day, hour, minute is greater than the present
THEN : 1.2.95
ELSE : 1.2.91

1.2.91 IF: The marker is set
THEN : Test the next station
ELSE : 1.2.92

1.2.92 : Set the quality flagon the minute to be "1" good
: Test the next station

1.2.93 IF: The minute is equal to 60
THEN : 1.2.94
ELSE : 1.2.95

1.2.94 : Set the minute to be 00
: Increment the hour by 1
: Increment the day, month and year as appropriate
: 1.2.2

1.2.95 IF: The identifier of the station is unique
THEN : 1.2.97
ELSE : 1.2.96

1.2.96 : Display the ID, position and date of the, ID in question
: Display the same information for any other identifiers in
the neighbourhood of the ID under consideration
: 1.2.98

1.2.97 : Display the ID, position and date of the ID in question

: Display the same information for any other identifiers with the same ID
: Display the track chart
: 1.2.98

1.2.98 IF : The user chooses to flag the minute as doubtful
THEN : 1.2.99
ELSE : 1.2.100

1.2.99 : Set the quality flag on the minute to be "Y, doubtful
: Test the next station

1.2.100 IF : The user chooses to flag the minute as erroneous
THEN : 1.2.101
ELSE : 1.2.102

1.2.101 :Set the quality flag on the minute to be "4", erroneous
:Test the next station

1.2.102 IF: An inference can be made of the correct minute
THEN : 1.2.103
ELSE : 1.2.101

1.2.103 : Display the ID, position and date of the ID in question
: Display the same information for the other stations with the inferred identifier
: Display the track chart
: 1.2.104

1.2.104 IF: The user accepts the inferred minute
THEN : 1.2.106
ELSE : 1.2.105

1.2.105 : Notify the user that the minute will be flagged as erroneous
: 1.2.101

1.2.106 IF: Only the minute should be changed
THEN : 1.2.107
ELSE : 1.2.108

1.2.107 : Preserve the original value of the minute
: Change the minute to the inferred value
: Set the quality flag on the minute to be "5", changed
: Set MARK
: 1.2.90

1.2.108 IF: Only the minute and hour should be changed
THEN : 1.2.109
ELSE : 1.2.110

1.2.109 : Preserve the original value of the minute
: Change the minute to the inferred value
: Set the quality flag on the minute to be "5", changed
: Preserve the original value of the hour
: Change the hour to the inferred value
: Set the quality flag on the hour to be "5", changed
: Set MARK
: 1.2.64

1. 2, 110 IF: Only the minute, hour and day should be changed

THEN : 1.2.111
ELSE : 1.2.112

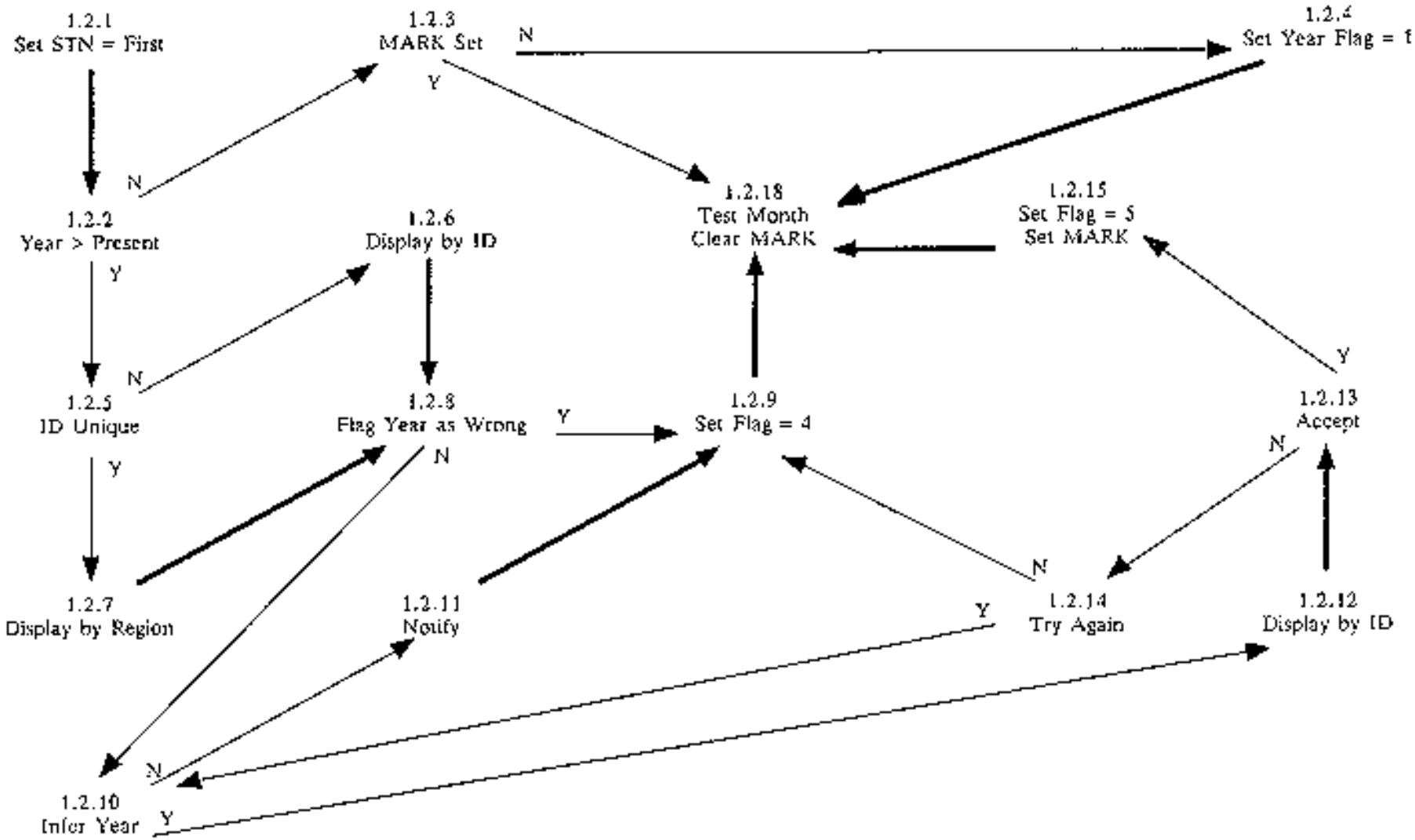
1.2.111 : : Preserve the original value of the minute
: Change the minute to the inferred value
: Set the quality flag on the minute to be "5", changed
: Preserve the original value of the hour
: Change the hour to the inferred value
: Set the quality flag on the hour to be "5", changed
: Preserve the original value of the day
: Change the day to the inferred value
: Set the quality flag on the day to be "5", changed
: Set MARK
: 1.2.40

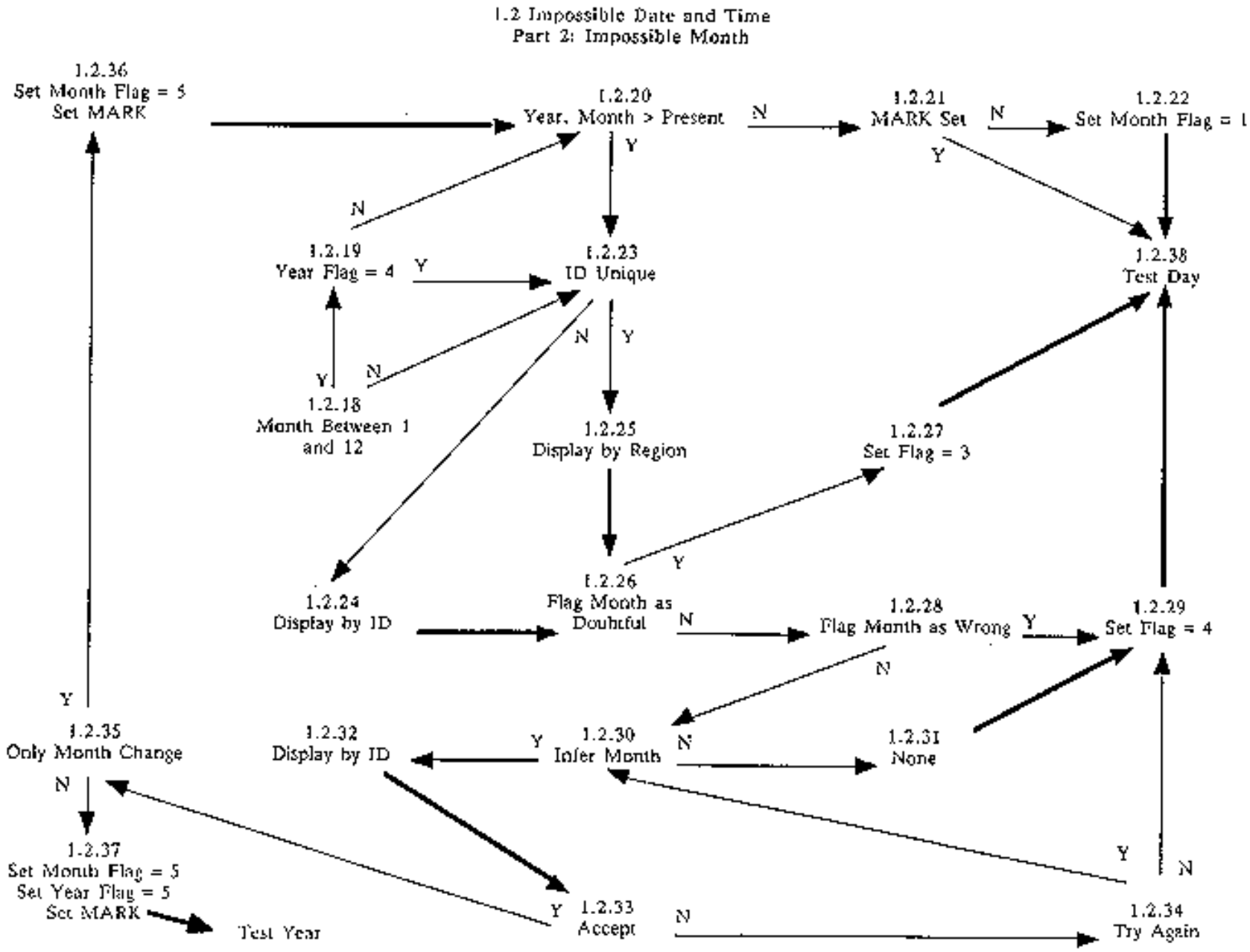
1.2.112 IF: Only the minute, hour, day and month should be changed
THEN : 1.2.113
ELSE :1.2.114

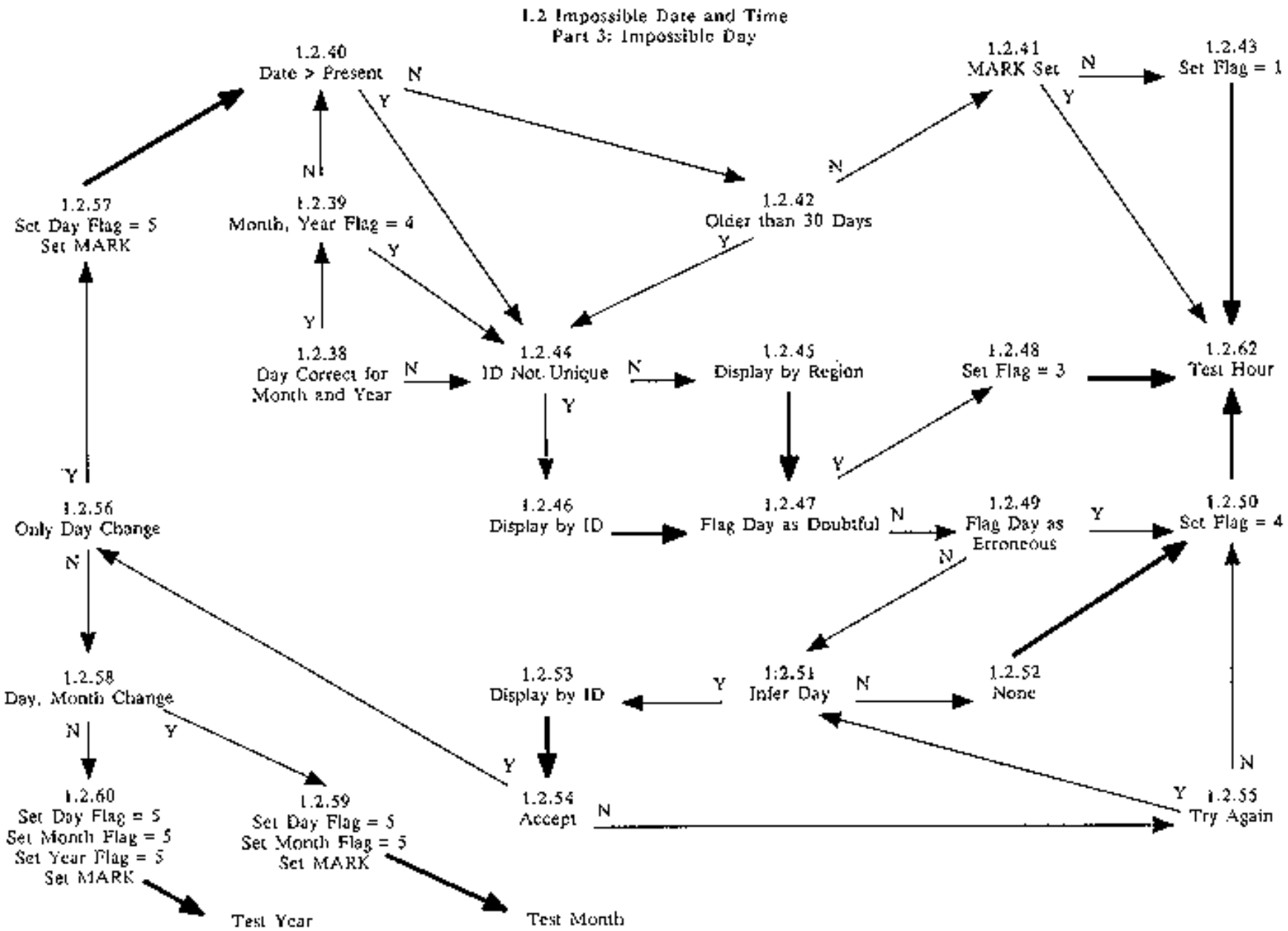
1.2.113 : Preserve the original value of the minute
: Change the minute to the inferred value
Set the quality flag on the minute to be "5", changed
: Preserve the original value of the hour
: Change the hour to the inferred value
: Set the quality flag on the hour to be "5", changed
: Preserve the original value of the day
: Change the day to the inferred value
: Set the quality flag on the day to be "5", changed
: Preserve the original value of the month
: Change the month to the inferred value
: Set the quality flag on the month to be '5', changed
: Set MARK
: 1.2.20

1.2.114 : : Preserve the original value of the minute Change the minute to the inferred value
: Set the quality flag on the minute to be "5", changed
: Preserve the original value of the hour Change the hour to the inferred value
: Set the quality flag on the hour to be "5", changed
: Preserve the original value of the day Change the day to the inferred value
: Set the quality flag on the day to be "5", changed
: Preserve the original value of the month Change the month to the inferred value
: Set the quality flag on the month to be "5", changed
: Preserve the original value of the year Change the year to the inferred value
: Set the quality flag on the year to be "5", changed
: Set MARK
: 1.2.2

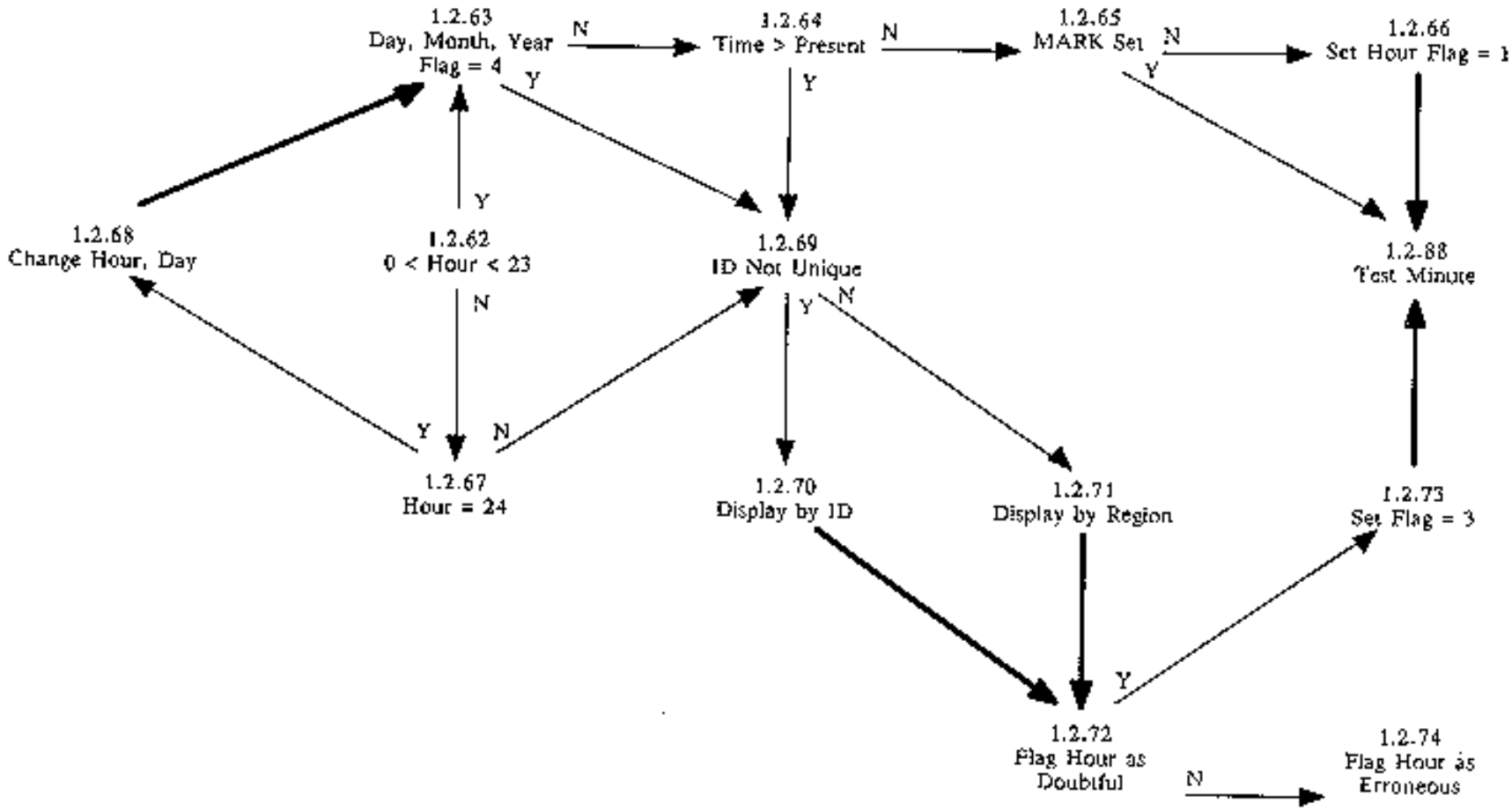
1.2 Impossible Date and Time
Part 1: Impossible Year



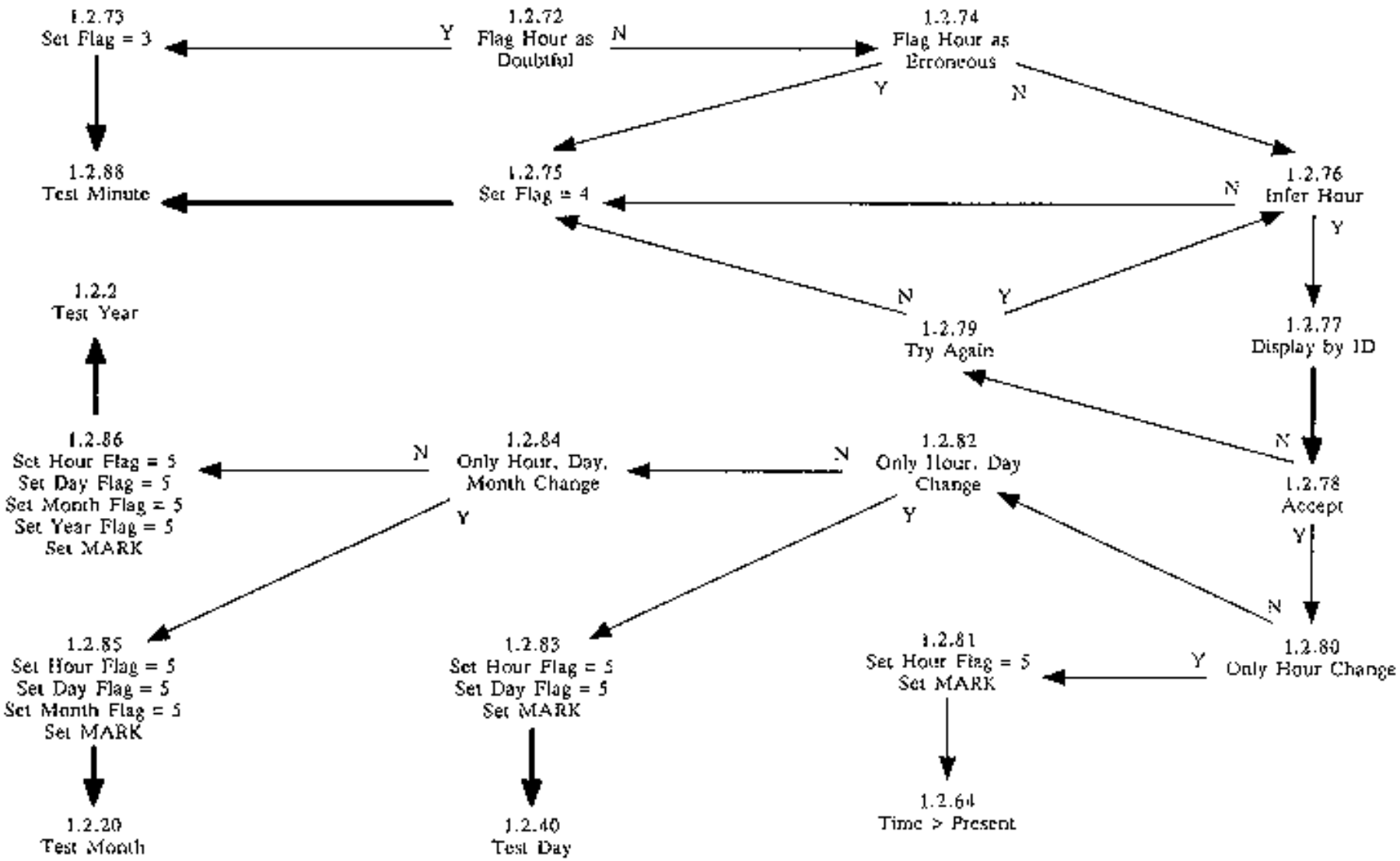

1.2 Impossible Date and Time
Part 2: Impossible Month
1.2.36
Set Month Flag = 5
Set MARK
1.2.20
Year, Month > Present
N
1.2.21
MARK Set
N
1.2.22
Set Month Flag = 1
Y
Y
N
1.2.19
Year Flag = 4
Y
1.2.23
ID Unique
1.2.38
Test Day
N
Y
Y
N
1.2.18
Month Between 1
and 12
1.2.25
Display by Region
1.2.27
Set Flag = 3
Y
1.2.24
Display by ID
1.2.26
Flag Month as
Doubtful
N
1.2.28
Flag Month as Wrong
Y
1.2.29
Set Flag = 4
N
Y
1.2.35
Only Month Change
1.2.32
Display by ID
Y
1.2.30
Infer Month
N
1.2.31
None
N
Y
N
1.2.37
Set Month Flag = 5
Set Year Flag = 5
Set MARK
Test Year
Y
1.2.33
Accept
N
1.2.34
Try Again


1.2 Impossible Date and Time
Part 3: Impossible Day
1.2.40
Date > Present
1.2.41
MARK Set
1.2.43
Set Flag = 1
1.2.57
Set Day Flag = 5
Set MARK
1.2.39
Month, Year Flag = 4
1.2.42
Older than 30 Days
1.2.38
Day Correct for
Month and Year
1.2.44
ID Not Unique
1.2.45
Display by Region
1.2.48
Set Flag = 3
1.2.62
Test Hour
1.2.56
Only Day Change
1.2.46
Display by ID
1.2.47
Flag Day as Doubtful
1.2.49
Flag Day as
Erroneous
1.2.50
Set Flag = 4
1.2.58
Day, Month Change
1.2.53
Display by ID
1.2.51
Infer Day
1.2.52
None
1.2.60
Set Day Flag = 5
Set Month Flag = 5
Set Year Flag = 5
Set MARK
1.2.59
Set Day Flag = 5
Set Month Flag = 5
Set MARK
1.2.54
Accept
1.2.55
Try Again
Test Year
Test Month

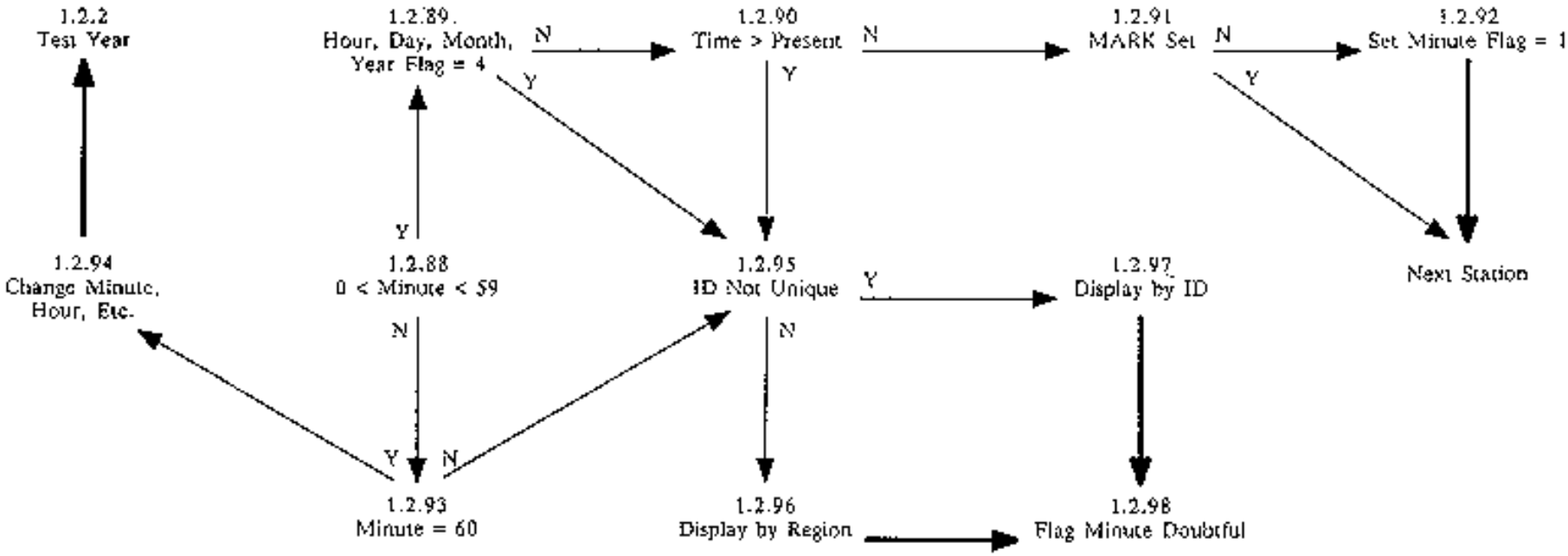
1.2 Impossible Date and Time
Part 4A: Impossible Hour



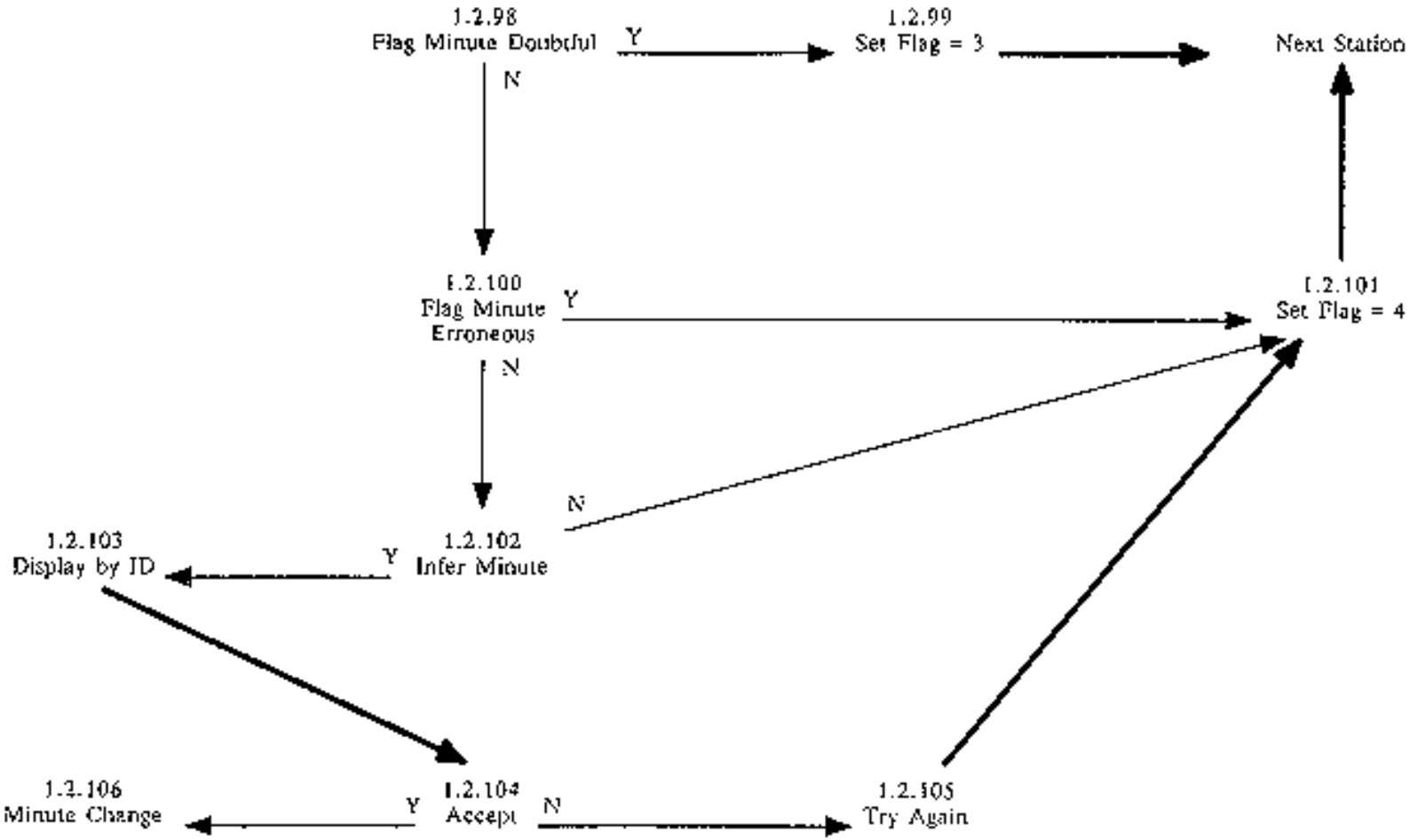
1.2 Impossible Date and Time
Part 4B: Impossible Hour



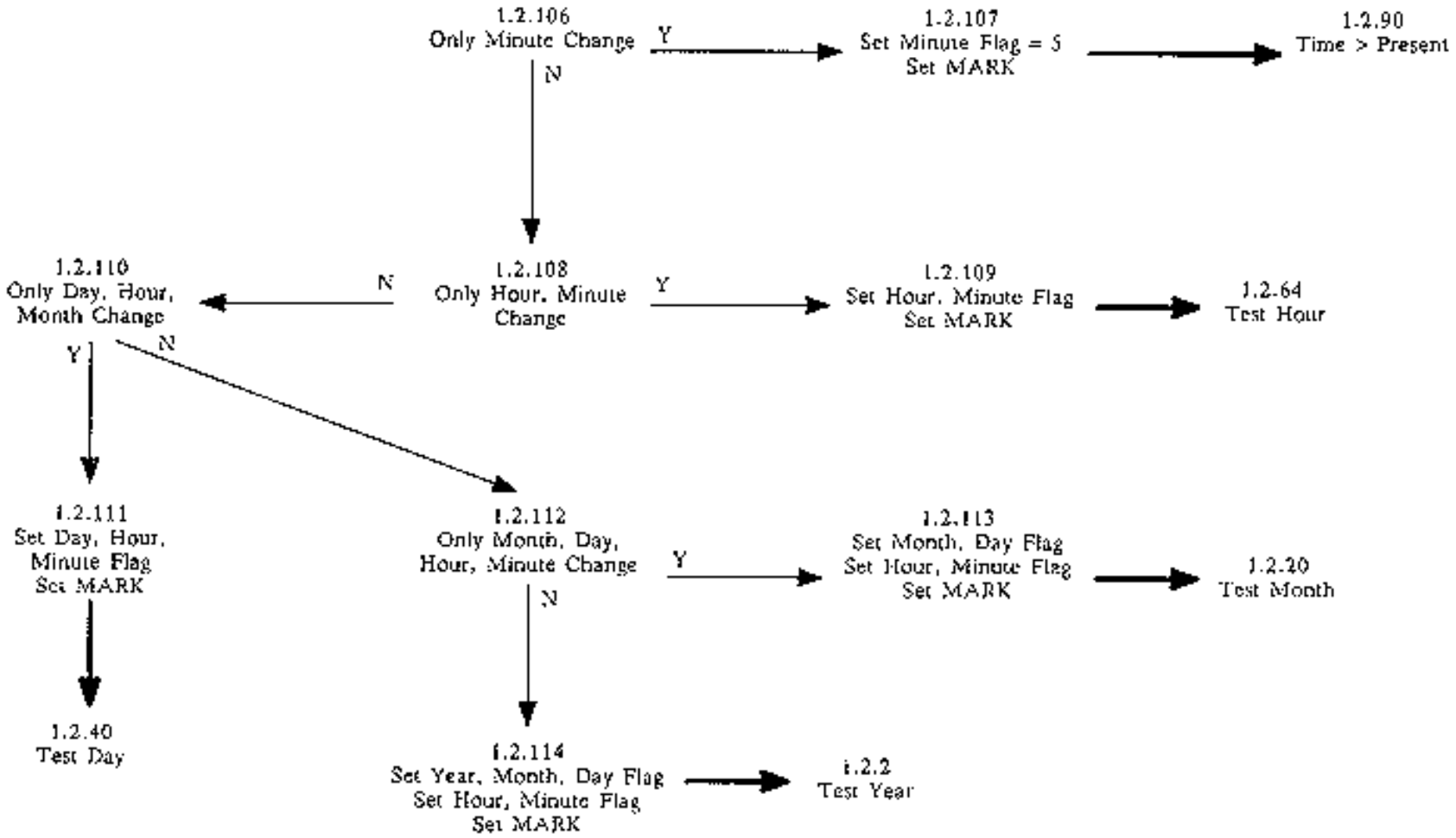
1.2 Impossible Date and Time
Part 5A: Impossible Minute



1.2 Impossible Date and Time
Part 5B: Impossible Minute



1.2 Impossible Date and Time
Part 5C: Impossible Minute



TEST NAME: 1.3 IMPOSSIBLE LOCATION

Prerequisites: Platform Identification Test
Impossible Date and Time Test
Sort the file by identifier and chronologically

Description:

This tests if the location of the observation is sensible. It does so by breaking the test into 2 parts. The two parts simply check that the latitude and longitude have possible values.

PART 1 begins by checking if the latitude lies between 90 degrees south and 90 degrees north inclusive. If it does, processing passes immediately to Part 2. If not, the identifier of the station is checked to see if it is known. If the identifier is known, the identifier, latitude, longitude, date and time of the station under consideration is listed. Also listed is the same information for all other stations with the same identifier in the incoming file. Processing then allows the, user to flag the latitude as erroneous. If the identifier is not known the user may choose to flag the latitude as erroneous.

If the user chooses to flag the latitude as erroneous, the quality flag is set to be "4", and processing passes to Part 2.

If the user chooses not to flag the latitude as erroneous, a latitude may be inferred. If the user chooses not to do this, the quality flag is set to be A" and processing passes to Part 2.

If an inference can be made, the user may do so. If the inference is accepted, the original value is preserved, the value changed to the new one, the quality flag set to be "S", changed and processing passes to Part 2.

PART 2 proceeds exactly the same as part 1 except the longitude is examined. In this case, the longitude must lie between 180 degrees west and 180 degrees cast. Note that longitudes given using a different co-ordinate system must be converted. After the longitude is checked in this way, processing passes to the next station.

History: None

Rules:

Part 1:

1.3.1 IF: The latitude lies between plus or Minus 90 degrees
THEN : 1.3.13
ELSE : 1.3.2

1.3.2 IF: The identifier of the station is known
THEN: 1.3.3
ELSE: 1.3.4

1.3.3 : List the identifier, latitude, longitude and date of the station with the suspect latitude
: List the identifiers, latitudes, longitudes and dates of all of the stations
with the same identifier
: Display the track chart
: 1.3.4

1.3.4 IF: The user chooses to set the quality flag on the latitude as erroneous
THEN: 1.3.5
ELSE: 1.3.6

1.3.5 ; Set the quality flag on the latitude for the suspect station to be A", erroneous
: 1.3.13

1.3.6 IF: The user chooses to infer the latitude

THEN: 1.3.7
ELSE: 1.3.5

1.3.7 IF: The user chooses to accept an inference
THEN: 1.3.9
ELSE: 1.3.8

1.3.8 IF: The user chooses to try to make another inference
THEN: 1.3.6
ELSE: 1.3.5

1.3.9 : Preserve the original value of the latitude
: Replace the original latitude with the inferred value
: Set the quality flag on the latitude, to be "5", changed
: 1.3.13

Part 2:

1.3.13 IF: The longitude lies between plus or minus 180 degrees
THEN: Test the next station
ELSE: 1.3.14

1.3.14 IF: The identifier of the station is known
THEN: 1.3.15
ELSE: 1.3.16

1.3.15 : List the identifier, latitude, longitude and date of the station with the suspect latitude
: List the identifiers, latitudes, longitudes and dates of all of the stations
with the same identifier
: Display the track chart
: 1.3.16

1.3.16 IF: The user chooses to set the quality flag on the longitude as erroneous
THEN: 1.3.17
ELSE: 1.3.18

1.3.17 : Set the quality flag on the longitude for the suspect station to be "4", erroneous
: Test the next station

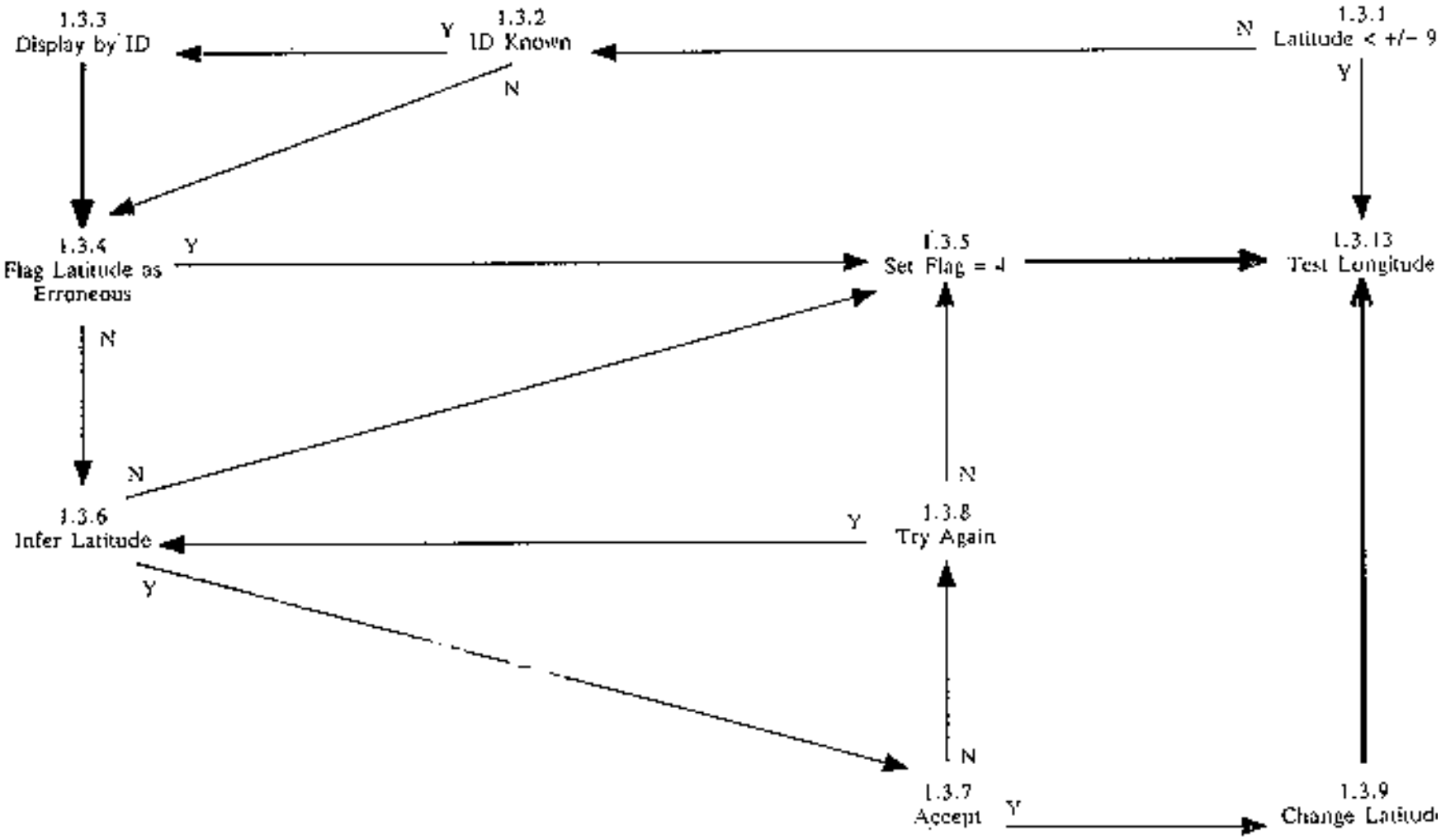
1.3.18 IF: The user chooses to infer the longitude
THEN: 1.3.19
ELSE: 1.3.17

1.3.19 IF: The user chooses to accept an inference
THEN: 1.3.21
ELSE: 1.3.20

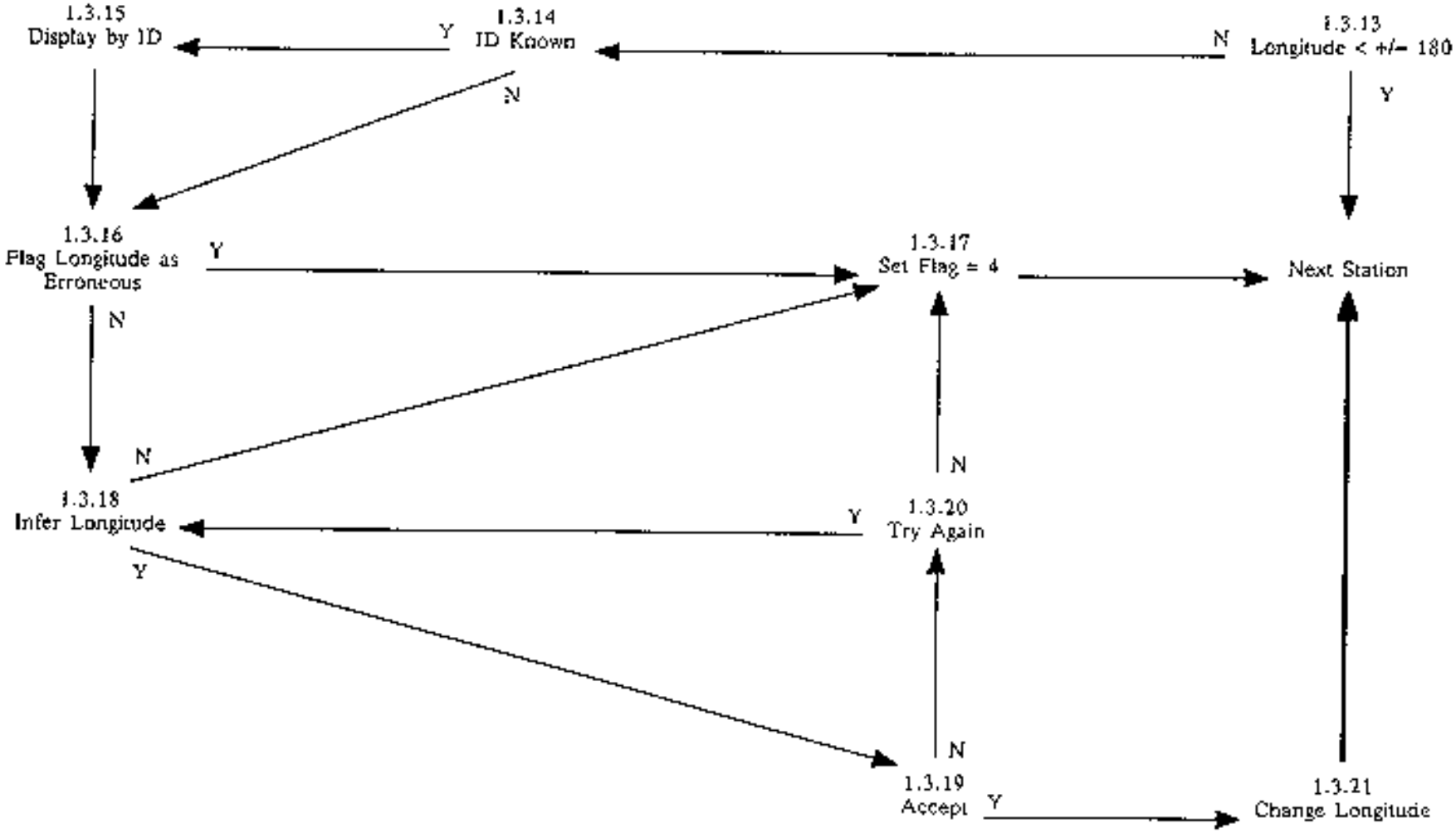
1.3.20 IF: The user chooses to try to make another inference
THEN: 1.3.18
ELSE: 1.3.17

1.3.21 : Preserve the original value of the longitude
: Replace the original longitude with the inferred value
: Set the quality flag on the longitude to be "5", changed
: Test the next station.

1.3 Impossible Location
Part 1: Impossible Latitude



1.3 Impossible Location
Part 2: Impossible Longitude



TEST NAME: 1.4 POSITION ON LAND

Prerequisites: Platform Identification Test
Impossible Date and Time Test
Impossible Position Test
A file of ocean bathymetry
Sort the file by identifier and chronologically.

Description:

This tests if the location of the observation is on land or water. It does so by comparing the location with a file of known bathymetric values. The user can choose to alter the recorded sounding, or the location of the station.

The test begins by checking if the latitude or longitude of the station has a quality flag set to be erroneous. If so, the next station is examined. If the position is not flagged as erroneous, then the position of the station is checked against a file of the ocean bathymetry to determine if the location is on land or not. If the station is at sea, it is examined to determine if there is a sounding and that the attached quality flag is not set to be erroneous. If there is no sounding, or if the value is flagged as erroneous, processing passes to the next station.

If the sounding is present and not flagged as erroneous, it is compared with the known water depth at the location of the station. If they agree, to within 10%, processing passes to the next station.

If the sounding and position do not agree, the identifier, date, time, position, sounding, depth from a bathymetry file and quality flags are displayed for the station under consideration and other stations in the neighbourhood. Also the track chart is displayed. The user can then choose to try to infer the correct sounding.

If the user chooses not to infer the sounding, the user can choose to flag the sounding as doubtful. If accepted, the quality flag is set to be "3" and processing passes to the next station. If the user chooses not to flag the sounding as doubtful, it is flagged as erroneous and processing automatically passes to the next station.

If the user accepts an inferred value, the original value is preserved, the inferred value replaces the original value, the quality flag on the sounding set to be changed, and processing passes to the next station.

If the station was determined to be on land, the identifier is examined to see if it is known. If not, the user can choose to flag the position as doubtful. If this is accepted, the quality flags on the latitude and longitude are set to be " 3 " and processing proceeds to the next station.

If the user rejects flagging the position as doubtful, the latitude and longitude are flagged as erroneous and processing proceeds to the next station.

If the identifier is known, the identifier, date, time, latitude, longitude and quality flags of the other stations with the same identifier are shown along with the same information for the suspect station. The user may choose to infer the correct position of the station. If the user chooses not to infer the position, they may choose to flag the position as doubtful as described above.

If the user chooses to accept the inference, the original value(s) of the position is preserved, the new values substituted, the quality flag set to be changed, and processing passes to check once more that the location is at sea. If the user chooses to not accept the inference, another may be tried. If no other is available or no other to be tried, the user can choose to flag the position as doubtful as described before.

History: None

Rules:

1.4.1 IF: The quality flag on the latitude or longitude is set to be erroneous
THEN : Test the next station
ELSE : 1.4.2

1.4.2 IF: The station location is at sea
THEN : 1.4.3
ELSE : 1.4.16

1.4.3 IF: There is a sounding value
THEN : 1.4.4
ELSE : Test the next station

1.4.4 IF: The value of the sounding is within 10% of the bathymetry at the location
THEN : Test the next station
ELSE : 1.4.5

1.4.5 : Display the identifier, date, time, latitude, longitude, sounding, depth and quality flags for the station under consideration
: Display the identifier, date, time, latitude, longitude, sounding, depth and quality flags for other stations in the neighbourhood of the, station under consideration
: 1.4.6

1.4.6 IF: The user chooses to infer the sounding
THEN : 1.4-7
ELSE : 1.4.13

1.4.7 IF: The user chooses to accept the inference
THEN : 1.4.9
ELSE : 1.4.8

1.4.8 IF: The user chooses to try another choice
THEN : 1.4.6
ELSE : 1.4.10

1.4.9 : Preserve the original value of the sounding
: Replace the sounding with the inferred value
: Set quality flag on the sounding to be "5", changed
: Test the next station

1.4.10 IF: The user chooses to flag the sounding as doubtful
THEN : 1.4.11
ELSE : 1.4.12

1.4.11 : Set the quality flag on the sounding to be "3", doubtful
: Test the next station

1.4.12 : Set the quality flag on the sounding to be "4", erroneous
: Test the next station

1.4.16 IF: The identifier of the station is known
: THEN 1.4.17
: ELSE 1.4.25

1.4.17 : Display the identifier, date, time, latitude, longitude, sounding, depth and quality flags for the station under consideration
: Display the identifier, date, time, latitude, longitude, sounding, depth and quality flags for other stations with the same identifier
: Display a track chart
: 1.4.18

1.4.18 IF: The user chooses to infer the position
THEN : 1.4.19

ELSE : 1.4.25

1.4.19 IF: The user chooses to accept the inference
THEN : 1.4.21
ELSE :1.4.20

1.4.20 IF: The user chooses to try another choice
THEN : 1.4.18
ELSE : 1.4.25

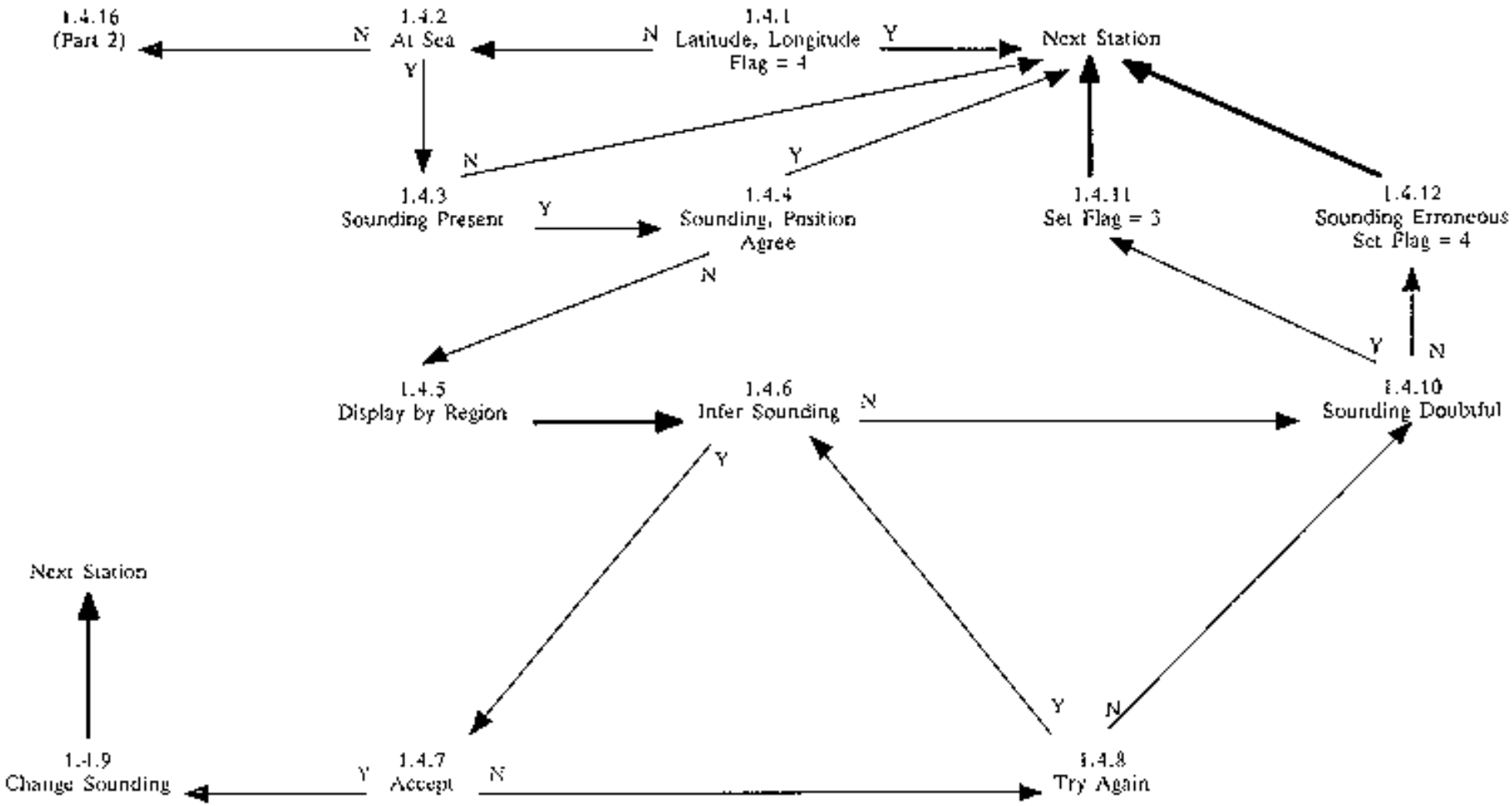
1.4.21 : Preserve the original value of the position
: Replace the position with the inferred value
: Set quality flag on the position to be "5", changed
: 1.4.2

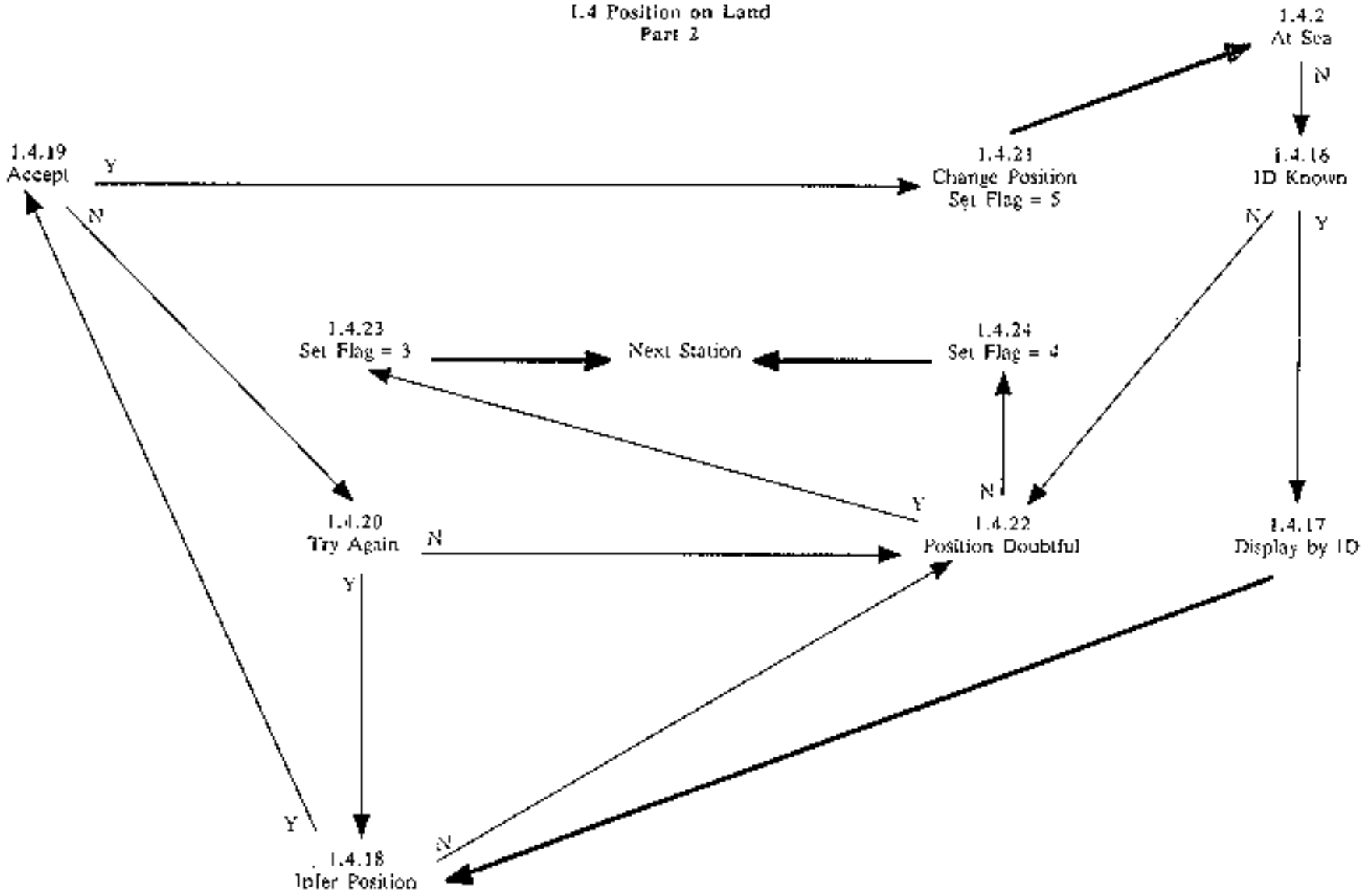
1.4.22 IF: The user chooses to flag the position as doubtful
THEN : 1.4.23
ELSE : 1.4.24

1.4.23 : Set the quality flag on the position to be "3", doubtful
: Test the next station

1.4.24 : Set the quality flag on the position to be "4", erroneous
: Test the next station

1.4 Position on Land
Part 1




1.4 Position on Land
Part 2
1.4.2
At Sea
N
1.4.19
Accept
Y
1.4.21
Change Position
Set Flag = 5
1.4.16
ID Known
N
Y
N
1.4.23
Set Flag = 3
Next Station
1.4.24
Set Flag = 4
Y
N
1.4.20
Try Again
N
1.4.22
Position Doubtful
1.4.17
Display by ID
Y
Y
N
1.4.18
Infer Position

TEST NAME: 1.5 IMPOSSIBLE SPEED

Prerequisites: Platform Identification Test
Impossible Date and Time Test
Impossible Position Test
A file of ship identifiers and maximum possible speeds
Sort the file by identifier and chronologically.

Description:

This tests if the speed of the platform conforms to the characteristics known of the platform**.** It makes use of a table of platform identifiers that records the maximum speed possible for each. Note that it tests the speed between two stations and if a problem is found, it assumes the problem lies with the station later in time.

The test begins by checking if there is more than one station of the identifier under consideration. If not, no testing can be performed. If there is more than one station, the identifier of the platform is tested to determine, if it is known. If it is not, no test of the speed may be performed and testing passes to the next station. If the identifier is known, the quality flags on the position, date and time of the station is checked. If any of these flags are set to be erroneous, processing passes to the next station. If none are set to erroneous, the speed of the platform between the first two stations is calculated based on the separation in location and time. This is compared to the maximum allowed speed for the platform. If the speed does not exceed the maximum, the next station is used to calculate the speed between stations.

If the speed exceeds the maximum allowed, the identifier, latitude, longitude, date, time and quality flags for each are displayed for all of the stations with the identifier under consideration. A track chart is also displayed. The user may then choose to examine the position of the later station of the pair that was used to calculate speed.

If the user chooses to examine the position, they may then choose to infer the correct position. If this is not selected, the user may choose to set the quality flag on the position as doubtful. If this is accepted, the quality flag is set to be doubtful, a marker set and the next station tested.

If the user chooses not to flag the position as doubtful, they may choose to flag it as erroneous. If this is accepted, the quality flag is set to be erroneous, a marker set and the next station tested.

If the user chooses to infer a position and then accepts the choice, the original position is preserved, the new position substituted, the quality flag set to indicate the position to be changed, the marker set to indicate the position was examined and processing passes to allowing the user to choose if the date and time should be examined.

If the user chooses not to flag the position as erroneous, or if the user chooses not to examine the position, they may then choose to examine the date and time of the station later in time. If this is not accepted, a marker is tested to see if the position was examined. If it was, processing passes to the next station. If it was not set, a marker is examined to see if the date and time was checked. If set, processing passes to the next station If neither marker has been set, the quality flags on the latitude, longitude date and time are all set to be doubtful, the user informed of this and processing passes to the next station.

If the user chooses to examine the date and time, then they may choose to infer the date and time. If they Choose not to, they can choose to flag the date and time as doubtful. If so, the quality flags on the year, month, clay, hour and minute are set to be doubtful. Then processing passes to the next station. If the user chooses not to flag the elate and time as doubtful, they can choose to flag them as erroneous. If so, the quality flags on the year, month, day, hour and minute are set to be doubtful. Then processing passes to the next station.

If the user chooses not to flag the date and time as erroneous, processing passes to ask the user if they wish to examine the position as described before.

The user may choose to infer the date and time and if they choose to accept it, the original value of the date and time are preserved, the new one substituted, the quality flag set to changed, and a marker set. Then if the

marker indicating the position has already been looked at, processing passes to the next station. If the marker was not set, processing allows the user to choose if the position should be examined.

History: None

Rules:

1.5.1 IF: There is more than 1 station with the same identifier
THEN : 1.5.2
ELSE : Test the next station

1.5.2 IF: The identifier is known
THEN : 1.5.3
ELSE : Test the next station

1.5.3 IF: Either the latitude nor longitude have a quality flag set to be erroneous
THEN : Test the next station
ELSE : 1.5.4

1.5.4 IF: The year, month, day, hour or minute have a quality flag set to be erroneous
THEN : Test the next station
ELSE : 1.5.5

1.5.5 IF: The speed between the station in question and the next earlier station is less than or equal to the maximum speed for the platform
THEN : Test the next station
ELSE : 1.5.6

1.5.6 : Display the identifier, latitude, longitude, year, month, day, hour, minute and quality flags for the later station Display the identifier, latitude, longitude, year, month, day, hour, minute and quality flags for the earlier station Display a track chart
: 1.5.7

1.5.7 IF: The user chooses to examine the position
THEN : 1.5.8
ELSE : 1.5.20

1.5.8 IF: The user chooses to infer the position of the later station
THEN : 1.5.9
ELSE : 1.5.16

1.5.9 IF: The user chooses to accept the choice
THEN : 1.5.11
ELSE : 1.5.10

1.5.10 IF: The user chooses to try again
THEN : 1.5.8
ELSE : 1.5.13

1.5.11 : Preserve the original value of the position
: Change the value of the position according to the inferred value
: Set the quality flag on the position to be "5", changed the position marker
: 1.5.12

1.5.12 IF: The date marker is set
THEN : Test the next station
ELSE : 1.5.20

1.5.13 IF: The user chooses to flag the position as doubtful
THEN : 1.5.14
ELSE : 1.5.15

1.5.14 : Set the quality flags on the latitude and longitude to be "3", doubtful
: Test the next station

1.5.15 IF: The user chooses to flag the position as erroneous
THEN : 1.5.16
ELSE : 1.5.20

1.5.16 : Set the quality flags on the latitude and Iongitude to be "3", erroneous
: Test the next station

1.5.20 IF: The user chooses to examine the date and time of the second station
THEN : 1.5.24
ELSE : 1.5.21

1.5.21 IF: The position marker has been set
THEN : Test the next station
ELSE : 1.5.22

1.5.22 IF: The date marker has been set
THEN : Test the next station
ELSE : 1.5.23

1.5.23 : Set the quality flags on the latitude and longitude to be "3", doubtful
: Set the quality flags on the year, month, day, hour and minute to be doubtful
: Test the next station

1.5.24 IF: The user chooses to infer the date and time of the later station
THEN : 1.5.25
ELSE : 1.5.29

1.5.25 IF: The user chooses to accept the choice
THEN : 1.5.27
ELSE : 1.5.26

1.5.26 IF: The user chooses to try again
THEN : 1.5.24
ELSE : 1.5.29

1.5.27 : Preserve the original value of the date and time
: Change the value of the date and time according to the inferred value
: Set the quality flag on the date to be "5", changed
: Set the date marker
: 1.5.28

1.5.28 IF: The position marker is set
THEN : Test the next station
ELSE : 1.5.7

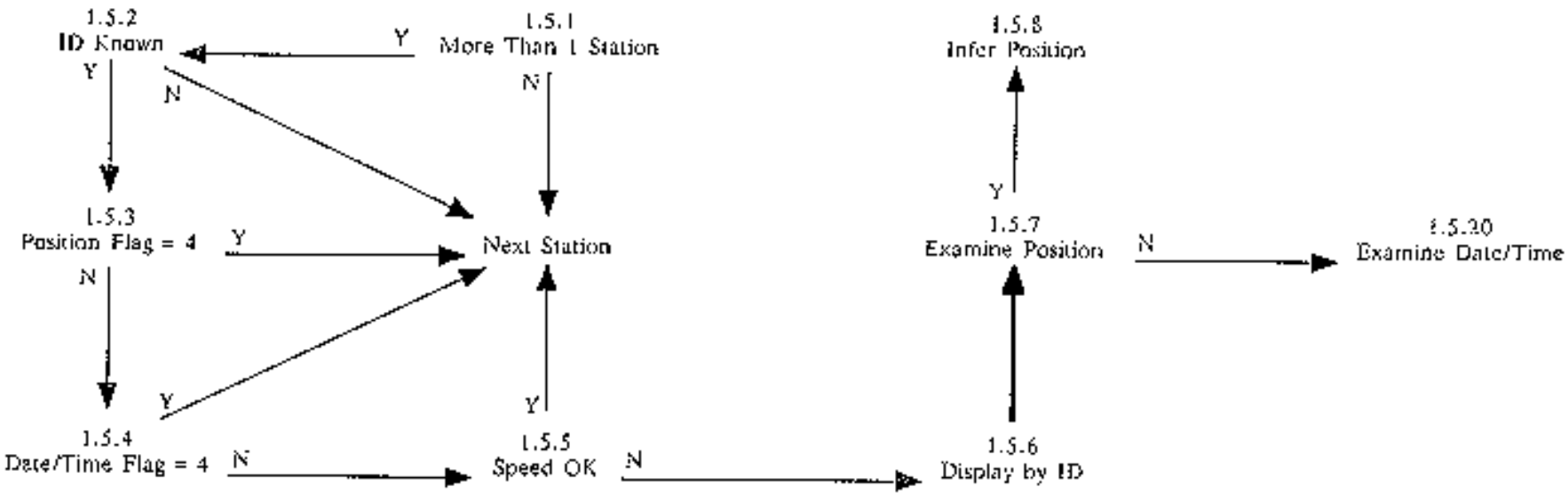
1.5.29 IF: The user chooses to flag the date and time as doubtful
THEN : 1.5.30
ELSE : 1.5.31

1.5.30 : Set the quality flags on the year, month, day, hour and minute to be doubtful
: Test the next station

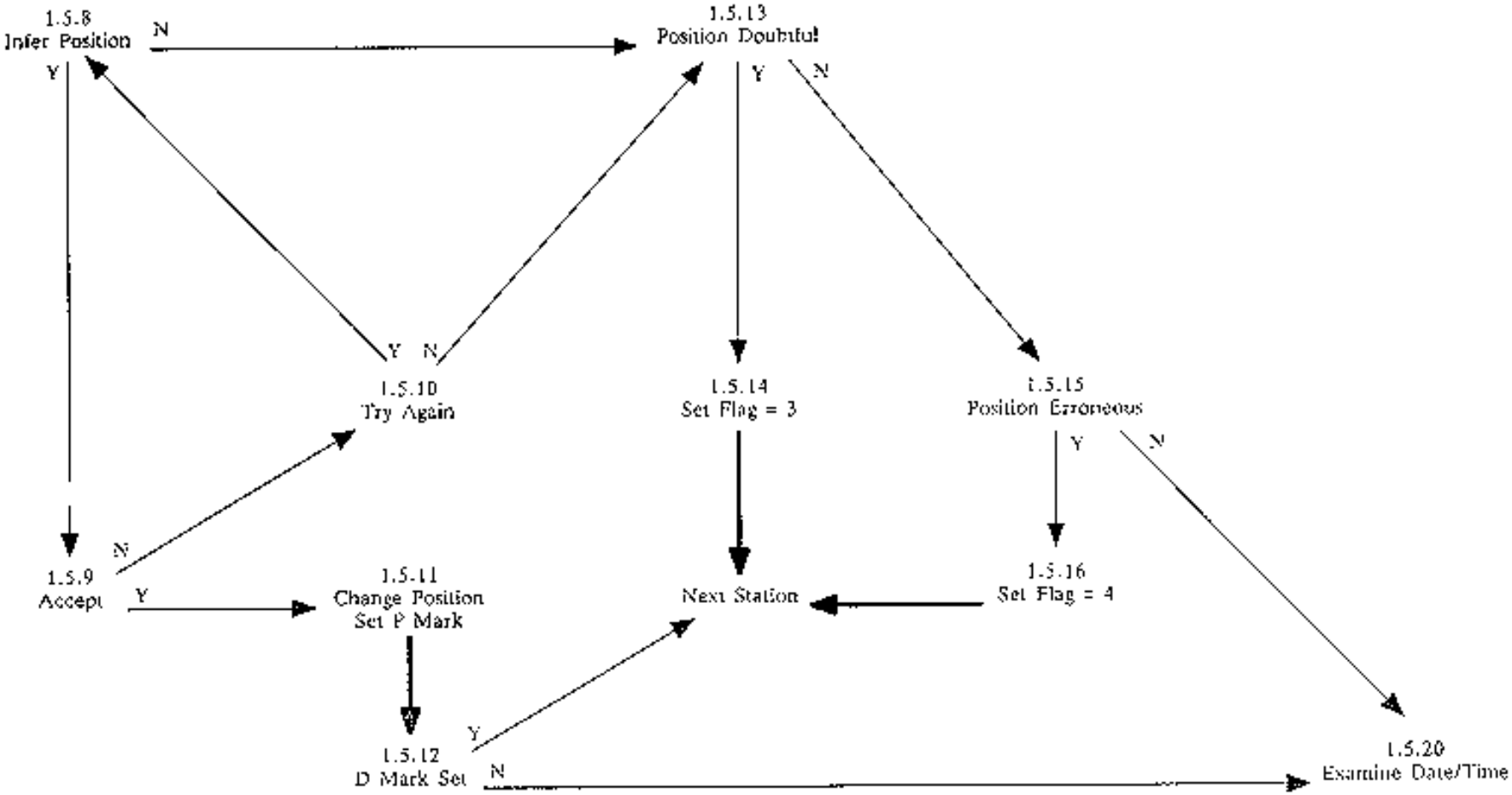
1.5.31 IF: The user chooses to flag the date and time as erroneous
THEN : 1.5.32
ELSE : 1.5.7

1.5.32 : Set the quality flags on the year, month, day, hour and minute to be erroneous
: Test the next station

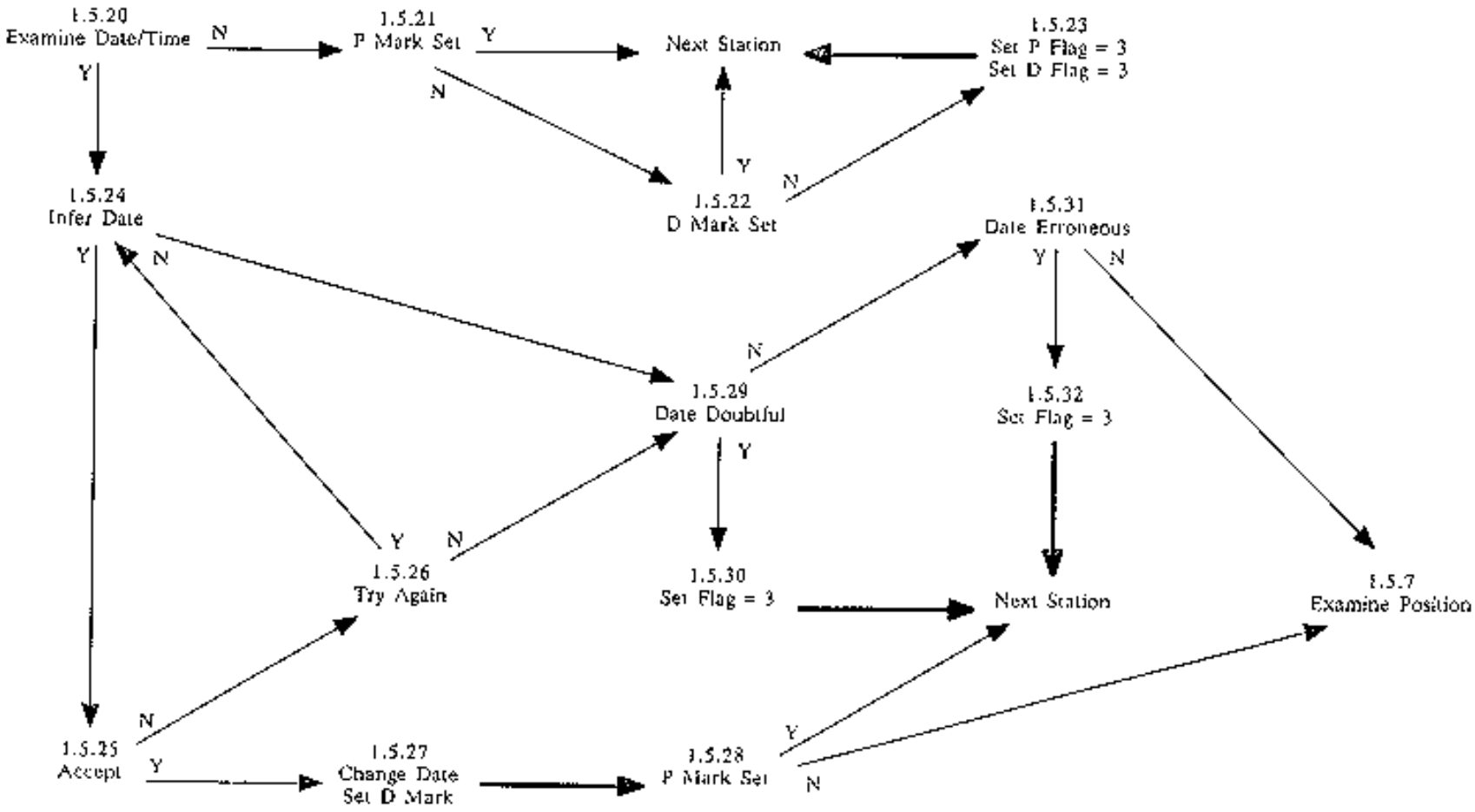
1.5 Impossible Speed
Part 1



1.5 Impossible Speed
Part 2



1.5 Impossible Speed
Part 3



TEST NAME: 1.6 IMPOSSIBLE SOUNDING

Prerequisites: Platform Identification Test
Impossible Date and Time Test
Impossible Position Test
Sort the file by identifier and chronologically

Description:

This tests if the sounding is sensible given a digital bathymetry.

The test begins by checking if the latitude or longitude of the station has a quality flag set to be erroneous. If so, the next station is examined. If the position is flagged as erroneous, the station is checked to see if the sounding is present. If present, the quality flag is set to be unchecked. If the sounding is not present, the next station is tested.

If the position is not flagged as erroneous, the station is checked to see if the sounding is present. If not present, the next station is tested. If the sounding is present, it is tested to be within 10% of the bathymetry. If it is, the quality flag on the sounding is set to be good.

If the sounding does not agree with the bathymetry, the user can choose to set the quality flag to be doubtful. If this is chosen, the quality flag is set to be doubtful. If the user chooses not to flag the sounding as doubtful, it is flagged as erroneous. No matter which flag is set, processing passes to test the next station.

History: None

Rules:

1.6.1 IF: The quality flag on the latitude or longitude is set to be erroneous
THEN : 1.6.2
ELSE : 1.6.4

1.6.2 IF: The sounding is present
THEN : 1.6.3
ELSE : Test the next station

1.6.3 : Set the quality flag on the sounding to be unchecked
: Test the next station

1.6.4 IF: The sounding is present
THEN : 1.6.5
ELSE : Test the next station

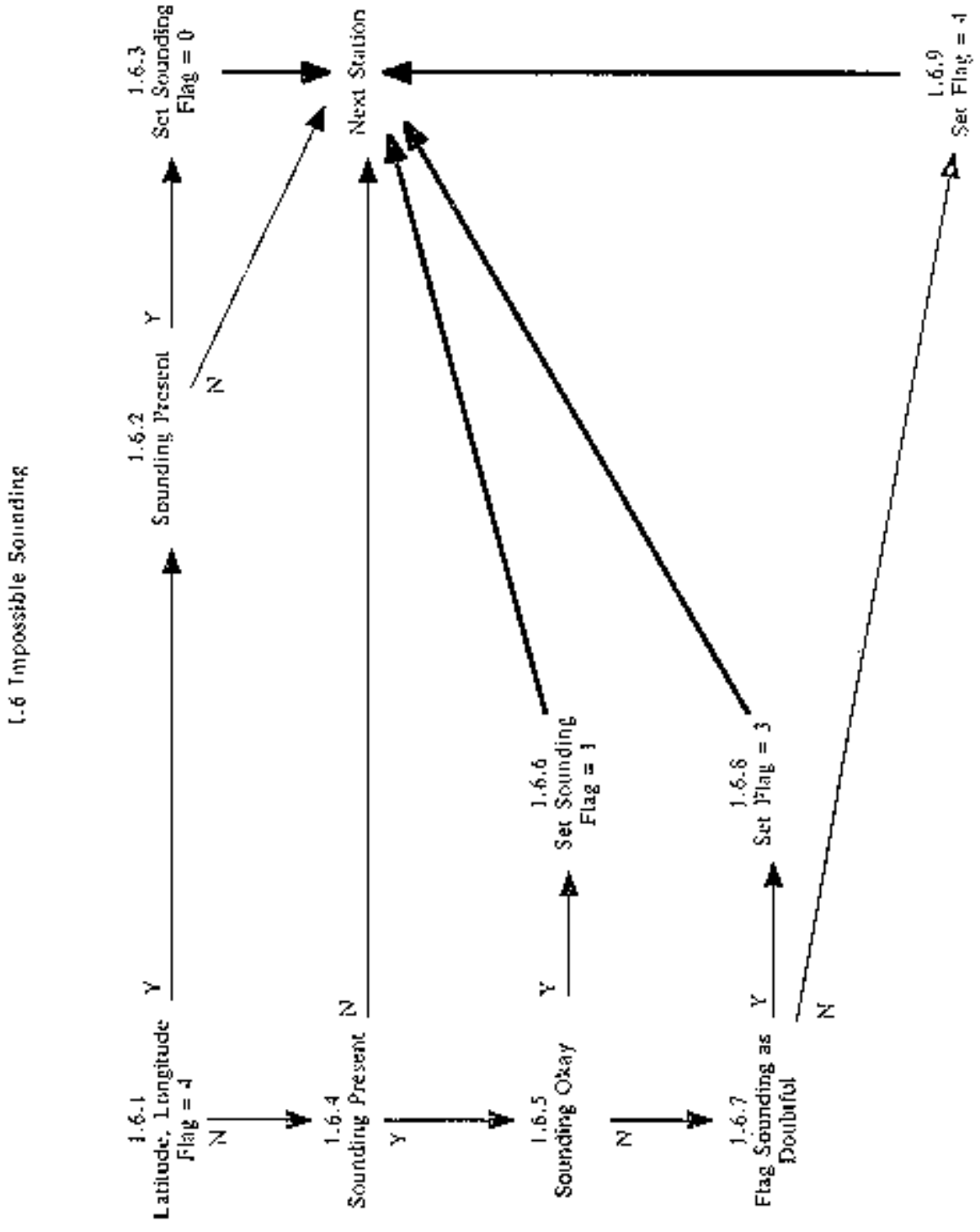
1.6.5 IF: The sounding is within 10% of the bathymetry
THEN : 1.6.6
ELSE : 1.6.7

1.6.6 : Set the quality flag on the sounding to be good
: Test the next station

1.6.7 IF: The user chooses to flag the sounding as doubtful
THEN : 1.6.8
ELSE : 1.6.9

1.6.8 : Set the quality flag on the sounding to be doubtful
: Test the next station

1.6.9 : Set the quality flag on the sounding to be erroneous
: Test the next station


1.6 Impossible Sounding
1.6.1
Latitude, Longitude
Flag = 4
1.6.2
Sounding Present
1.6.3
Set Sounding
Flag = 0
1.6.4
Sounding Present
1.6.5
Sounding Okay
1.6.6
Set Sounding
Flag = 1
1.6.7
Flag Sounding as
Doubtful
1.6.8
Set Flag = 3
1.6.9
Set Flag = 4
Next Station
Y
N

TEST NAME: 2.1 GLOBAL IMPOSSIBLE PARAMETER VALUES

Prerequisites: All of Stage 1 tests
The data should be sorted by identifier. For each unique identifier, the data should be sorted by increasing observation date and time ignoring any quality flags
All directional values should be converted on input to values between 0 and 360 degrees with north being zero degrees and cast being 90 degrees.

Description:

These rules are used to check if observed parameter values are within probable globally defined limits. It begins by examining the first parameter at the shallowest depth and proceeds to look at other parameter values at the same depth before looking at values at the next depth. The test begins by examining if the parameter value exceeds the maximum recorded in table 2.1 below. If it does not, the value is tested against the minimum value as is described below. If it does exceed the maximum, the identifier for the profile is checked to see if it is known. If it is unknown, the identifier and value of the parameter at all depths of the profile are displayed. As well, the same information for the depth being considered in the suspect profile at other profiles in the neighbourhood are displayed. If the identifier is known, the identifier and value of the parameter at all depths of the profile and the same information for the depth being considered in the suspect profile for other profiles with the same identifier in the input file are displayed. In either case, the user can then choose to infer the value or not. If the user chooses not to inter the value, they may choose to flag the value as doubtful.

If an inference is made, the original value is changed, the original is preserved and the quality flag set to "changed". Then a marker is tested to see if the value has been tested against the minimum value. If so, the next parameter value is tested. If not, the test checks the value against the permitted minimum as in table 2.1 below.

If the user chooses to flag a value as doubtful, the quality flag is set to be doubtful. If not set as doubtful, it is set as erroneous. In either case, the marker is then tested as described above.

The test then goes on to test if the same parameter value is less than or equal to the minimum value recorded in table 2.1. If it is not, the parameter is tested to see if it is the wind direction. If not, the quality flag is tested to see if it has already been set. If so that next parameter is tested. If not, the quality flag is set to good, and the next parameter tested.

If the value is equal to the minimum, the parameter is examined further to see if it is recording a direction. If not, the quality flag is examined and if not set already, it is set to be good. If already set, or when set to good, the next parameter is tested.

If it is a direction, and the value is equal to the minimum, and the data source uses this minimum to indicate calm conditions, the quality flag is examined if any of these conditions are not met. If all of the conditions are met, the corresponding speed value is examined. For example, if wind direction was the parameter derived from an IGOSS source, and the value was zero, the wind speed value would be tested. If the speed value is zero, the quality flag is examined. If not zero, the identifier is examined to see if it is known. If it is unknown, the identifier, speed and direction at all depths of the profile are displayed. As well, the same information for the depth being considered in the suspect profile at other profiles in the neighbourhood are displayed. If the identifier is known, the identifier, speed and direction at all depths of the profile and the same information for the depth being considered in the suspect profile for other profiles with the same identifier in the input file are displayed. In either case, the user can then choose to infer either the speed or direction value.

If an inference is made, the original value is saved and the quality flag set to "changed". Then the next parameter is tested.

If the user chooses not to infer a value, they may choose to flag the value as doubtful. If this is not accepted, the value is flagged as erroneous. In either case, the next parameter is then tested.

Table 2.1: Global Impossible Parameter Values

PARAMETER	MIN	MAX	
Wind Speed	0	60	m/sec
Wind Direction	0	360	degrees
Air Temperature (Dry)	-80	40	degrees C
Air Pressure	850	1060	hectoPascals
Air Pressure Tendency	-30	30	hPa/hour
Water Temperature	-2.5	35	degrees C
Salinity	0	40	psu
Current Speed	0	3	m/sec
Current Direction	0	360	degrees
Cloud Code	0	9	
Air Pressure	950	1050	mb
Weather Code	0	9	
Wave Period	0	20	sec
Wave Height	0	30	m
Sounding	0	10000	m
Depth	0	10000	m

History: None

Rules:

2.1.1 IF: The parameter value is greater than the maximum value in table 2.1
THEN : 2.1.2
ELSE : Set the marker 2.1.16

2.1.2 IF: The identifier is known
THEN : 2.1.3
ELSE : 2.1.4

2.1.3 : Display the identifier and parameter values for the profile with the suspect value
: Display the identifiers and parameter values for all other stations with the same identifier in the incoming file and at the same depth as the suspect value
: 2.1.5

2.1.4 : Display the identifier and parameter values for the profile with the suspect value
: Display the identifiers and parameter values for other stations in the incoming file and in the neighbourhood of the profile in question and at the same depth as the suspect value
: 2.1.5

2.1.5 IF: The user wishes to infer the value
THEN : 2.1.9
ELSE : 2.1.6

2.1.6 IF: The user wishes to flag the value as doubtful
: THEN 2.1.7
: ELSE 2.1.8

2.1.7 : Set the quality flag on the value to be "3", doubtful
: 2.1.12

2.1.8 : Notify the user that the quality flag is set to erroneous
: Set the quality flag on the value to be "4", erroneous
: 2.1.12

2.1.9 IF: The user chooses to accept an inference
THEN : 2.1.11

ELSE : 2.1.10

2.1.10 IF: The user chooses to try again
THEN : 2.1.5
ELSE : 2.1.6

2.1.11 : Preserve the original value
: Reset the parameter value to the new value
: Set the quality flag on the parameter to "5", changed'
: 2.1.12

2.1.12 IF: A marker is set indicating that the value has been tested against the maximum value
THEN : Clear the marker
: Test the next parameter
ELSE : Set the marker to indicate the value has been tested against the maximum
: 2.1.16

2.1.16 IF: The parameter value is less than the minimum value in table 2.1
THEN : 2.1.2
ELSE : 2.1.17

2.1.17 IF: The parameter is a direction
THEN : 2.1.20
ELSE : 2.1.18

2.1.18 IF: The quality flag is already set
THEN : Clear the marker
: Test the next parameter
ELSE : 2.1.19

2.1.19 : Set the quality flag to be good
: Clear the marker
: Test the next parameter

2.1.20 IF: The parameter value equals the minimum value in table 2.1
THEN : 2.1.21
ELSE : 2.1.18

2.1.21 IF: The data source uses the minimum direction value to indicate calm conditions
THEN : 2.1.22
ELSE : 2.1.18

2.1.22 IF: The corresponding parameter value for speed has a value of zero
THEN : 2.1.18
ELSE : 2.1.23

2.1.23 IF: The identifier of the profile is known
THEN : 2.1.25
ELSE : 2.1.24

2.1.24 : Display the identifier, speed and direction for the profile with the suspect value
: Display the identifier, speed and direction for other stations in the incoming file and in the neighbourhood of the profile in question and at the same depth as the suspect value
: 2.1.26

2.1.25 : Display the identifier, speed and direction for the profile with the suspect value
: Display the identifier, speed and direction for all other stations with the same identifier in the incoming file and at the same depth as the suspect value

: 2.1.26

2.1.26 IF: The user chooses to infer the speed and/or direction
THEN : 2.1.30
ELSE : 2.1.27

2.1.27 IF: The user chooses to flag the value as doubtful
THEN : 2.1.28
ELSE : 2.1.29

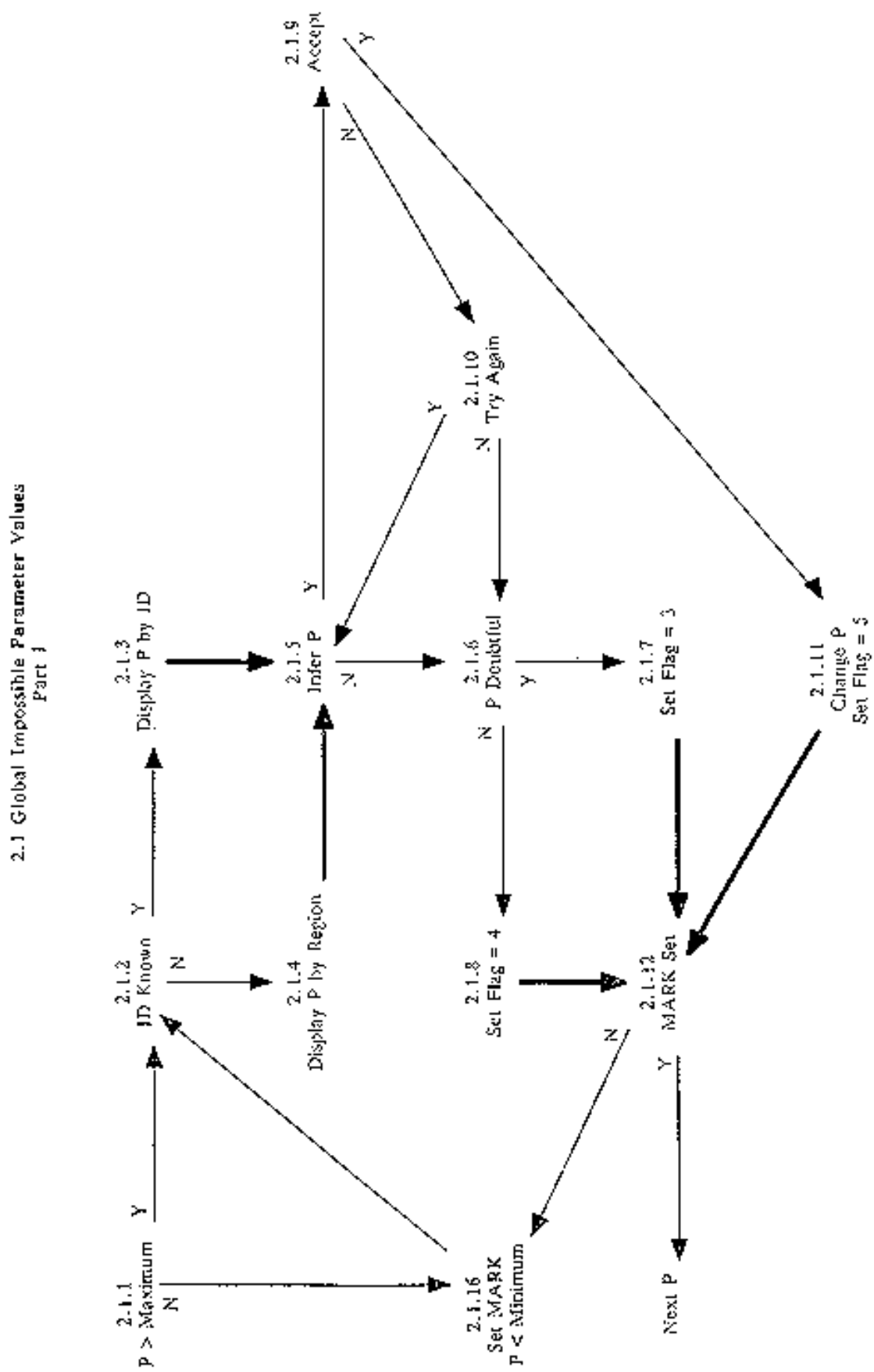
2.1.28 : Set the quality flag on the value to be "3", doubtful
: Clear the marker
: Test the next parameter

2.1.29 : Notify the user that the quality flag is set to erroneous
: Set the quality flag on the value to be "4", erroneous
: Clear the marker
: Test the next parameter

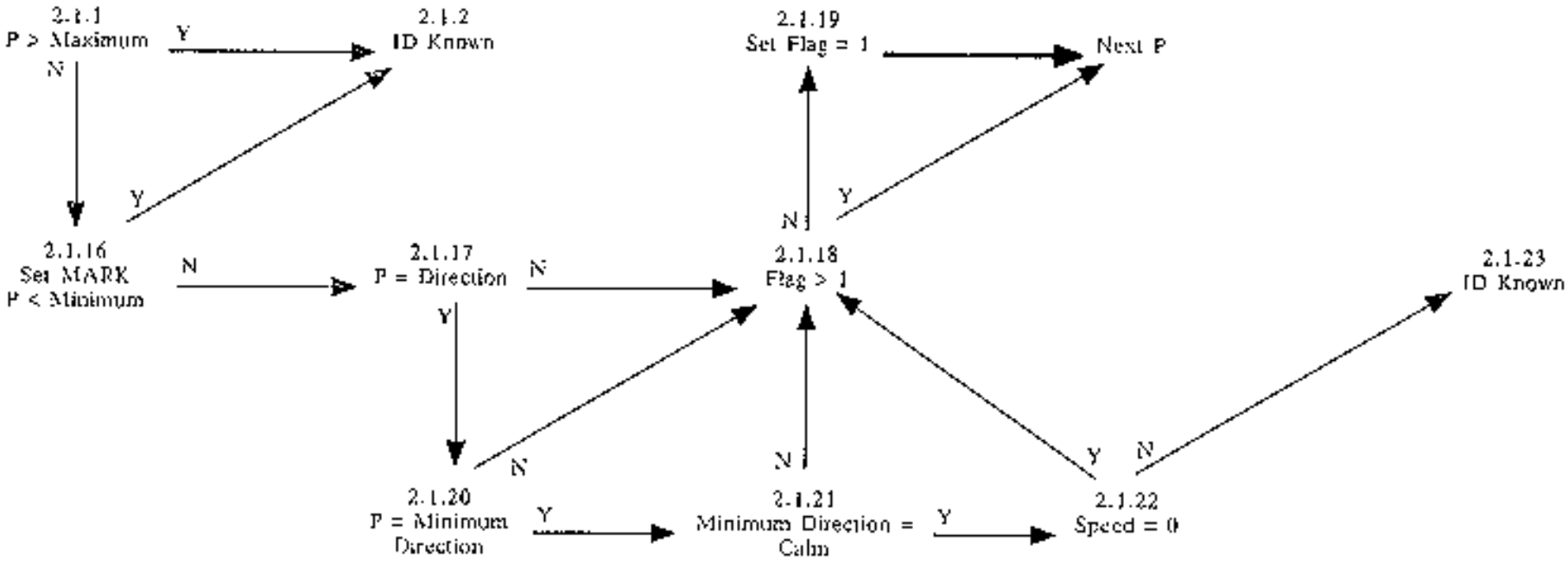
2.1.30 IF: The user chooses to accept an inference
THEN : 2.1.32
ELSE : 2.1.31

2.1.31 IF: The user chooses to try again
THEN : 2.1.29
ELSE : 2.1.27

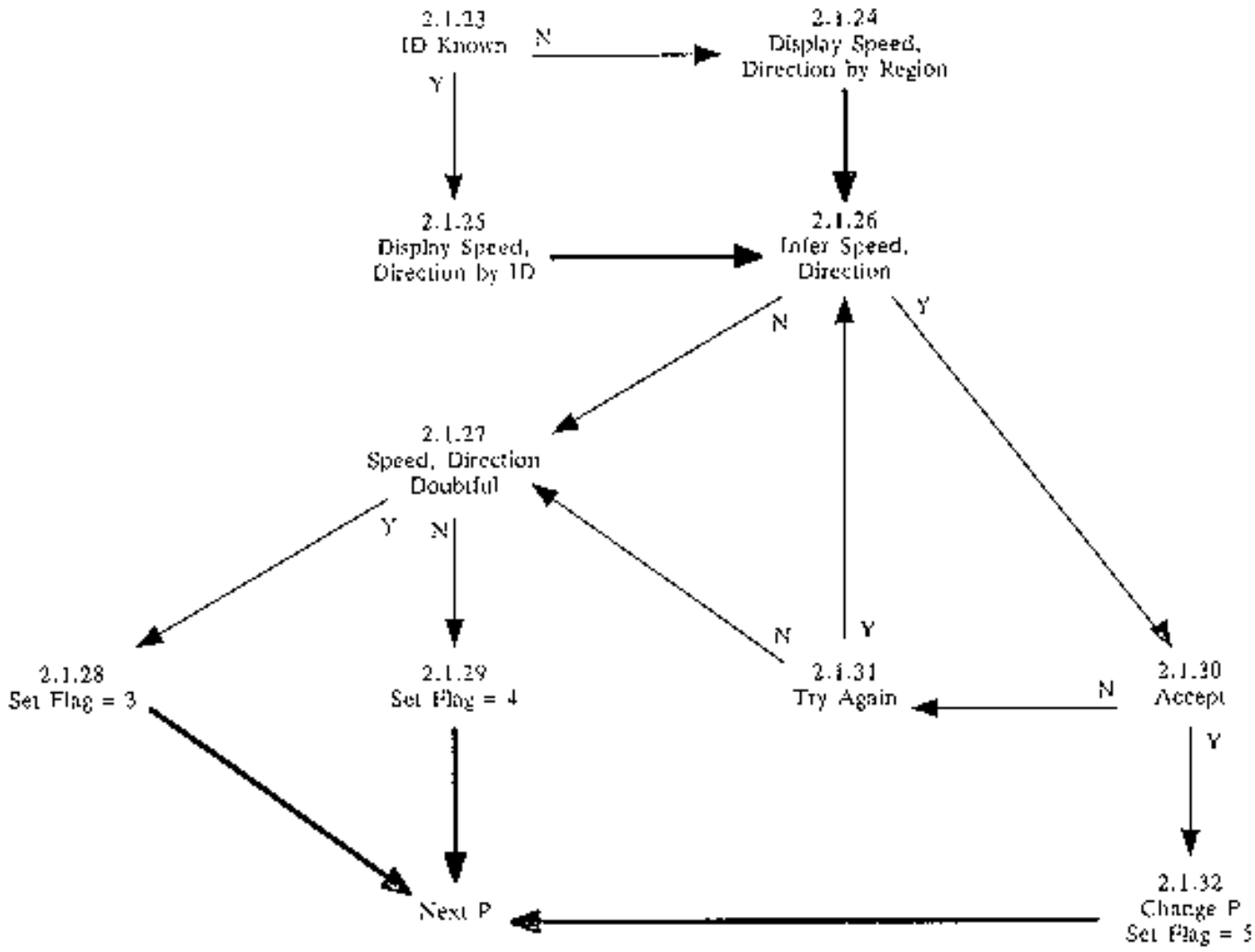
2.1.32 : Preserve the original value of speed and/or direction
: Reset the speed and/or direction to the new value(s)
: Set the quality flag on the speed and/or direction to "5", changed
: Clear the marker
: Test the next parameter


2.1 Global Impossible Parameter Values
Part 1
2.1.1
P > Maximum
Y
N
2.1.2
ID Known
Y
N
2.1.3
Display P by ID
2.1.4
Display P by Region
2.1.5
Infer P
Y
N
2.1.6
P Doubtful
N
Y
2.1.7
Set Flag = 3
2.1.8
Set Flag = 4
2.1.9
Accept
Y
N
2.1.10
Try Again
Y
N
2.1.11
Change P
Set Flag = 5
2.1.12
MARK Set
Y
N
2.1.16
Set MARK
P < Minimum
Next P

2.1 Global Impossible Parameter Values
Part 2A



2.1 Global Impossible Parameter Values
Part 2B



TEST NAME: 2.2 REGIONAL IMPOSSIBLE PARAMETER VALUES

Prerequisites: All of Stage 1 tests
Global Impossible Parameter Values Test

The data should be sorted by identifier. For each unique identifier, the data should be sorted by increasing observation date and time ignoring any quality flags

All directional values should be converted on input to values between 0 and 360 degrees with north being zero degrees and cast being 90 degrees.

Description:

This test allows for a more precise examination of parameter values based on the geographic region in which the observation was made. To begin, the quality flags on the latitude and longitude are examined. If either is flagged as erroneous, the data from the next station are examined. If the position is not erroneous, and the station lies within the boundaries of a geographic region given in table 2.2, then the parameter value is tested against values given in the same table. If no test is given, the data at the next station are tested. If the data lie within a region defined in Table 2.2, the same rules, and logic is used as in the Global Impossible Parameter Test.

Table 2.2 Regional Impossible Parameter Values

REGION NAME		LOCATION
Mediterranean Sea		30N,4E; 30N,4OE; 40N,35E; 42N,20E; 50N,15E; 40N,5E; 30N,4E
PARAMETER	**MIN**	**MAX**
Water temperature	13.0	40.0 degrees C
Depth/sounding	0.0	5200 m
Red Sea		10N,40E; 20N,5OE; 30N,30E; 10N,40E
PARAMETER	**MIN**	**MAX**
Water temperature	21.7	40.0 degrees C
Depth/sounding	0.0	3500 m

History: None

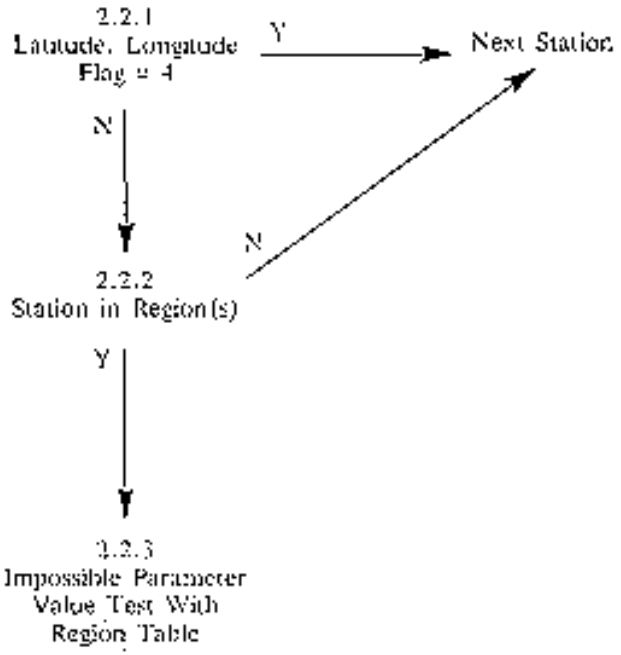
Rules:

2.2.1 IF: The latitude or longitude has a quality flag of erroneous
THEN : Test the next station
ELSE : 2.2.2

2.2.2 IF: The station lies within a region(s) defined in table 2.2
THEN : 2.2.3
ELSE : Test the next station

2.2.3 : (Execute the rules of the Global Impossible Parameter Test)

2.2 Impossible Regional Parameter Value



TEST NAME: **2.3 INCREASING DEPTH**

Prerequisites: All of Stage 1 tests
Depths are ordered from shallowest to deepest in a profile

Description:

These rules test if the depths of the observations are monotonically increasing. DEPTH1 always refers to the depth being examined, DEPTH2 to another depth at the station. The test begins by determining if there is more than one depth in the profile. If not, the next profile is examined. If there is more than one depth, DEPTH1 is set to the first depth and the quality flag is examined. If this quality flag is set to erroneous, DEPTH1 is tested to determine if it is the deepest in the profile. If it is, the next profile is examined. If it is not, DEPTH1 is set to the next depth, and this test of the quality flag repeated. If DEPTH1 is not indicated as erroneous, DEPTH2 is set to be the next depth and the quality flag on it is tested. If it is set as erroneous, DEPTH2 is tested if it is the deepest. If so, the next profile is examined. If not, DEPTH2 is set to the next depth and the test of the quality flags repeated. If the quality flag is not set to erroneous, DEPTH2 is tested to be greater than DEPTH1. If it is greater, DEPTH1 is set to DEPTH2.. Then, DEPTH2 is tested to determine if it is the deepest in the profile as described above. If DEPTH2 is not greater than DEPTH1, the user can flag DEPTH2 as doubtful or erroneous. In either case, DEPTH1 is set to DEPTH2 and the process repeats down the profile until the deepest depth is tested. At this point, the next profile is tested.

History: None

Rules:

2.3.1 IF: There is more than 1 depth in the profile
THEN : 2.3.2
ELSE : Test the next profile

2.3.2 : Set DEPTH1 to be the first depth
: 2.3.3

2.3.3 IF: The value of DEPTH1 has a quality flag set to be erroneous
THEN : 2.3.4
ELSE : 2.3.6

2.3.4 IF: DEPTH1 is the deepest depth in the profile
THEN : Test the next profile
ELSE : 2.3.5

2.3.5 : Set DEPTH1 to be the next depth in the profile
: 2.3.3

2.3.6 : Set DEPTH2 to be the next depth in the profile
: 2.3.7

2.3.7 IF: The value of DEPTH2 has a quality flag set to be erroneous
THEN : 2.3.8
ELSE : 2.3.9

2.3.8 IF: DEPTH2 is the deepest depth in the profile
THEN : Test the next profile
ELSE : 2.3.6

2.3.9 IF: DEPTH2 is deeper than DEPTH1
THEN : 2.3.10
ELSE : 2.3.11

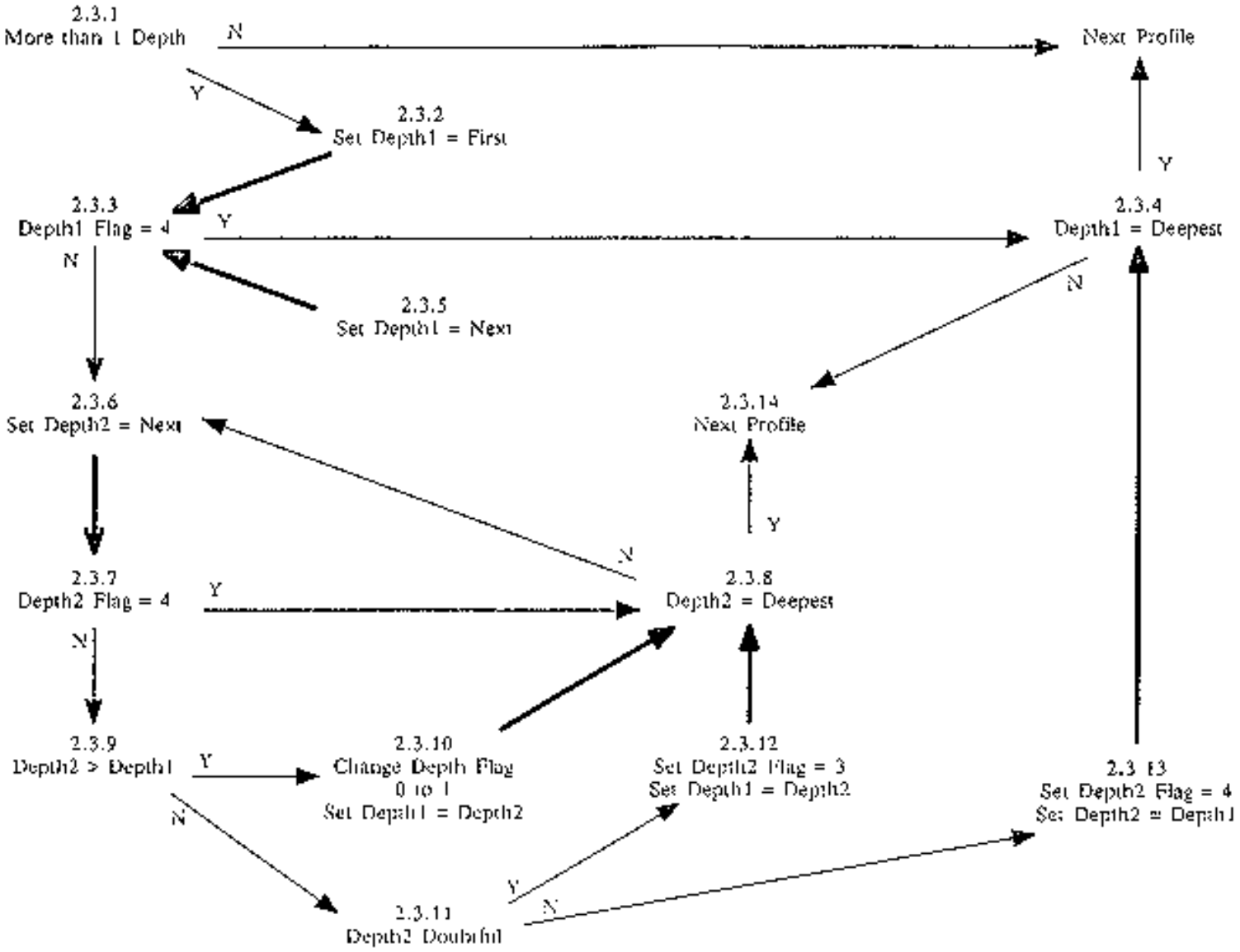
2.3.10 : Change the quality flagon the depth from "0", unchecked, to "1", correct
: Set DEPTH1 = DEPTH2
: 2.3.8

2.3.11 IF: The user chooses to flag DEPTH2 as doubtful
THEN : 2.3.12
ELSE : 2.3.13

2.3.12 : Set the quality flag on DEPTH2 to "3", doubtful
: Set DEPTH1 = DEPTH2
: 2.3.8

2.3.13 : Notify the user that the value is flagged as erroneous
: Set the quality flag on DEPTH2 to "4"', erroneous
: Set DEPTH1 = DEPTH2
: 2.3.4

2.3 Depth Increasing



TEST NAME: 2.4 GLOBAL PROFILE ENVELOPE

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Parameter values are ordered from shallowest to deepest depth
Profiles are sorted by identifier, then increasing date and time for each identifier

Description:

These rules test if the observed values lie within an envelope of permitted values within depth ranges. It begins by ensuring that the first parameter recorded at a station has a defined envelope. If not, it tests if there is another parameter at the station to test. If not, the next station is tested. If there is another parameter at the station, it is tested to see if there is a defined envelope as just described.

If an envelope is defined for the parameter profile under consideration, the quality flag for the first depth is examined. If it is set to erroneous, the depth is tested to see if it is the deepest. If so the station is tested to see if there is another parameter to be tested. If the depth is not the deepest, the depth is set to be the next, and the quality flag on the depth tested as described.

If the quality flag on the depth is not set to erroneous, the quality flag on the parameter value is examined. If it is set to erroneous, the depth is examined to see if it is the deepest.

If the parameter flag is not set to erroneous, the parameter value is tested to lie within the envelope defined in table 2.4. If it lies within, the depth is tested if it is the deepest. If the value lies outside of the envelope the identifier of the station is examined to see if it is known. If not, the entire parameter profile and quality flags are displayed. The parameter values and quality flags at the same depth and at stations in the neighbourhood of the station with the suspect value are also displayed. If the identifier is known, the same information as above is displayed but now for stations with the same identifier as the station with the suspect value. The user can then choose to infer the value of the suspect parameter.

If the user chooses to infer the value, it may be flagged as doubtful. If this is selected, the quality flag on the value is set to be doubtful, and the depth tested to determine if it is the deepest. If the user rejects flagging the value as doubtful, it is flagged as erroneous, and the depth tested as just described.

The user may choose to infer the value, the results are displayed and then may choose to accept it or not. If accepted, the old value is preserved, the new value substituted for it and the quality flag set to changed. If the user rejects the choice, they may choose to try again or flag the profile as doubtful.

Table 2.4: Parameter envelopes

Depth Range (metres)	**Temperature** (degrees C)	**Salinity** (psu)
0 to 50	-2.5 to 35.0	0.0 to 40.0
>50 to 100	-2.5 to 30.0	1.0 to 40.0
>100 to 400	-2.5 to 28.0	3.0 to 40.0
>400 to 1100	-2.0 to 27.0	10.0 to 40.0
>1100 to 3000	-1.5 to 18.0	22.0 to 38.0
>3000 to 5500	-1.5 to 7.0	33.0 to 37.0
> 5500	-1.5 to 4.0	33.0 to 37.0

History: None

Rules:

2.4.1 : Set the first parameter to be the one to consider
: Set the depth to be the shallowest in the profile
: 2.4.2

2.4.2 IF: An envelope is defined for the parameter
THEN : 2.4.5
ELSE : 2.4.3

2.4.3 IF: There is another parameter profile at the station
THEN : 2.4.4
ELSE : Test the nest station

2.4.4 : Set the parameter under consideration to be the next for the station
: Set the depth to be the shallowest for the parameter
: 2.4.2

2.4.5 IF: The quality flag on the depth is set to be erroneous
THEN : 2.4.6
ELSE : 2.4.8

2.4.6 IF: The depth is the deepest for that parameter in the profile
THEN : 2.4.3
ELSE : 2.4.7

2.4.7 : Set the depth to be the next deeper in the profile
: 2.4.5

2.4.8 IF: The quality flag on the parameter is set to erroneous
THEN : 2.4.6
ELSE : 2.4.9

2.4.9 IF: The parameter value lies within the envelope defined in table 2.4
THEN : 2.4.6
ELSE : 2.4.10

2.4.10 IF: The identifier of the station is known
THEN : 2.4. 11
ELSE : 2.4.12

2.4.11 : Display the identifier, parameter values and quality flags at all depths in the profile under consideration
: Display the identifier, parameter values and quality flags at the same depth as the suspect value at all stations with the same identifier as the suspect station
: 2.4.13

2.4.12 : Display the identifier, parameter values and quality flags at all depths in the profile under consideration
: Display the identifier, parameter values and quality flags at the same depth as the suspect value at all stations in the neighbourhood of the suspect station
: 2.4.13

2.4.13 IF: The user chooses to infer the parameter value
THEN : 2.4.17
ELSE : 2.4.14

2.4.14 IF: The user chooses to flag the value as doubtful
THEN : 2.4.15
ELSE : 2.4.16

2.4.15 : Set the quality flag on the value to "3", doubtful
: 2.4.6

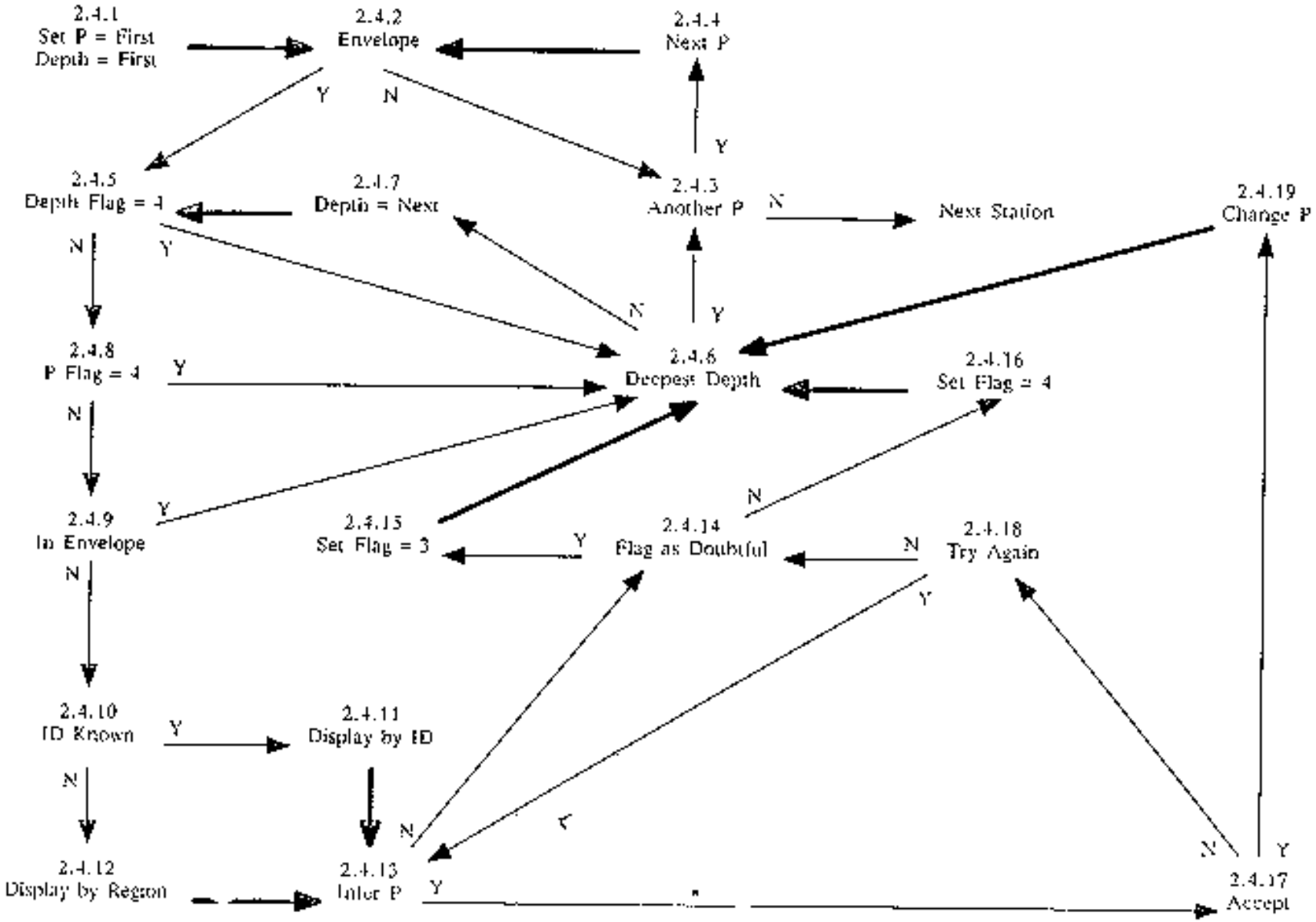
2.4.16 : Set the quality flag on the value to "4", erroneous
: 2.4.6

2.4.17 IF: The user chooses to accept an inference
THEN : 2.4.19
ELSE : 2.4.18

2.4.18 IF: The user chooses to try again
THEN :2.4.13
ELSE : 2.4.14

2.4.19 : Preserve the original value of the parameter
: Reset the parameter value to the new value
: Set the quality flag on the parameter to "5", changed
: 2.4.6

2.4 Global Profile Envelope



TEST NAME: 2.5 CONSTANT PROFILE

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Profiles sorted by identifier and by increasing date and time for each identifier.
Depths are ordered from shallowest to deepest

Description:

The test is applied in two forms to data received through the IGOSS system. The first applies to those stations that have data digitized at inflection points. If not digitized at inflection points, the second form of the test is applied.

If the data were digitized at inflection points, then there must be observations at more than 2 depths. If not, the next profile is examined. If there are more than two depths, DEPTH1 is set to be the first depth, DEPTH2 the next depth and DEPTH3 the next depth. VALUE1, VALUE2 and VALUE3 are set to be the values of the parameter at the depths just defined. If any of the quality flags at the three depths is set to be erroneous, DEPTH3 is tested to determine if it is the deepest. If so, the next profile is tested. If not, DEPTH1 is set to DEPTH2, DEPTH2 is set to DEPTH3, VALUE1 is set to VALUE2 and VALUE2 is set to VALUE3. DEPTH3 is set to the next depth in the profile and VALUE3 to the value of the parameter at the new DEPTH3. Then the quality flags on the depths are tested as described before.

If none of the quality flags on the three depths is set to be erroneous, the same test is applied to the quality flags on the corresponding three parameter values. If any one is set to be erroneous, DEPTH3 is tested to be the deepest in the profile with subsequent actions described above. If none are set to be erroneous, then the three values are tested to determine if they are all identical. If they are not, DEPTH3 is tested to be deepest in the profile. If they are all the same, the profile identifier is tested to determine if it is known. If known, the entire parameter-depth profile with quality flags is displayed. As well, the parameter values at other stations with the same identifier and in the same depth range as DEPTH2 are displayed. If the identifier is not known, the profile is displayed as described above. As well, the parameter values from other profiles in the neighbourhood of the profile under consideration and in the same depth range as DEPTH2 are displayed. *In either case, the user is then asked if the parameter value at DEPTH2 should be inferred. If so, the user makes the inference and may accept. If accepted, the original value is preserved, the new value substituted, the quality flag on the parameter value at DEPTH2 is set to "5", changed, and then the DEPTH3 is tested to be the deepest in the profile. If no inference is accepted, the user can choose to set the quality flag on the value to be doubtful or erroneous. In either case, the flag is set and DEPTH3 tested to see if it is the deepest in the profile.

If the data were digitized at selected depths, then the profile is examined to determine if there is more than one observation in the profile. If not, the next profile is examined. If there is, DEPTH1 is set to the first depth, DEPTH2 to the next depth, and parameter values, VALUE1 and VALUE2, set to the values of the parameters at DEPTH1 and DEPTH2. If any of the quality flags on the two. depths is set to be erroneous, then DEPTH2 is examined to see if it is the deepest in the profile. If it is, a marker is examined to see if it indicates the parameter values are the same at all depths. If not, the next profile is examined. If the marker has been set, that is all values are the same in the profile, then all quality flags on parameter values which are not set to erroneous are set to doubtful, and the next profile examined.

If DEPTH2 is not the deepest in the profile, DEPTH1 is set to DEPTH2, DEPTH2 to the next depth in the profile and the corresponding parameter values are reset. Then the test of the quality flags on the depths is conducted.

If neither of the quality flags on the depths is set to be erroneous, the quality flags on VALUE1 and VALUE2 are examined to see if either is set to be erroneous. If one is, DEPTH2 is tested to be the deepest in the profile, and actions proceed as described above. If neither flag is set to be erroneous, the two values are tested to determine if they are equal. If not, the next profile is tested. If they are, a marker is set, indicating the two parameter values are identical. Then DEPTH2 is tested to see if it is the deepest. The test then proceeds as described above.

History: None

Rules:

2.5.1 IF: The data were digitized at inflection points
THEN : 2.5.2
ELSE : 2.5.20

2.5.2 IF: There are observations at more than 2 depths in the profile
THEN : 2.5.3
ELSE : Test the next profile

2.5.3 : Set DEPTH1 to the first depth in the profile, DEPTH2 to be the next depth and DEPTH3 to be the next depth
: Set VALUE1 to the parameter value at the first depth in the profile, VALUE2 to the parameter value at the next depth and VALUE3 to be the parameter value at the next depth
: 2.5.4

2.5.4 IF: Any of DEPTH], DEPTH2 or DEPTH3 have a quality flag set to erroneous
THEN : 2.5.5
ELSE : 2.5.7

2.5.5 IF: DEPTH3 is the deepest in the profile
THEN : Test the next profile
ELSE : 2.5.6

2.5.6 : Set DEPTH1 = DEPTH2, DEPTH2 DEPTH3, DEPTH3 next depth in the profile
: Set VALUE1 = VALUE2, VALUE2 VALUE3, VALUE3 = to the parameter value at the next depth in the profile
: 2.5.4

2.5.7 IF: Any of VALUE1, VALUE2, VALUE3 have a quality flag set to erroneous
THEN : 2.5.5
ELSE : 2.5.8

2.5.8 IF: VALUE1 = VALUE2 = VALUE3
THEN : 2.5.10
ELSE : 2.5.5

2.5.10 IF: The profile identifier is known
THEN : 2.5. 11
ELSE : 2.5.12

2.5.11 : Display the parameter values, depths and quality flags for the entire profile under consideration
: Display the parameter values, depths, flags and observation times for all profiles with the same identifier and in the same depth range as DEPTH2
: 2.5.13

2.5.12 : Display the parameter values, depths and quality flags for the entire profile under consideration
: Display the parameter values, depths, flags and observation times for all profiles in the neighbourhood of the profile under consideration and in the same depth range as DEPTH2
: 2.5.13

2.5.13 IF: The user chooses to infer a value for VALUE2
THEN : 2.5.14
ELSE : 2.5.17

2.5.14 IF: The user accepts the inferred value
THEN : 2.5.15
ELSE : 2.5.16

2.5.15 : Infer the value for VALUE2
: Preserve the original value of the parameter
: Set the new value to be the inferred one
: Set the quality flag on the parameter value to be "5", changed
: 2.5.5

2.5.16 IF: The user chooses to flag VALUE2 as doubtful
THEN : 2.5.17
ELSE : 2.5.18

2.5.17 : Set the quality flag on VALUE2 to be "3", doubtful
: 2.5.5

2.5.18 : Notify the user that the quality flag has been set to erroneous
: Set the quality flag on VALUE2 to be '4', erroneous
: 2.5.5

2.5.20 IF: There are observations at more than one depth in the profile
THE : 2.5.21
ELSE : Test the next profile

2.5.21 : Set DEPTH1 to the first depth in the profile, DEPTH2 to be the next depth
: Set VALUE1 to the parameter value at the first depth in the profile, VALUE2 to the parameter value at the next depth
: 2.5.22

2.5.22 IF: Any of DEPTH1 or DEPTH2 have a quality flag set to erroneous
THEN : 2.5.23
ELSE : 2.5.25

2.5.23 IF: DEPTH2 is the deepest in the profile
THEN : 2.5.28
ELSE : 2.5.24

2.5.24 : Set DEPTH1 DEPTH2, and DEPTH2 = the next depth in the profile
: Set VALUE1 VALUE2, VALUE2 = to the parameter value at the next depth in the profile
: 2.5.22

2.5.25 IF: Either of VALUE1 or VALUE2 have a quality flag set to erroneous
THEN : 2.5.23
ELSE : 2.5.26

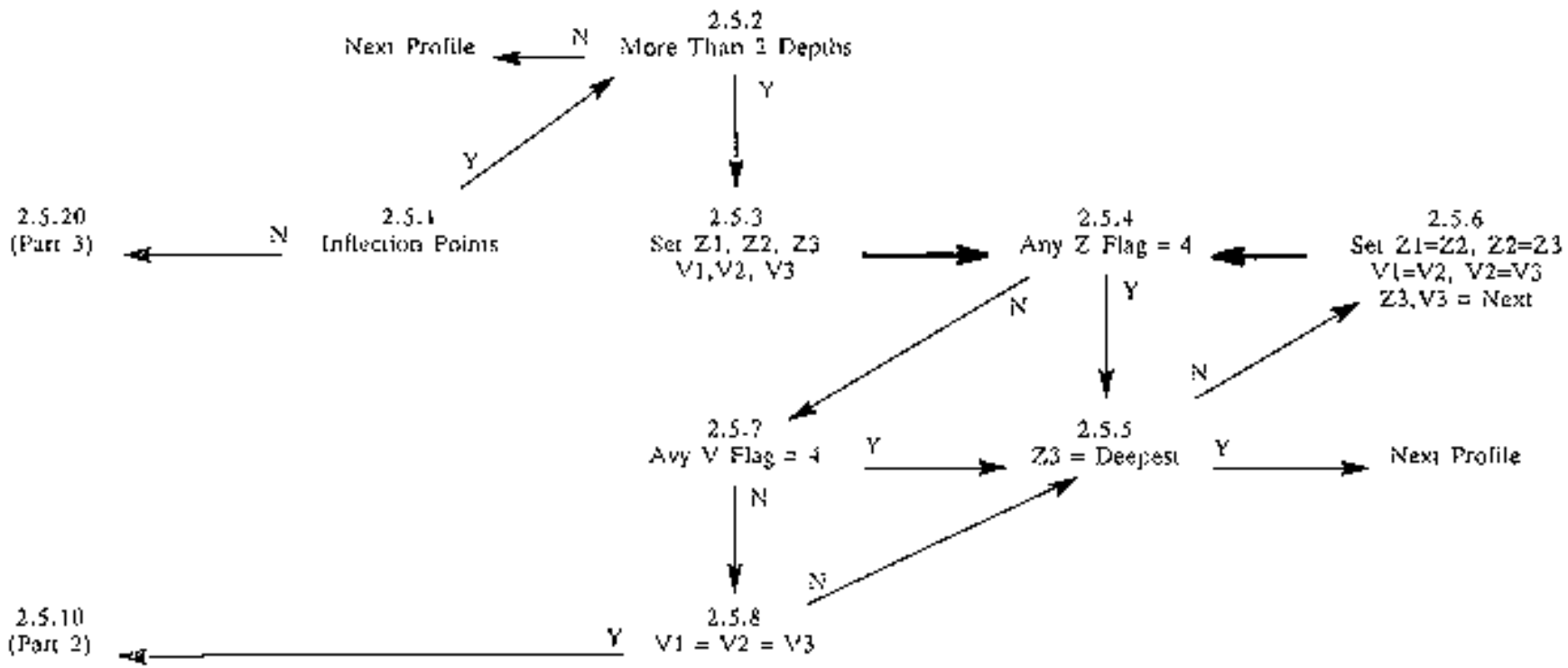
2.5.26 IF: VALUE1 = VALUE2
THEN : 2.5.27
ELSE : Test the next profile

2.5.27 Set a marker indicating that the last values examined were identical
2.5.23

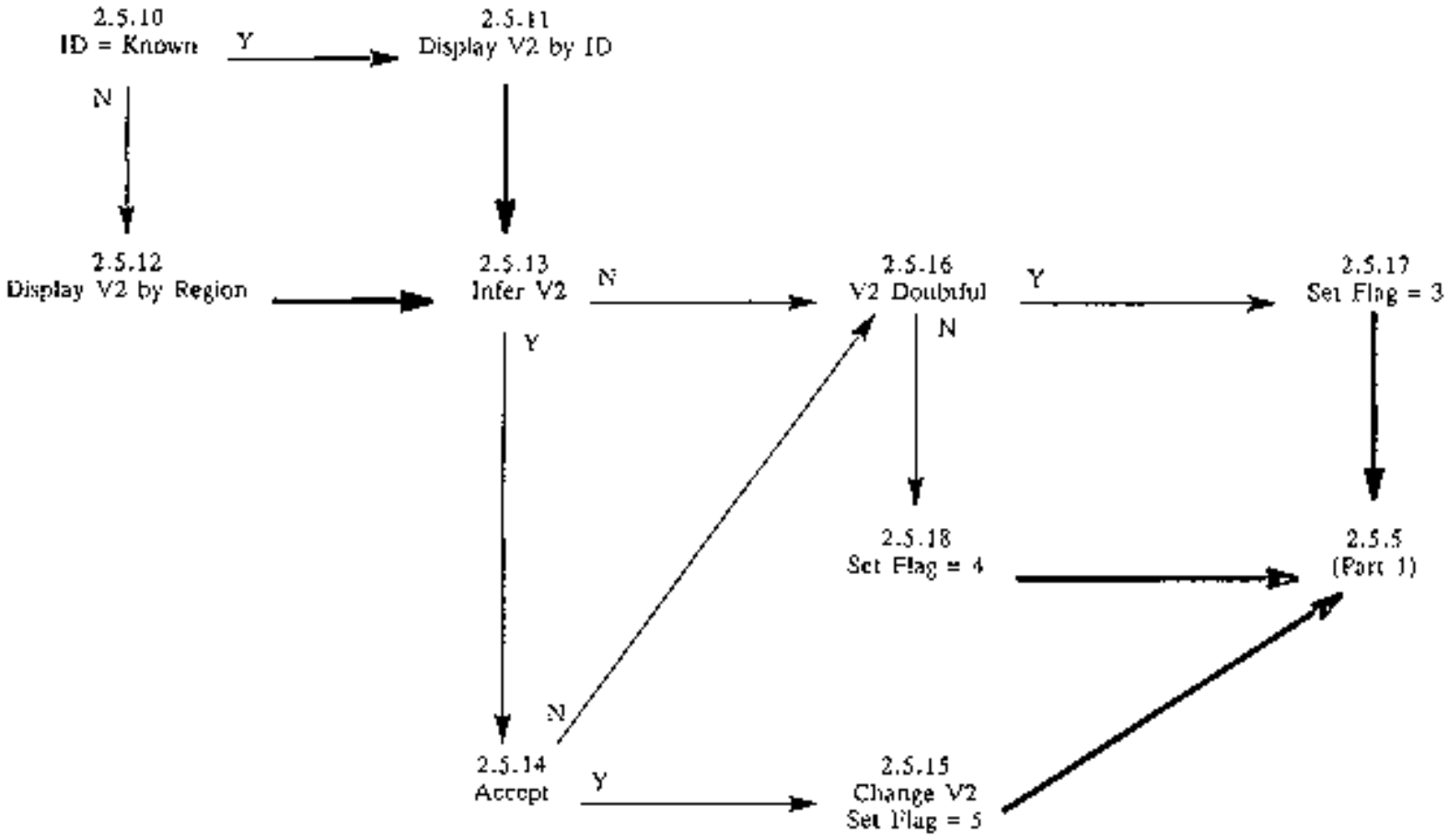
2.5.28 IF: The marker was set indicating the last values were identical
THEN : 2.5.29
ELSE : Test the next profile

2.5.29 : For all of the quality flags on parameter values in the profile which are not set to be erroneous, set them to "3", doubtful
: Test the next profile

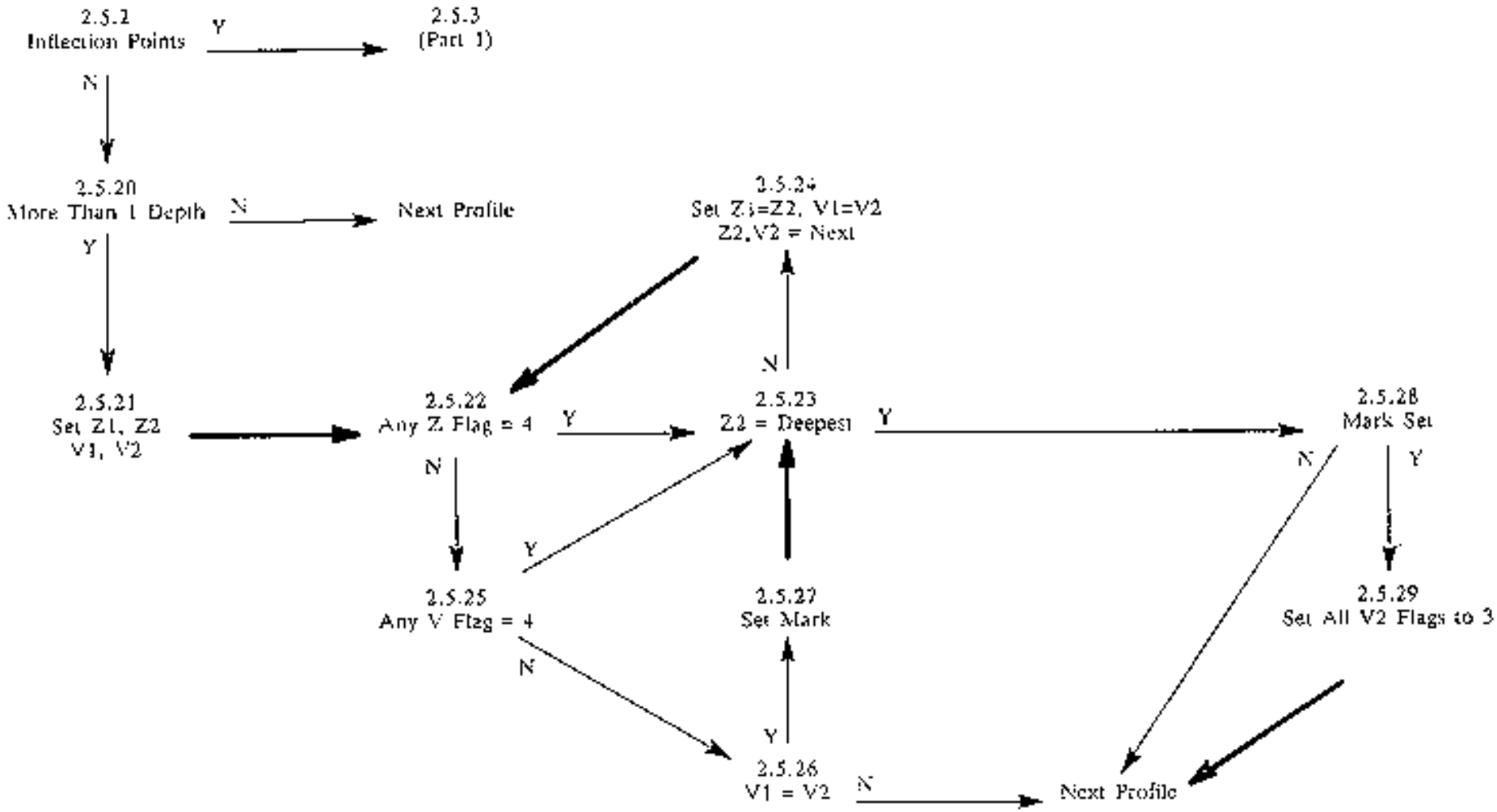
2.5 Constant Profile (Part 1)



2.5 Constant Profile (Part 2)



2.5 Constant Profile (Part 3)



TEST NAME: 2.6 FREEZING POINT TEST

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Sort by profile identifiers and date time in identifier

Description:

This test is the observed temperature at a given depth and salinity is colder than the calculated freezing point temperature. The algorithm for this is described below. It is expressed as a relationship between temperature, salinity and pressure. Conversions of depth to pressure may be made using the algorithm given in the reference below.

The test begins by determining if both temperature and salinity observations at the same pressure exist for the profile. If not, the next station is tested. If so, the PRESSURE is set to the first pressure, and TEMP and SAL set to the temperature and salinity values at PRESSURE. The quality flags on both TEMP and SAL are examined. If either flag is set to be erroneous, the pressure is tested to see if it is the deepest in the profile. If it is, test the next station. If not, set PRESSURE, TEMP and SAL to the values at the next pressure and then test the quality flags on TEMP and SAL.

If the quality flags on both TEMP and SAL are not set to be erroneous, then test the flag on PRESSURE. If it is set to be erroneous, test if the pressure is the deepest in the profile and continue as described above. If the quality flag on the pressure is not set to be erroneous, test if the salinity lies within the range of 27 to 35 PSU. If not, test if the pressure is the deepest. If the salinity is in the range, then calculate the freezing temperature based on the salinity and pressure using the algorithm below. If the observed temperature is greater than or equal to the calculated freezing temperature, then test if the pressure is the deepest in the profile. If the observed temperature is less than the calculated freezing temperature, then test if the profile identifier is known. If known, display the entire temperature and salinity profile, with quality flags. As well, display the temperature and salinity values and quality flags from the same pressure range as that under consideration and at the other profiles with the same identifier. If the identifier is not known, display all of the same information, but this time from profiles in the neighbourhood of the profile under consideration. Then, for either display ask the user if they wish to infer the values for temperature and/or salinity. If so, infer the values, preserve the original and set the quality flag to 5. The inferred value must lie within the permitted Global Impossible Parameter Values. Then, test if the salinity lies within 27 to 35 PSU and proceed as described above.

If the user chooses not to infer values, temperature and /or salinity values may be flagged as doubtful or erroneous. In either case, the appropriate quality flag(s) is set and the pressure is tested to determine if it is the deepest in the profile.

The inferred value is the, calculated freezing temperature.

Algorithm:

$T = -0.0575*S+1.71052E-3*S^{3/2} -2.154996E4*S^{-2} -7/53E=4*P$

Where T is the calculated freezing point temperature,
S is the salinity in PSU and must lie between 27 and 35,
P is the pressure level in decibars of the observed salinity

Reference:

UNESCO Technical Papers in Marine Science #44, Algorithms for Computation of Fundamental Properties of Seawater, UNESCO, 1983.

History: None

Rules:

2.6.1 IF: There are both temperature and salinity profiles at the station
THEN : 2.6.2
ELSE : Test the next station

2.6.2 : Set PRESSURE to be the first pressure in the profile
: Set TEMP and SAL to be the temperature and salinity at PRESSURE
: 2.6.3

2.6.3 IF: Either TEMP or SAL has a quality flag set to be erroneous
THEN : 2.6.4
ELSE : 2.6.6

2.6.4 IF: PRESSURE is the deepest in the profile
THEN : Test the next station
ELSE : 2.6.5

2.6.5 : Set PRESSURE to be the next in the profile
: Set TEMP and SAL to be the temperature and salinity at PRESSURE
: 2.6.3

2.6.6 IF: The quality flag on PRESSURE is set to be erroneous
THEN : 2.6.4
ELSE : 2.6.7

2.6.7 IF: SAL lies between 27 and 35 PSU
THEN : 2.6.8
ELSE : 2.6.4

2.6.8 IF: TEMP is greater than or equal to the calculated freezing point temperature
THEN : 2.6.4
ELSE : 2.6.9

2.6.9 IF: The identifier of the station is known
THEN : 2.6.11
ELSE : 2.6.10

2.6.10 : Display the profiles of temperature and salinity by pressure with the associated quality flags
: Display the values and flags of the temperature and salinity in the same pressure range as PRESSURE for stations in the neighbourhood of the station under consideration
: 2.6.12

2.6.11 : Display the profiles of temperature and salinity by pressure with the associated quality flags
: Display the values and flags of the temperature and salinity in the same pressure range as PRESSURE for stations with the same identifier as the station under consideration
: 2.6.12

2.6.12 IF: The user chooses to infer a value for TEMP and /or SAL
THEN : 2.6.13
ELSE : 2.6.14

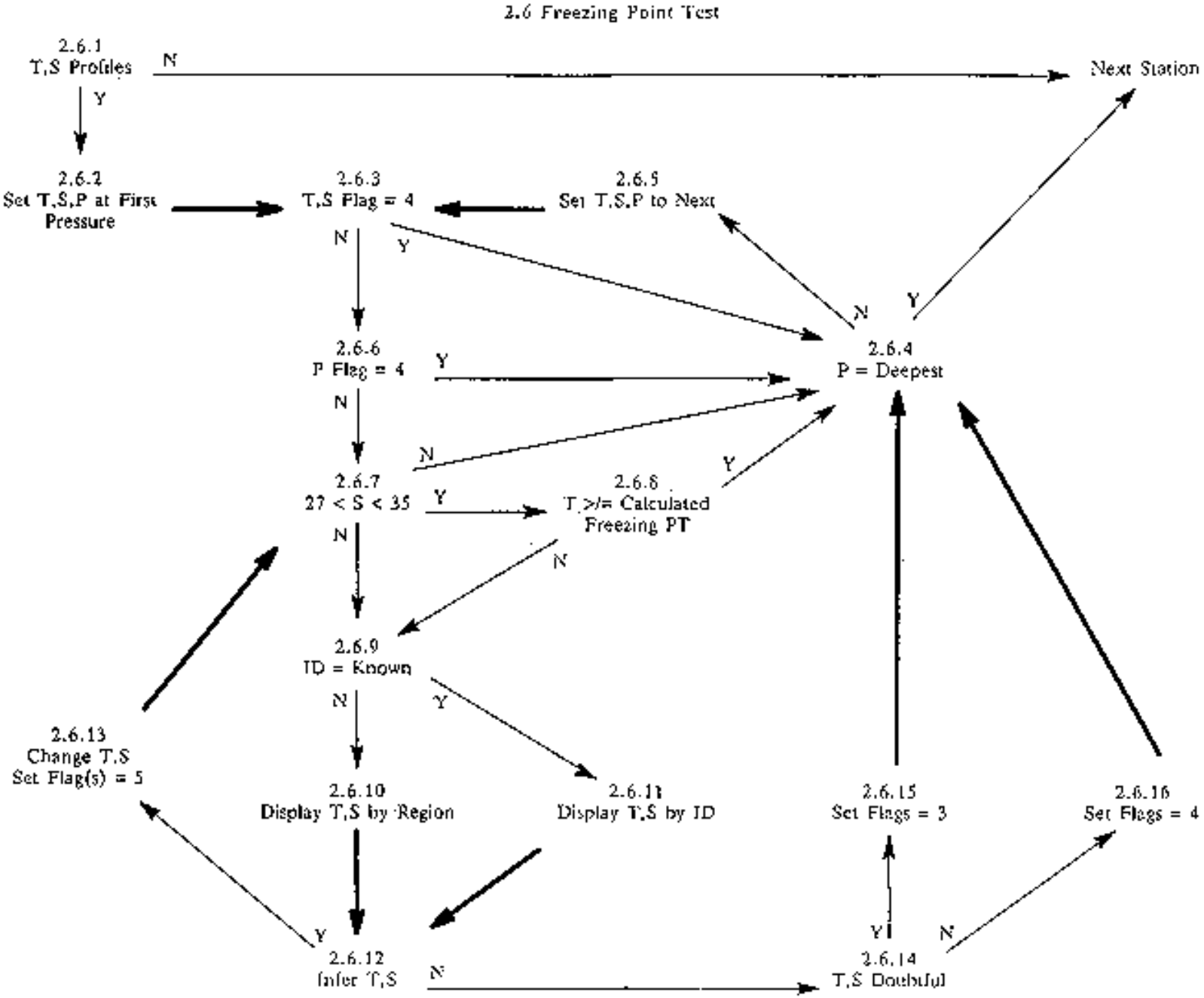
2.6.13 : Infer the value(s) for TEMP and/or SAL
: Preserve the original value(s) of TEMP and/or SAL
: Set the quality flag(s) on TEMP and/or SAL to be "5", changed

: 2.6.7

2.6.14 IF: The user chooses to flag TEMP and/or SAL as doubtful
THEN : 2.6.15
ELSE : 2.6.16

2.6.15 : Set the quality flag on TEMP and/or SAL to be "3", doubtful : 2.6.4

2.6.16 : Notify the user that the quality flag on TEMP has been set to erroneous
: Set the quality flag on TEMP to "4", erroneous
: 2.6.4


2.6 Freezing Point Test
2.6.1
T,S Profiles
N
Y
Next Station
2.6.2
Set T,S,P at First Pressure
2.6.3
T,S Flag = 4
2.6.5
Set T,S,P to Next
N
Y
N
Y
2.6.6
P Flag = 4
Y
2.6.4
P = Deepest
N
N
Y
2.6.7
27 < S < 35
Y
2.6.8
T >/= Calculated Freezing PT
N
N
2.6.9
ID = Known
N
Y
2.6.13
Change T,S
Set Flag(s) = 5
2.6.10
Display T,S by Region
2.6.11
Display T,S by ID
2.6.15
Set Flags = 3
2.6.16
Set Flags = 4
Y
Y
N
2.6.12
Infer T,S
N
2.6.14
T,S Doubtful

TEST NAME: 2.7 SPIKE TEST

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Sort by profile identifiers and date time in identifier

Description:

This test uses the procedures described in WMO/IOC Manuals and Guides #3 to determine if a value in a profile represents a spike. Note that the threshold value for salinity has been modified.

Algorithm:

If (| V2 - (V3 + V1))/2 | - | V1-V3 | /2 > V THRESHOLD
Then the V2 exceeds the spike test

Parameter	Threshold
Temperature	2.0 degrees C
Salinity	0.3 PSU

History: None

Rules:

2.7.1 IF: There are observations at more than two depths in the profile
THEN : 2.7.2
ELSE : Test the next station

2.7.2 : Set DEPTH to be the first depth in the profile, DEPTH2 to be the next depth in the profile and DEPTH3 to be the next depth
: Set VALUE1 to be the value of the parameter at DEPTH1, VALUE2 to be the value of the parameter at DEPTH2 and VALUE3 to be the value of the parameter at DEPTH3
: 2.7.3

2.7.3 IF: Any of DEPTH1, DEPTH2 or DEPTH3 have a quality flag set to be erroneous
THEN : 2.7.4
ELSE : 2.7.6

2.7.4 IF: DEPTH3 is the deepest in the profile
THEN : Test the next station
ELSE : 2.7.5

2.7.5 : Set DEPTH1 to DEPTH2, DEPTH2 TO DEPTH3 and DEPTH3 to be the next in the profile
: Set VALUE1 to VALUE2, VALUE2 to VALUE3 and VALUE3 to be the value of the parameter at DEPTH3
: 2.7.3

2.7.6 : IF: The quality flag on VALUE1, VALUE2 or VALUE3 is set to be erroneous
: THEN : 2.7.7
: ELSE : 2.7.9

2.7.7 IF: There are any other parameters available for these depths
THEN : 2.7.8
ELSE : 2.7.4

2.7.8 : Set VALUE1 VALUE2, VALUE3 to be values of the next parameter at depths DEPTH1, DEPTH2 and DEPTH3
: 2.7.6

2.7.9 IF: The VALUE2 exceeds the spike test described above
THEN : 2.7.10
ELSE : 2.7.7

2.7.10 IF: The identifier of the station is known
THEN : 2.7.11
ELSE : 2.7.12

2.7.11 : Display the profiles by depth with the associated quality flags
: Display VALUE2 and flags of the same parameter in the same depth range as DEPTH2 for stations with the same identifier as the station under consideration
: 2.7.13

2.7.12 : Display the profiles by depth with the associated quality flags
: Display VALUE2 and flags of the same parameter in the same depth range as DEPTH2 for stations in the neighbourhood of the station under consideration
: 2.3.13

2.7.13 IF: The user chooses to infer a value for VALUE2
THEN : 2.7.14
ELSE ; 2.7.17

2.7.14 IF: The user chooses to accept the inferred value
THEN ; 2.7.15
ELSE : 2.7.16

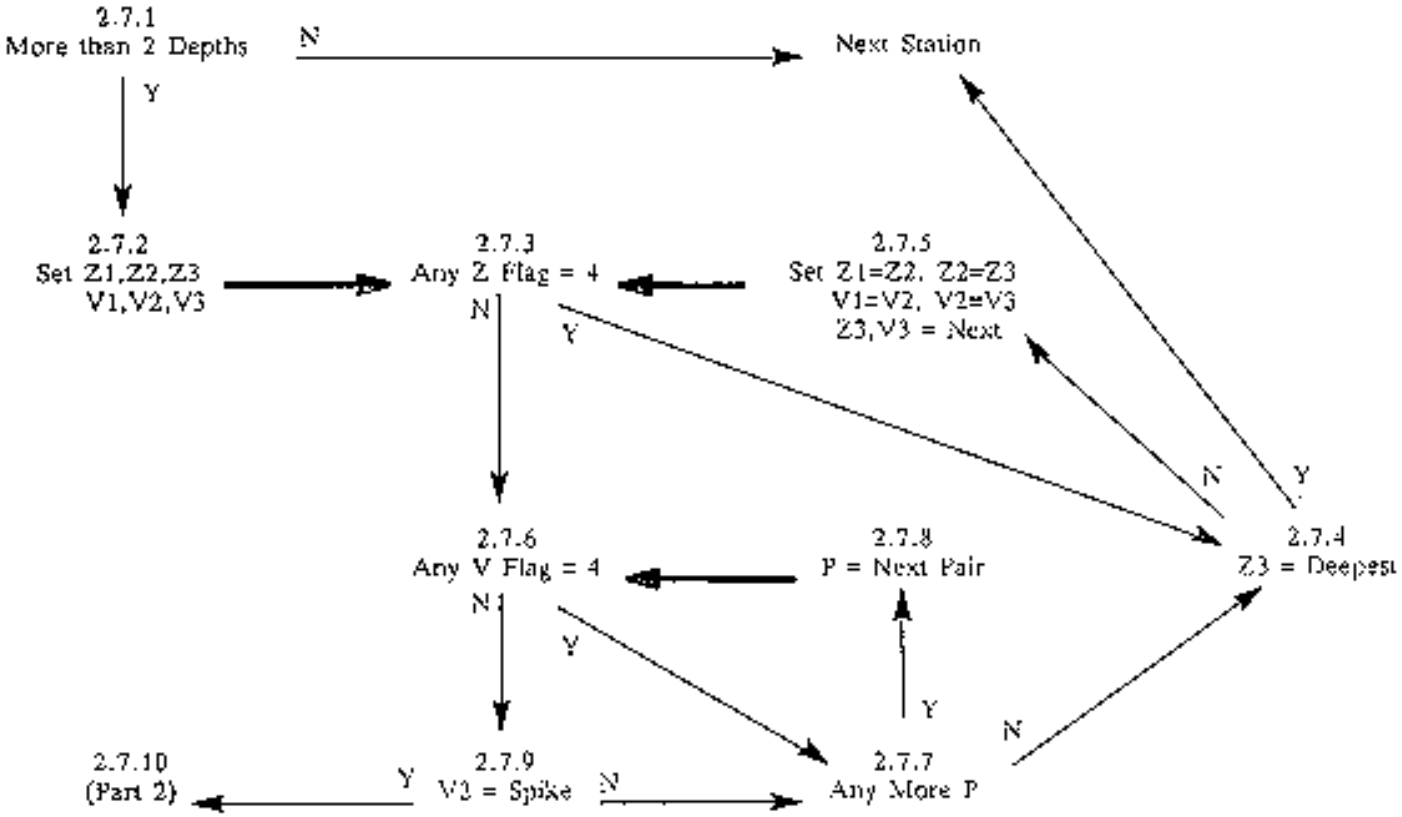
2.7.15 : Preserve the original value
: Substitute the new value
: Set the quality flag(s) on VALUE2 to be "5", changed
2.7.7

2.7.16 IF: The user chooses to flag VALUE2 as doubtful
THEN : 2.7.17
ELSE : 2.7.18

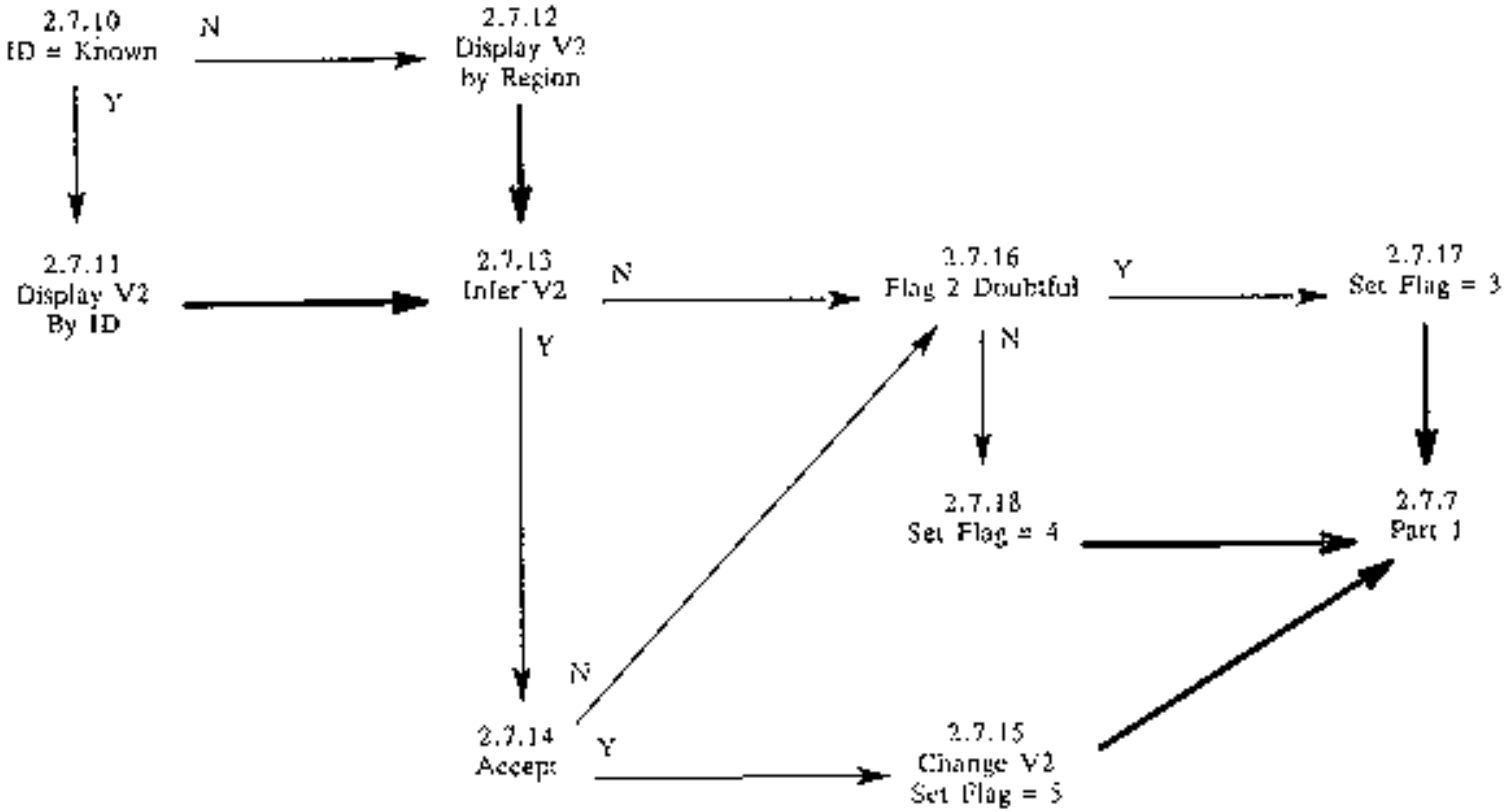
2.7.17 Set the quality flagon VALUE2 to be "3", doubtful
: 2.7.7

2.7.18 : Notify the user that the quality flagon VALUE2 has been set to erroneous
: Set the quality flag on VALUE2 to "4", erroneous
: 2.7.7

2.7 Spike Test (Part 1)



2.7 Spike Test (Part 2)



TEST NAME: 2.8 TOP AND BOTTOM SPIKE

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Profiles sorted by identifier and by increasing date and time for each identifier

Description:

This test examines the shallowest and deepest observations to see if there is a spike present. To conduct the test, the depth and parameter values must not be flagged as erroneous. The algorithm to test for a spike is described below.

The test starts by ensuring the profile under consideration has observations at more than one depth. If not, the next station is tested. If there is more than one depth, DEPTH1 is set to the shallowest depth and DEPTH2 to the next depth. VALUE1 and VALUE2 are set to be the values of the first parameter in the station corresponding to DEPTH1 and DEPTH2.

The quality flags on the depths are examined next. If one of them is set to be erroneous, a marker is examined to see if the top spike test was completed. If the marker is not set, DEPTH2 is set to be the deepest depth in the profile, and DEPTH1 to be the next shallower depth. VALUE1 and VALUE2 are set to be the values of the first parameter corresponding to DEPTH1 and DEPTH2. At this time, the marker is set declaring the top spike test was completed. The quality flags on the depths are then tested and action proceeds as described above.

If the marker is set, the station is tested to see if there is another parameter available. If not, the next station is examined. If there is another parameter, depths and values are set as described later and processing continues to check the quality flags on the depths.

If neither of the quality flags on the depths is set to be erroneous, the quality flags on the parameter values under consideration are examined. If either is set to be erroneous, the data are examined to see if there is another parameter observed at the depths under consideration. If not, the marker is set declaring the top spike test is complete. Processing then passes to check this marker and action proceeds as described above. If there are other parameters, VALUE1 and VALUE2 are set to be the parameter values of the next parameter at the depths under consideration. Next the quality flags on the depths are tested and actions continue as described above.

If neither of the parameter values under consideration have a quality flag set to be erroneous, the values are examined to determine if there is a spike at the top or bottom (whichever is being tested at the time). If there is no spike, other parameters at the same depths are looked for and actions proceed as described previously.

If a spike is found, the identifier of the station is examined. If the identifier is known, the entire profile of the parameter at the station is displayed along with the associated quality flags. As well, the parameter values and flags in the same depth range at all other stations with the same identifier are displayed. If the identifier is not known, the same information as just described is displayed but this time the parameter values at all other stations in the neighbourhood of the suspect profile are displayed. In either case, the user can choose to infer a correct value for either the surface value (for the top spike test) or the deepest value (for the bottom spike test).

If the user chooses to infer the value, the results are displayed and, if the user accepts the choice under consideration, the original value is preserved, the new value is inserted and the quality flag on the value set to changed. The new value is then checked to be sure it does not fail the spike test and action proceeds as described before. If the user rejects the inference, they may try another.

If the user chooses not to infer a value, the value may be flagged as doubtful.

If the user chooses to flag the value as doubtful, the quality flag on the value is set to be doubtful and the station is checked to see if there are more parameters at the station. If the user chooses not to flag the value as doubtful, it is flagged as erroneous, and the station is checked to see if there are more parameters.

Algorithm:

Top Spike

IF VDN < (V1 - V2) < VUP

then no spike is detected

Parameter	**VDN**	**VUP**
Temperature	-10.0	10.0 degrees C.
Salinity	-5.0	5.0 PSU

Bottom Spike

IF VDN < (V2 - VI) < VUP

then no spike is detected

Parameter	**VDN**	**VUP**
Temperature	-10.0	10.0 degrees C.
Salinity	-5.0	5.0 PSU

History: None

Rules:

2.8.1 IF: There is more than 1 depth in the profile
THEN : 2.8.2
ELSE : Examine the next station

2.8.2 : Set P to be the first parameter with associated depths
: Set Z 1 to be the shallowest depth for P
: Set Z2 to be the next shallowest depth for P
: Set VI to be the value of P at Z 1
: Set V2 to be the value of P at Z2
: 2.8.3

2.8.3 IF: The quality flags on Z1 or Z2 is set to be erroneous
THEN : 2.8.4
ELSE : 2.8.8

2.8.4 IF: A marker is set
THEN : 2.8.6
ELSE : 2.8.5

2.8.5 : Set P to be the first parameter with associated depths
: Set Z2 to be the deepest depth for P
: Set Z1 to be the next shallower depth for P
: Set VI to be the value of P at Z1
: Set V2 to be the value of P at Z2
: Set the marker
: 2.8.3

2.8.6 IF: There is another parameter at the station
THEN : 2.8.7
ELSE : Clear the marker
: Examine the next station

2.8.7 : Set P to be the next
: Set V1 to be the value of P at Z1
: Set V2 to be the value of P at Z2
: 2.8.3

2.8.8 IF: The quality flag on the parameter under consideration and observed at Z1 or Z2 has a quality flag set to be erroneous
THEN : 2.8.10
ELSE : 2.8.9

2.8.9 IF: There is a spike in P
THEN : 2.8. 11
ELSE : 2.8. 10

2.8.10 IF: There is another parameter at the station
THEN : 2.8.7
ELSE : Set marker
: 2.8.4

2.8.11 IF: The identifier of the station is known
THEN : 2.8.12
ELSE : 2.8.13

2.8.12 : Display the platform identifier, position, date and profile of the station under consideration
: Display the parameter values and quality flags at the same depth as the suspect values for other stations with the same identifier
: 2.8.14

2.8.13 : Display the platform identifier, position, date and profile of the station under consideration
: Display the parameter values and quality flags at the same depth as the suspect values for other stations in the same region
: 2.8.14

2.8.14 IF: The user chooses to infer the value
THEN : 2.8.18
ELSE : 2.8.15

2.8.15 IF: The user chooses to flag the top or bottom observation as doubtful
THEN : 2.8.16
ELSE : 2.8.17

2.8.16 : Set the quality flag on the top or bottom observation to be "3", doubtful
: 2.8.10

2.8.17 : Notify the user that the quality flag on the top or bottom observation will be set to "4", erroneous
: Set the quality flag on the top or bottom observation to be "4", erroneous
: 2.8.10

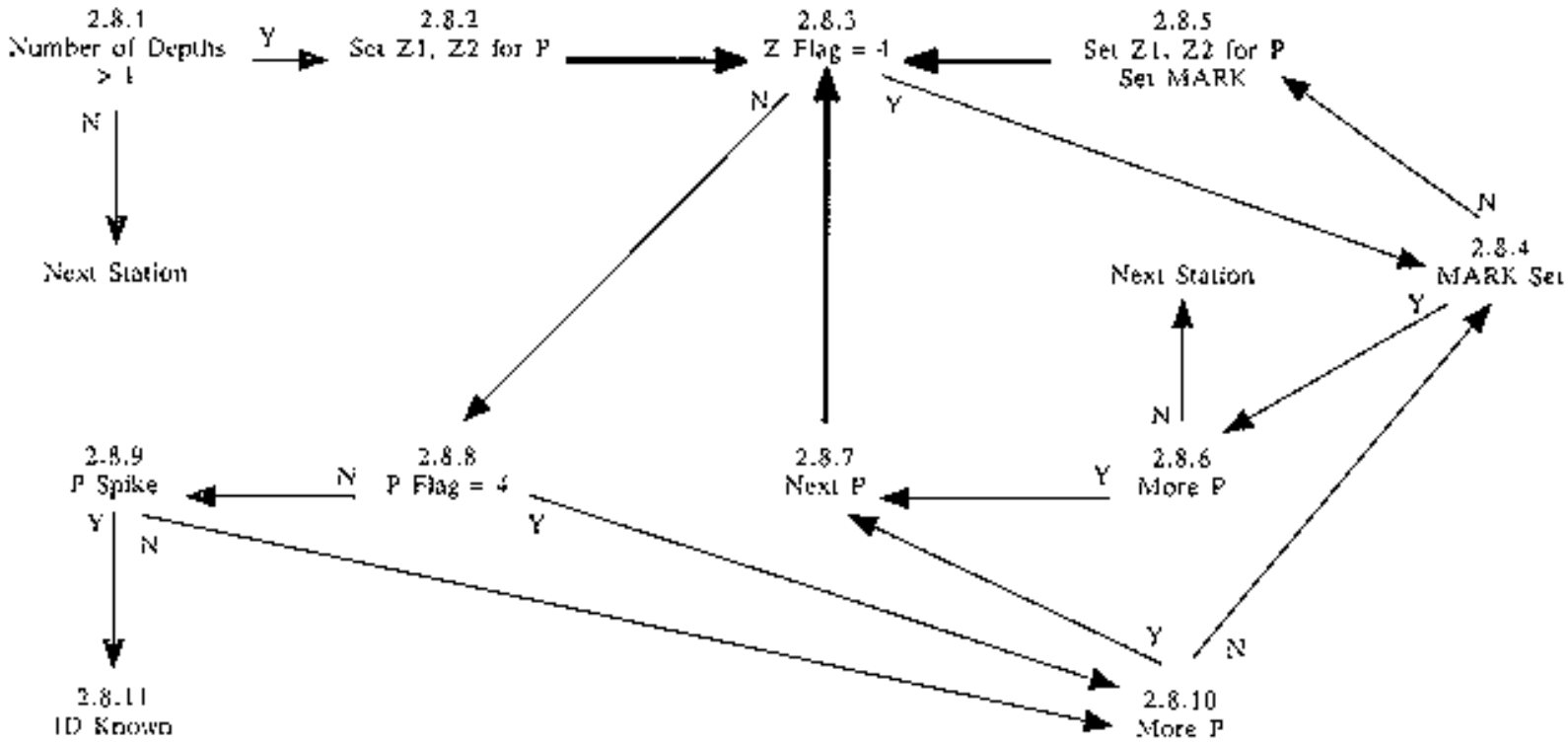
2.8.18 IF: The user chooses to accept an inference
THEN : 2.8.20
ELSE : 2.8.19

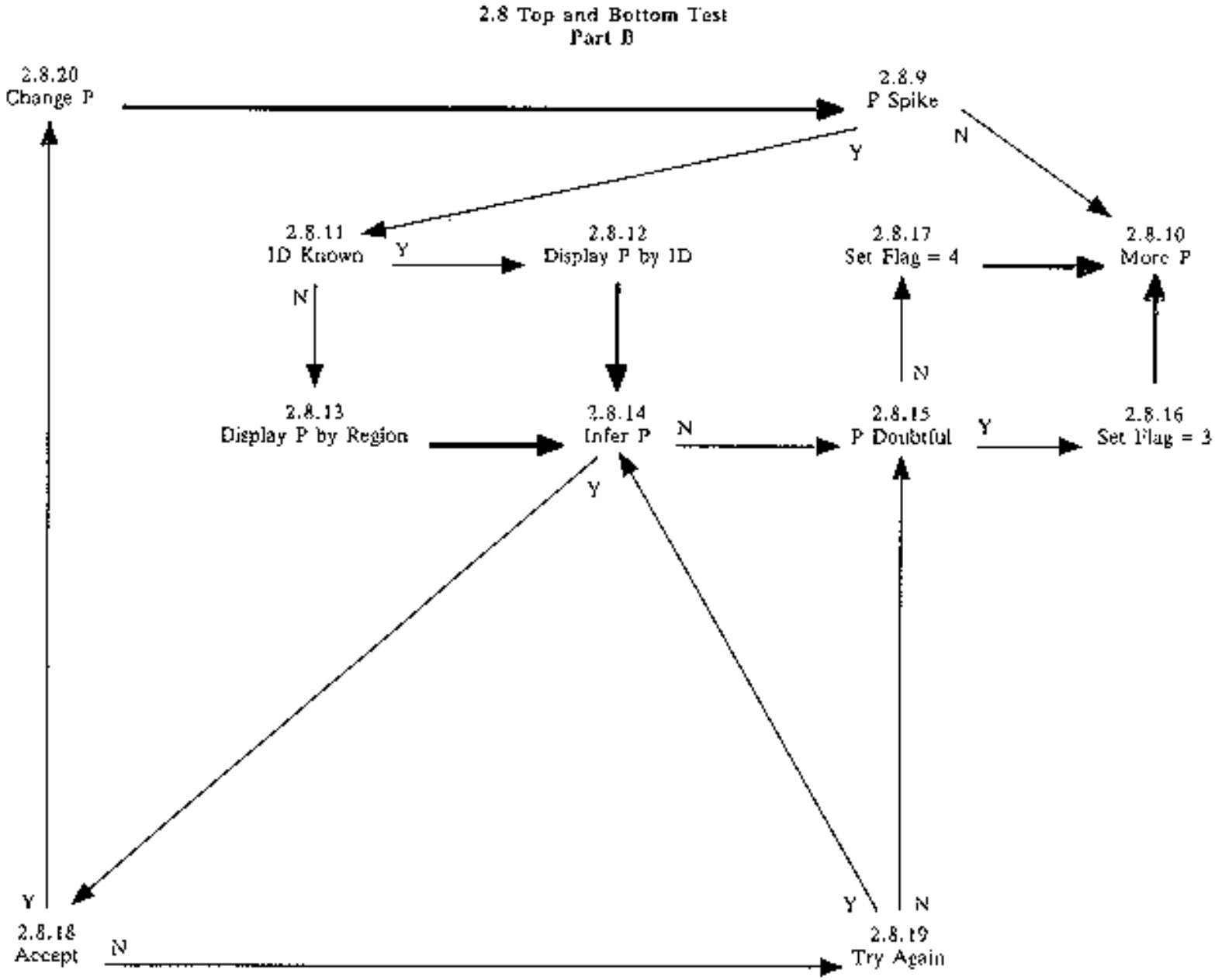
2.8.19 IF: The user chooses to try again
THEN : 2.8.14

ELSE : 2.8.15

2.8.20 : Preserve the original value and depth
: Substitute the inferred value
: Set the quality flag on the new value to be "5", changed
: 2.8.9

2.8 Top and Bottom Test
Part A




2.8 Top and Bottom Test
Part B
2.8.20
Change P
2.8.9
P Spike
Y
N
2.8.11
ID Known
Y
2.8.12
Display P by ID
2.8.17
Set Flag = 4
2.8.10
More P
N
N
2.8.13
Display P by Region
2.8.14
Infer P
N
2.8.15
P Doubtful
Y
2.8.16
Set Flag = 3
Y
Y
Y
N
2.8.18
Accept
N
2.8.19
Try Again

TEST NAME: 2.9 GRADIENT TEST

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Profiles sorted by identifier and by increasing date and time for each identifier

Description:

This test checks that the gradient between two adjacent pairs of points does not exceed a certain threshold given later in table 2.9 below.

The test starts by ensuring the profile under consideration has observations at more than two depths. If not, the next station is tested. If there are more than two depths, DEPTH1 is set to be the first depth, DEPTH2 to be the next depth and DEPTH3 to be the next depth in the profile. VALUE1, VALUE2 and VALUE3 are set to the values of the first parameter at the corresponding depths. Next, the quality flags on the three depths are examined to see if any one is set to be erroneous. If so, DEPTH3 is tested if it is the deepest in the profile. If so, the next station is tested. If DEPTH3 is not the deepest, DEPTH1 is set to DEPTH2, DEPTH2 to DEPTH3 and DEPTH3 to the next depth in the profile. Values for VALUE1, VALUE2 and VALUE3 are set to be those for the first parameter at the corresponding depths. Next the quality flags on the depth are examined and the actions are described above.

If none of the quality flags on the depths are set to be erroneous, the quality flags on the values are examined. If any one of these is set to be erroneous, the station is examined to see if there are other parameters not yet tested at the depths under consideration. If there are no other parameters, DEPTH3 is tested to be the deepest and actions proceed as described before. If there are other parameters, VALUE1, VALUE2 and VALUE3 are set to the values of the next parameter at the depths under consideration. The quality flags on the depths are tested as described above.

If none of the quality flags on the values is set to be erroneous, VALUE2 is tested to see if the gradients between values above and below in the profile are reasonable. If they are, the station is examined to see if there are other parameters not yet tested at the depths under consideration. The resulting actions are described above.

If the gradient test fails, the identifier of the station is examined to determine if it is known. If the identifier is known, the entire profile of the parameter at the station is displayed along with the associated quality flags. As well, the parameter values and flags in the same depth range at all other stations with the same identifier are displayed. If the identifier is not known, the same information as just described is displayed but this time the parameter values at all other stations in the neighbourhood of the suspect profile are displayed. In either case, the user can then choose to infer a correct value for VALUE2.

If the user chooses not to infer a value, they may choose to flag the value as doubtful. If accepted, the quality flag is set to be doubtful and processing checks if there are more parameters at the given depths. If the user chooses not to flag the value as doubtful, it is flagged as erroneous and checks are made if there are more parameters.

If the user chooses to infer a value they are presented with the results.

If the user chooses to accept the inferred value, the original is preserved, the new value is inserted and the quality flag on the value set to changed. The new value is then checked to ensure it passes the gradient test.

Algorithm:

IF ($|V2 - (V1 + V3)/2| > V\_GRAD$

then V2 fails the gradient test

Table 2.9

Parameter **V-GRAD**

Temperature 10 degrees C
Salinity 5 PSU

History: None

Rules:

2.9.1 IF: There are more than 3 depths
THEN : 2.9.2
ELSE : Examine the next station

2.9.2 : Set P to be the first parameter at the station
: Set DEPTH1, DEPTH2 and DEPTH3 to be the shallowest depths for P
:Set VALUE], VALUE2 and VALUE3 to be the values of the parameters at the three depths
: 2.9.3

2.9.3 IF: Any of the quality flags on the depths are set to be erroneous
THEN : 2.9.4
ELSE : 2.9.6

2.9.4 IF: DEPTH3 is the deepest depth available at the station
THEN : Examine the next station
ELSE
: 2.9.5

2.9.5 : Set P to be the first parameter at the station
: Set DEPTH1 = DEPTH2, DEPTH2 = DEPTH3 and DEPTH3 to be the next in the profile for P
: Set VALUE1, VALUE2 and VALUE3 to be the values of the parameters at the three depths
: 2.9.3

2.9.6 IF: Any of the quality flags on the values are set to be erroneous
THEN : 2.9.7
ELSE : 2.9.9

2.9.7 IF: There are other parameters to be examined at the given set of depths
THEN : 2.9.8
ELSE : 2.9.4

2.9.8 : Set P to be the next parameter at the station
: Set DEPTH], DEPTH2 and DEPTH 3 to be the shallowest depths for P
: Set VALUE1, VALUE2 and VALUE3 to be the values of the parameters at the three depths
: 2.9.3

2.9.9 IF: The gradients of the values exceed the permitted thresholds
THEN : 2.9.10
ELSE : 2.9.7

2.9.10 IF: The identifier of the station is known
THEN : 2.9.12
ELSE : 2.9.11

2.9.11 : Display the platform identifier, position, date and profile of the station under consideration
: Display the parameter values and quality flags at the same depth as the suspect values for other stations in the same region

: 2.9.13

2.9.12 : Display the platform identifier, position, date and profile of the station under consideration
: Display the parameter values and quality flags at the same depth as the suspect values for other stations with the same identifier
: 2.9.13

2.9.13 IF: The user chooses to infer the value
THEN : 2.9.17
ELSE : 2.9.14

2.9.14 IF: The user chooses to flag VALUE2 as doubtful
THEN : 2.9.15
ELSE : 2.9.16

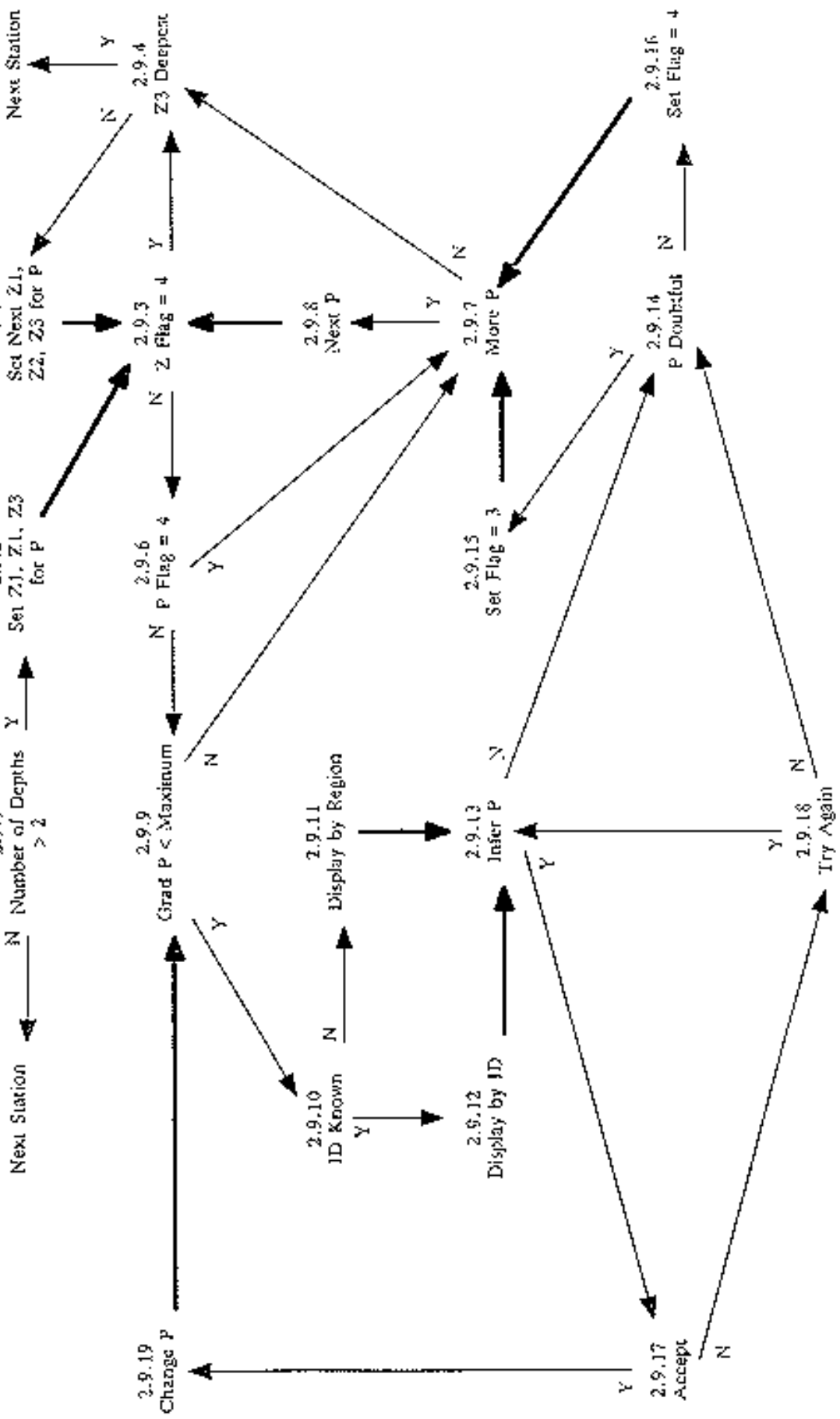
2.9.15 : Set the quality flag on VALUE2 to be "3",, doubtful
: 2.9.7

2.9.16 : Notify the user that the quality flag on VALUE2 will be set to "4", erroneous
: Set the quality flag on VALUE2 to be "4", erroneous
; 2.9.7

2.9.17 IF: The user chooses to accept an inference
THEN : 2.9.19
ELSE : 2.9.18

2.9.18 IF: The user chooses to examine another inference
THEN : 2.9.13
ELSE : 2.9.14

2.9.19 : Preserve the original value and depth
: Substitute the inferred value
: Set the quality flag on the new value to be "5", changed
: 2.9.9


2.9 Gradient Test
2.9.1
Number of Depths > 2
N
Next Station
Y
2.9.2
Set Z1, Z1, Z3 for P
2.9.3
Z Flag = 4
N
Y
2.9.4
Z3 Deepest
N
Y
Next Station
2.9.5
Set Next Z1, Z2, Z3 for P
2.9.6
P Flag = 4
N
Y
2.9.7
More P
Y
N
2.9.8
Next P
2.9.9
Grad P < Maximum
N
Y
2.9.10
ID Known
N
Y
2.9.11
Display by Region
2.9.12
Display by ID
2.9.13
Infer P
Y
N
2.9.14
P Doubtful
N
Y
2.9.15
Set Flag = 3
2.9.16
Set Flag = 4
2.9.17
Accept
Y
N
2.9.18
Try Again
N
Y
2.9.19
Change P

TEST NAME: 2.10 DENSITY INVERSION TEST

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Profiles sorted by identifier and by increasing date and time for each identifier

Description:

This test checks that there is no density inversion as depth increases.

The test starts by ensuring the profile under consideration has observations at more than one depth. If not, the next station is tested. If there is more than one depth, DEPTH1 is set to be the first depth, and DEPTH2 to be the next depth. The quality flags on the depths are examined to see if any one is set to be erroneous. If so, DEPTH2 is tested if it is the deepest in the profile. If so, the next station is tested. If DEPTH2 is not the deepest, DEPTH1 is set to DEPTH2, and DEPTH2 to the next depth in the profile.

If none of the quality flags on the depths are set to be erroneous, the profile is tested to ensure that both a temperature and a salinity are present. If not, the depth is tested to determine if it is the deepest. If both present, the quality flags on the temperature and salinity values are examined. If any one of these is set to be erroneous, the station is examined to see if DEPTH2 is the deepest depth and processing proceeds as already described.

If none of the quality flags on the values is set to be erroneous, the density is calculated at DEPTH1 and DEPTH2 and compared. If the density at DEPTH2 is greater than or equal to that at DEPTH1, DEPTH2 is tested to see if it is the deepest in the profile.

If the density at the deeper depth is less than that at the shallower depth, the identifier of the station is examined to determine if it is known. If the identifier is known, the temperature, salinity and density profiles at the station are displayed along with the associated quality flags. As well, the same variables and flags in the same depth range at all other stations with the same identifier are displayed. If the identifier is not known, the same information as just described is displayed but this time the parameter values at all other stations in the neighbourhood of the suspect profile are displayed. In either case, the user can then choose to infer a correct value for VALUE2.

If the user chooses not to infer a value, they may choose to flag the value as doubtful. If accepted, the quality flag is set to be doubtful and processing checks if there are more parameters at the given depths. If the user chooses not to flag the value as doubtful, it is flagged as erroneous and DEPTH2 then checked to determine if it the deepest in the profile.

If the user chooses to infer a value, the user is presented with the results.

If the user chooses to accept the inferred value, the original is preserved, the new value is inserted and the quality flag on the value set to changed. The new value is then checked to ensure it passes the density inversion test.

History: None

Rules:

2.10.1 IF: There are more than 1 depth
THEN : 2.10.2
ELSE : Examine the next station

2.10.2 : Set DEPTH1, and DEPTH2 to be the shallowest depths
: 2.10.3

2.10.3 IF: Any of the quality flags on the depths are set to be erroneous
THEN : 2.10.4

ELSE : 2.10.6

2.10.4 IF: DEPTH2 is the deepest depth available at the station
THEN : Examine the next station
ELSE : 2.10.5

2.10.5 : Set DEPTH] = DEPTH2, and DEPTH2 to be the next depth
: 2.10.3

2.10.6 IF: Both a temperature and salinity observation are present at DEPTH1 and DEPTH2
THEN : 2.10.7
ELSE : 2.10.4

2.10.7 IF: Any of the quality flags on the temperatures or salinities are set to be erroneous
THEN : 2.10.4
ELSE : 2.10.8

2.10.8 IF: The calculated density at DEPTH2 is less than that at DEPTH1
THEN : 2.10.9
ELSE : 2.10.4

2.10.9 IF: The identifier of the station is known
THEN : 2.10.11
ELSE : 2.10.10

2.10.10 : Display the platform identifier, position, date and profile of the station under consideration
: Display the parameter values and quality flags at the same depth as the suspect values for other stations in the same region
: 2.10.12

2.10.11 : Display the platform identifier, position, date and profile of the station under consideration
: Display the parameter values and quality flags at the same depth as the suspect values for other stations with the same identifier
: 2.10.12

2.10.12 IF: The user chooses to infer the values of the temperature and salinity at DEPTH2
THEN : 2.10.16
ELSE : 2.10.13

2.10.13 IF: The user chooses to flag the temperature and/or salinity at DEPTH2 as doubtful
THEN : 2.10.14
ELSE : 2.10.15

2.10.14 : Set the quality flag on the temperature and/or salinity to be "3", doubtful
: 2.10.4

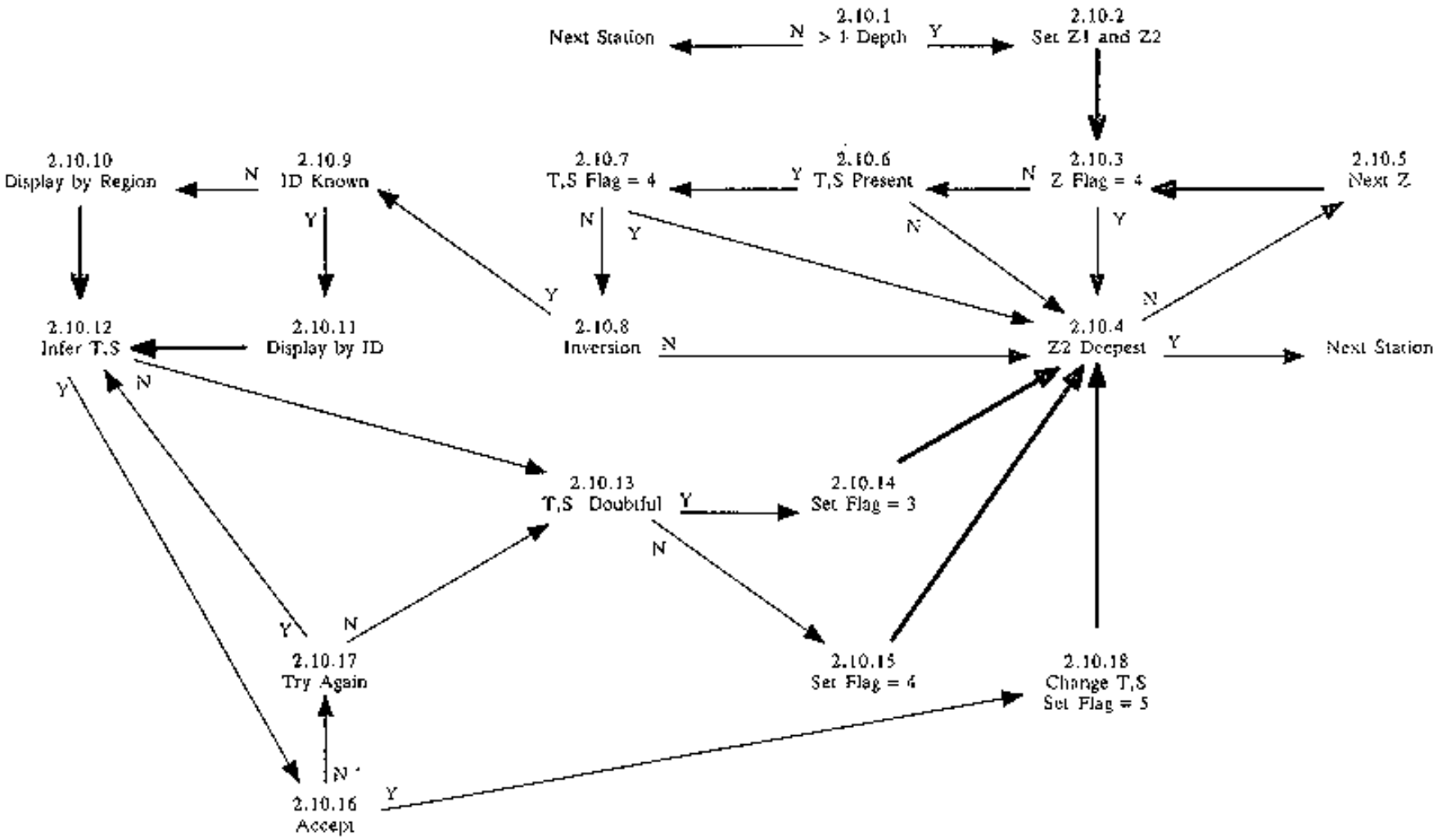
2.10.15 : Set the quality flag on the temperature and/or salinity to be "4", erroneous
: 2.10.4

2.10.16 IF: The user chooses to accept an inference
THEN : 2.10.18
ELSE : 2.10.17

2.10.17 IF: The user chooses to examine another inference
THEN : 2.10.12
ELSE : 2.10.13

2.10.18 : Preserve the original value and depth
: Substitute the inferred value
: Set the quality flag on the new value to be "5", changed
: 2.10.4

2.10 Density Inversion



TEST NAME: 3.1 LEVITUS SEASONAL STATISTICS

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Profiles should be sorted by latitude and longitude.

Description:

This test determines if the temperature and salinity observations lie within certain ranges of the mean value given by the Levitus Seasonal Statistics Atlas. If the profile lies close to land and the depth is less than 50 metres, the observed value should lie within 5 standard deviations of the mean value. For all other locations the observed value should lie within 3 standard deviations.

The test begins by checking that the quality flags on neither the latitude nor the longitude are set to be erroneous. If they are the next station is tested. If not, the test starts by setting the first depth under consideration to be the shallowest in the profile. The station is tested to determine if there is a temperature value at the depth in question. If there is not, the station is tested to see if there is a salinity observation. If there is no salinity, the depth is tested to determine if it is the deepest available in the profile. If it is, the next station is tested. If the depth is not the deepest, the next depth is examined and a marker is cleared. This marker is used to indicate that the last variable tested was salinity. Again the sta don is tested to determine if there is a temperature at the new depth.

If there is a temperature observation at the depth, the parameter value is set to the observed temperature and the quality flag on the depth is tested. If the quality flag is set to be erroneous, the climatology test cannot be applied and so the depth is checked if it is the deepest. Processing from this stop proceeds as already described.

If the quality flag on the depth is not set to be erroneous, then the quality flag on the parameter under consideration is checked. If this is set to be erroneous, the marker (described above) is examined. If this marker has been set, the depth is examined to determine if it is the deepest in the profile. If the marker has not been set, the station is tested to see if there exists a salinity observation at the depth under consideration. If there is not, the depth is tested to see if it is the deepest in the profile.

If there is a salinity observation, the parameter value is set to be the observed salinity and the marker is set. Next the quality flag on the depth is tested and processing proceeds as previously described.

If the parameter flag is not set to be erroneous, the location is tested to be within 1000 kilometers (this distance is defined by the way the mean values were calculated in the Levitus atlas) of land. If it is, the depth is tested to see if it is less than 50 metres. If this is also true, the parameter value is tested to see if it lies within 5 standard deviations of the climatological mean at the station position and the given depth. If so, the marker is checked and action proceeds as described before. If the observation exceeds the range, the parameter values are displayed and processing continues as described later.

If the observation is not within 1000 kilometers of land or if it is not less than 50 metres, then the parameter value is tested to see if it lies within 3 standard deviations of the climatological mean at the station position and the given depth. If this is true, the marker is checked and processing proceeds as already described.

If the parameter value is outside of the prescribed limits, the parameter profile is displayed along with the climatological mean and the appropriate standard deviation limit at the same location. Parameter values at neighbouring stations within the same depth range are also displayed. The user may then choose to set the quality flag on the parameter at the depth to be inconsistent. If the flag is not already set to be inconsistent, the user must confirm the change of the flag. If not confirmed, no action is taken. If confirmed, the quality flag is changed to inconsistent. If the user chooses not to set the flag to be inconsistent, it is set to be doubtful. No matter what action is performed against the quality flag, afterwards the marker is checked and processing continues as already described above.

History: None

Rules:

3.1.1 IF: Any one of the latitude or longitude has a quality flag set to be erroneous
THEN : Test the next station
ELSE : 3.1.2

3.1.2 : Set DEPTH to be the shallowest depth in the profile
: Set VALUE to be the value of the temperature observation at DEPTH
: 3.1.3

3.1.3 IF: There is a temperature observation at DEPTH
THEN : 3.1.8
ELSE : 3.1.4

3.1.4 IF: There is a salinity observation at DEPTH
THEN : 3.1.6
ELSE : 3.1.5

3.1.5 IF: DEPTH is the deepest in the profile
THEN : Test the next station
ELSE : 3.1.7

3.1.6 : Set the parameter value, VALUE, to be the observed salinity at DEPTH
: Set MARK to indicate that salinity is the parameter under consideration
: 3.1.9

3.1.7 : Set DEPTH to be the next deeper depth in the profile
: Clear MARK
: 3.1.3

3.1.8 : Set the parameter value, VALUE, to be the observed temperature at DEPTH
: 3.1.9

3.1.9 IF: The quality flag on DEPTH is set to be erroneous
THEN : 3.1.5
ELSE : 3.1.10

3.1.10 IF: The quality flag on VALUE is set to be erroneous
THEN : 3.1.11
ELSE : 3.1.12

3.1.11 IF: MARK is set
THEN : 3.1.5
ELSE : 3.1.4

3.1.12 IF: The station is within 1000 km of the coast
THEN : 3.1.13
ELSE : 3.1.14

3.1.13 IF: DEPTH is less than 50 meters
THEN : 3.1.15
ELSE : 3.1.14

3.1.14 IF: VALUE lies within 3 standard deviations of the climatological mean in the depth range of DEPTH and at the same location as the station
THEN : 3.1.11
ELSE : 3.1.16

3.1.15 IF: VALUE lies within 5 standard deviations of the climatological mean in the depth range of DEPTH and at the same location as the station
THEN : 3.1.11
ELSE : 3.1.16

3.1.16 : Display the parameter profile in question
: Display the climatological mean and 3 or 5 standard deviations as appropriate
: Display parameter values in the same depth range for neighbouring stations
: 3.1.17

3.1.17 IF: The user chooses to flag VALUE as inconsistent
THEN : 3.1.18
ELSE : 3.1.21

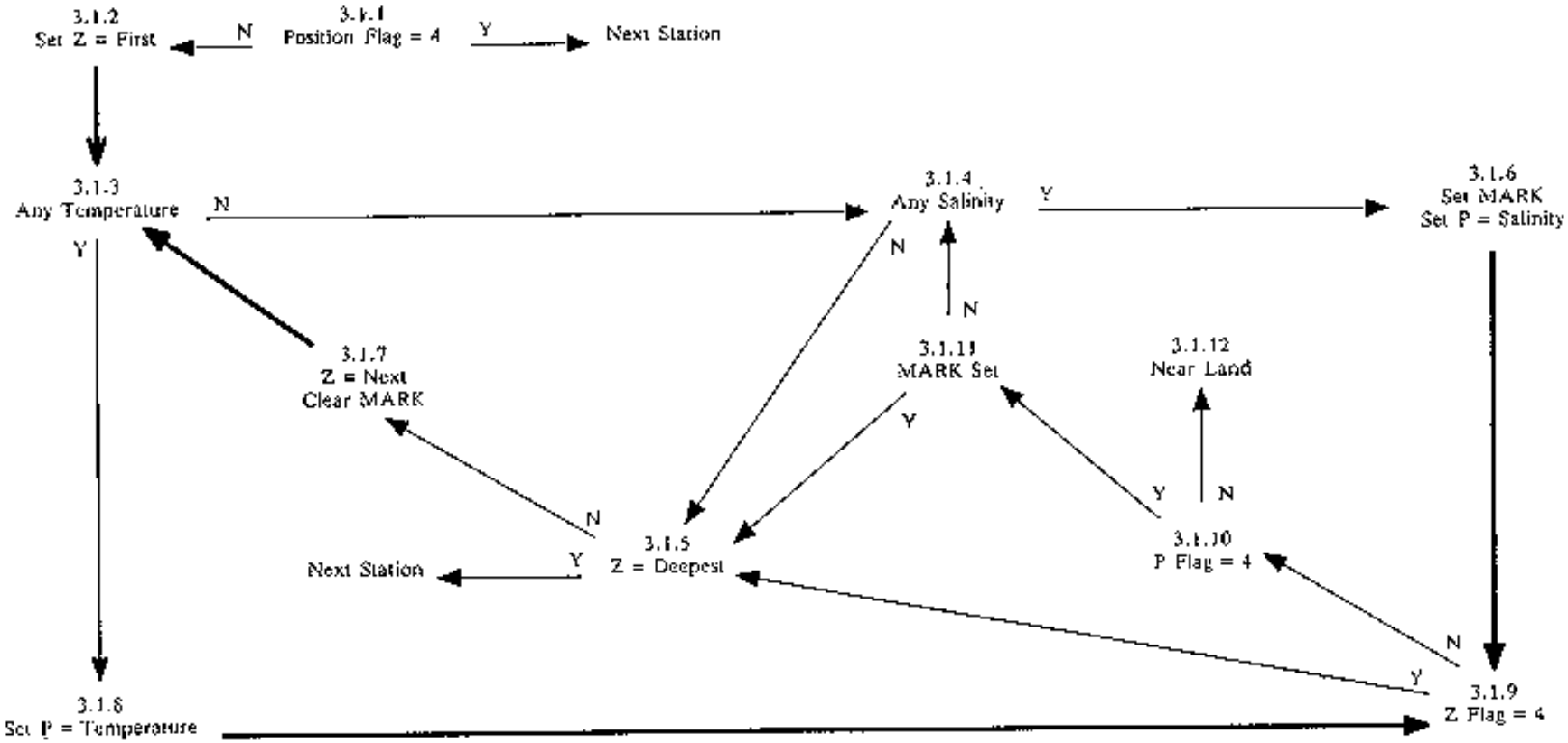
3.1.18 IF: The quality flag on VALUE is already set to be inconsistent
THEN : 3.1.11
ELSE : 3.1.19

3.1.19 IF: The user confirms to change the quality flag from doubtful to inconsistent
THEN : 3.1.20
ELSE : 3.1.11

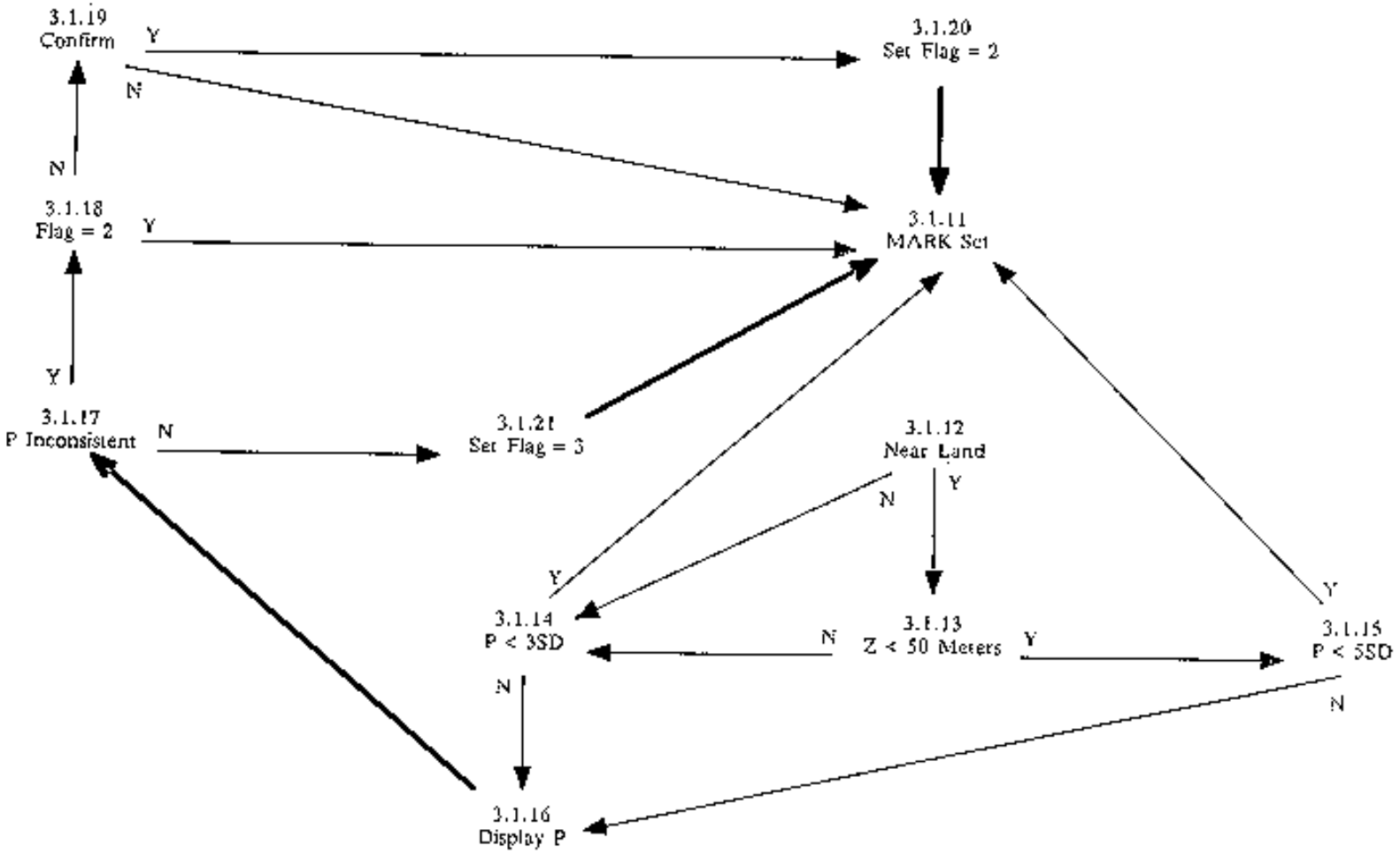
3.1.20 : Set the quality flag on VALUE at DEPTH to "2", inconsistent
: 3.1.11

3.1.21 : Notify the user that the quality flag on VALUE will be set to doubtful
: Set the quality flag on VALUE at DEPTH to "3", doubtful
: 3.1.11

3.1 Levitus Seasonal Statistics
Part A



3.1 Levitus Seasonal Statistics
Part B



TEST NAME: 3.2 EMERY AND DEWAR CLIMATOLOGY

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.

Profiles are sorted by latitude and longitude within the region covered by the atlas. This is 10 degrees south to 60 degrees north latitude for both the Atlantic and Pacific oceans. The Atlantic ocean stretches from 0 degrees west to 80 degrees west longitude. The Pacific Ocean extends from 80 degrees west to 120 degrees east longitude.

Description:

This test uses the Emery and Dewar climatology to test if the observed temperatures and salinities lie within 3 standard deviations of the climatological mean. It also tests if a salinity at a given temperature lies within 3 standard deviations of the climatological salinity at the given temperature.

The test begins by ensuring that neither the latitude nor longitude has a quality flag set to be erroneous. If one is set, the next station is tested. If both are fine, the depth is set to be the shallowest in the profile and the quality flag is tested. If it is set to be erroneous, the testing proceeds to Part 3.

If the quality flag on the depth is not set to be erroneous, but there is no temperature observation at the depth, testing proceeds to Part 2. If there is a temperature, but the quality flag is set to be erroneous, processing passes to Part 2. If the quality flag is not set to be erroneous, the temperature is tested to be within 3 standard deviations of the climatological mean at the given depth. If the observation lies within this limit, testing proceeds to Part 2.

If the temperature lies beyond 3 standard deviations from the mean, the temperature profile is displayed. The climatological temperature profile and 3 standard deviations is also displayed. As well, temperature values in the same depth range from neighbouring stations are displayed. The user may then choose to flag the temperature as inconsistent. If he chooses not to do so, the quality flag on the temperature is set to be doubtful and testing proceeds to Part 2.

If the user chooses to flag the temperature as inconsistent, but it has a quality flag assigned as doubtful, the user must confirm the decision. If confirmed,, the flag is changed from doubtful to inconsistent. If not confirmed, the flag remains as doubtful. If the flag was not already set to be doubtful, the flag is set to be inconsistent as chosen by the user. In any case, the testing then proceeds to Part 2.

Part 2 of the test checks if there is a salinity observation at the depth under consideration. If not, the depth is checked to see if it is the deepest in the profile. If it is, testing proceeds to the next station. If it is not, the depth is set to be the next deeper in the profile and the quality flag on the depth tested. Actions proceed as described before.

If there is a salinity but its quality flag is set to be erroneous, the depth is tested to determine if it is the deepest in the profile. Testing from this point proceeds as already described above. If the quality flag on the salinity is not set to be erroneous, the value is tested to lie within 3 standard deviations of the climatological mean at the depth under consideration. The treatment of salinity is the same as previously described for temperature. After the quality flag has been set, testing proceeds to Part 3.

Part 3 begins by testing if either the temperature or the salinity has a quality flag set to be erroneous. If so, the depth is tested to determine if it is the deepest in the profile and actions proceed as already described. If both values are fine, the salinity value is tested to lie within 3 standard deviations of the climatological mean salinity at the given temperature. If it does, the depth is tested to determine if it is the deepest, and so on. If it lies outside of 3 standard deviations, the temperature-salinity curve is displayed for the station. At the same time, the climatological T-S curve and 3 standard deviations of salinity from the mean is displayed. Finally, temperature and salinity values in the same depth range but at neighbouring stations are displayed. The user may then choose to set the quality flags on the temperature and/or salinity. Processing proceeds as described before. After the flags are set, the depth is tested to determine if it is the deepest in the profile. Subsequent actions have already been described.

History: None

Rules:

3.2.1 IF: Any one of latitude, or longitude has a quality flag set to, be erroneous
THEN : Test the next station
ELSE : 3.2.2

3.2.2 : Set DEPTH to be the shallowest depth in the profile
: 3.2.3

3.2.3 IF: The quality flag on DEPTH is set to be erroneous
THEN : 3.2.24
ELSE : 3.2.4

3.2.4 IF: There is a temperature observation at DEPTH
THEN : 3.2.5
ELSE : 3.2.13

3.2.5 IF: The quality flag on temperature is set to be erroneous
THEN : 3.2.13
ELSE : 3.2.6

3.2.6 IF: The temperature value lies within 3 standard deviations of the climatological mean at the given depth for the given station location
THEN : 3.2.13
ELSE : 3.2.7

3.2.7 : Display the entire temperature profile with quality flags
: Display the climatological mean and 3 standard deviations
: Display temperature and quality flags in the same depth range from neighbouring stations
: 3.2.8

3.2.8 IF: The user chooses to set the quality flag on the temperature to be inconsistent
THEN : 3.2.10
ELSE : 3.2.9

3.2.9 : Notify the user that the quality flag on the temperature will be set to doubtful
: Set the quality flag on the temperature to "3",, doubtful
: 3.2.13

3.2.10 IF: The quality flag on temperature is already set to be doubtful
THEN : 3.2.11
ELSE : 3.2.12

3.2.11 IF: The user confirms that the quality flag on temperature should be changed from doubtful to inconsistent
THEN : 3.2.12
ELSE : 3.2.13

3.2.12 : Set the quality flag on the temperature to "2", inconsistent
: 3.2.13

3.2.13 IF: There is a salinity observation at DEPTH
THEN : 3.2.16
ELSE : 3.2.14

3.2.14 IF: Depth is the deepest in the profile
THEN : Test the next station
ELSE : 3.2.15

3.2.15 : Set DEPTH to be the next in the profile
: 3.2.3

3.2.16 IF: The quality flag on salinity is set to be erroneous
THEN : 3.2.14
ELSE : 3.2.17

3.2.17 IF: The salinity observation lies within 3 standard deviations of the climatological mean at the given depth and location
THEN : 3.2.24
ELSE : 3.2.18

3.2.18 : Display the entire salinity profile with quality flags
: Display the climatological mean and 3 standard deviations
: Display salinity and quality flags in the same depth range from neighbouring stations
: 3.2.19

3.2.19 IF: The user chooses to set the quality flag on salinity to be inconsistent
THEN : 3.2.21
ELSE : 3.2.20

3.2.20 : Notify the user that the quality flagon the salinity will beset to doubtful
: Set the quality flag on the salinity to "3", doubtful
: 3.2.24

3.2.21 IF: The quality flag on salinity is already set to be doubtful
THEN : 3.2.23
ELSE : 3.2.22

3.2.22 : Set the quality flag on the salinity to "2", inconsistent
: 3.2.24

3.2.23 IF: The user confirms that the quality flag on salinity should be changed from doubtful to inconsistent
THEN : 3.2.22
ELSE : 3.2.24

3.2.24 IF: The quality flag on temperature is set to be erroneous
THEN : 3.2.14
ELSE : 3.2.25

3.2.25 IF: The quality flag on salinity is set to be erroneous
THEN : 3.2.14
ELSE : 3.2.26

3.2.26 IF: The salinity observation lies within 3 standard deviations of the climatological salinity at the given temperature and location
THEN : 3.2.14
ELSE : 3.2.27

3.2.27 : Display the temperature-salinity profile with quality flags
: Display the climatological temperature-salinity profile and 3 standard deviations
: Display the temperature-salinity values and quality flags at the same depth range from neighbouring stations

: 3.2.28

3.2.28 IF: The user chooses to set the quality flagon temperature and /or salinity to be inconsistent
THEN : 3.2.30
ELSE : 3.2.29

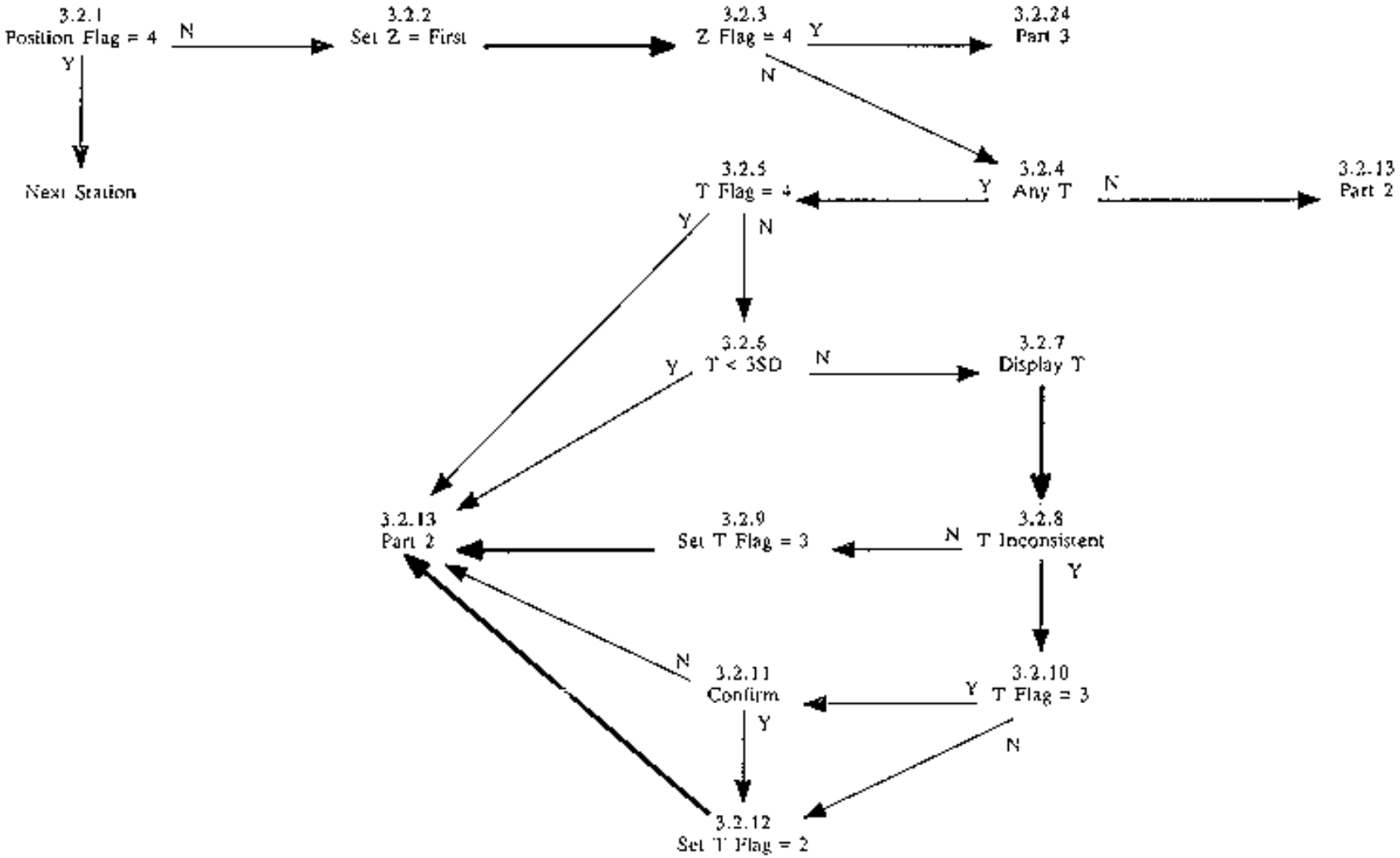
3.2.29 : Notify the user that the quality flagon the temperature and/or salinity will beset to doubtful
: Set the quality flag on the temperature and/or salinity to "3", doubtful
: 3.2.14

3.2.30 IF: The quality flag on temperature and/or salinity is already set to be doubtful
THEN : 3.2.32
ELSE : 3.2.31

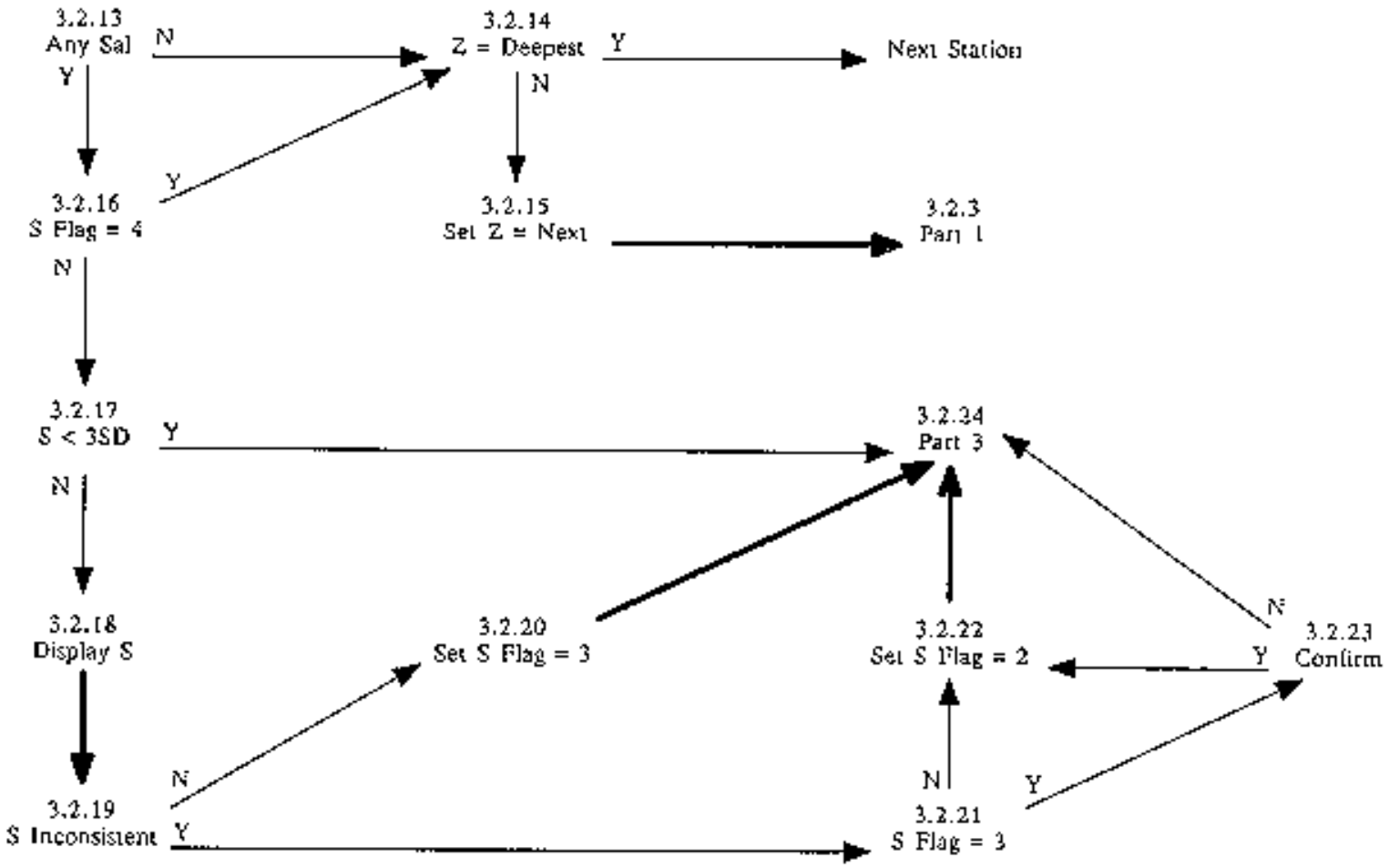
3.2.31 : Set the quality flag on the temperature and/or salinity to "2", inconsistent
: 3.2.14

3.2.32 IF: The user confirms that the quality flag on temperature and/or salinity should be changed from doubtful to inconsistent
THEN : 3.2.31
ELSE : 3.2.14

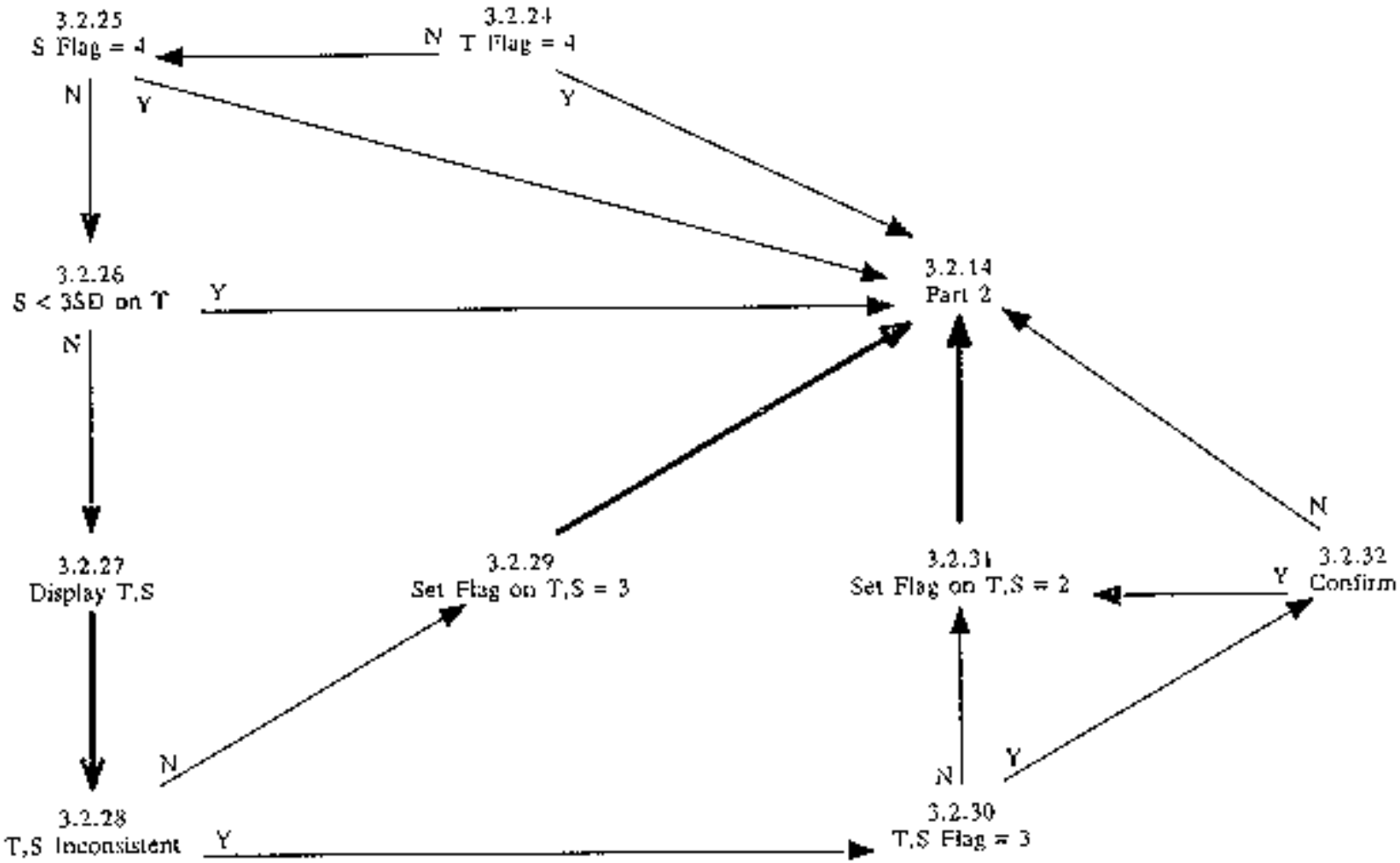
3.2 Emery and Dewar Climatology
Part 1



3.2 Emery and Dewar Climatology
Part 2



3.2 Emery and Dewar Climatology
Part 3



TEST NAME: 3.3 ASHEVILLE SST CLIMATOLOGY

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
The stations are sorted by latitude and longitude.

Description:

This test determines if the observed sea surface temperature lies within 3 standard deviations of the Asheville climatological mean for the given location and month.

The test starts by determining if any one of the latitude, longitude or month has a quality flag set to be erroneous. If so, the next station is tested. If not, but if there is no surface observation, the next station is tested. If there is a sea surface temperature observation but it has a quality flag set to be erroneous, the next station is tested.

If the surface temperature observation is fine, and it lies within 3 standard deviations of the climatological mean for the given location and month, then the next station is tested. If the observation lies outside of the limit, the surface value is displayed along with the climatological mean, 3 standard deviations from the mean, and surface temperatures from neighbouring stations. The user may then choose to set the quality flag to be inconsistent. If not, the flag is set to be doubtful.

If the user chooses to set the flag to be inconsistent, but the present value is already set to be doubtful, the user must confirm the flag be changed. If confirmed, the flag is changed from doubtful to inconsistent, otherwise it is left unaltered. After the quality flag has been set, the next station is tested.

History: None

Rules:

3.3.1 IF: Any one of latitude, longitude or month has a quality flag set to be erroneous
THEN : Test the next station
ELSE : 3.3.2

3.3.2 IF: There is an observation at the surface
THEN : 3.3.3
ELSE : Test the next station

3.3.3 IF: There is a surface temperature observation
THEN : 3.3.4
ELSE : Test the next station

3.3.4 IF: The quality flag on the temperature is set to be erroneous
THEN : Test the next station
ELSE : 3.3.5

3.3.5 IF: The temperature value lies within 3 standard deviations of the climatological mean at the given location in the given month
THEN : Test the next station
ELSE : 3.3.6

3.3.6 : Display the temperature and its quality flag
: Display the climatological temperature and 3 standard deviations
: Display surface temperatures from neighbouring stations in the same month
: 3.3.7

3.3.7 IF: The user chooses to set the quality flag on the temperature to be inconsistent
THEN : 3.3.9

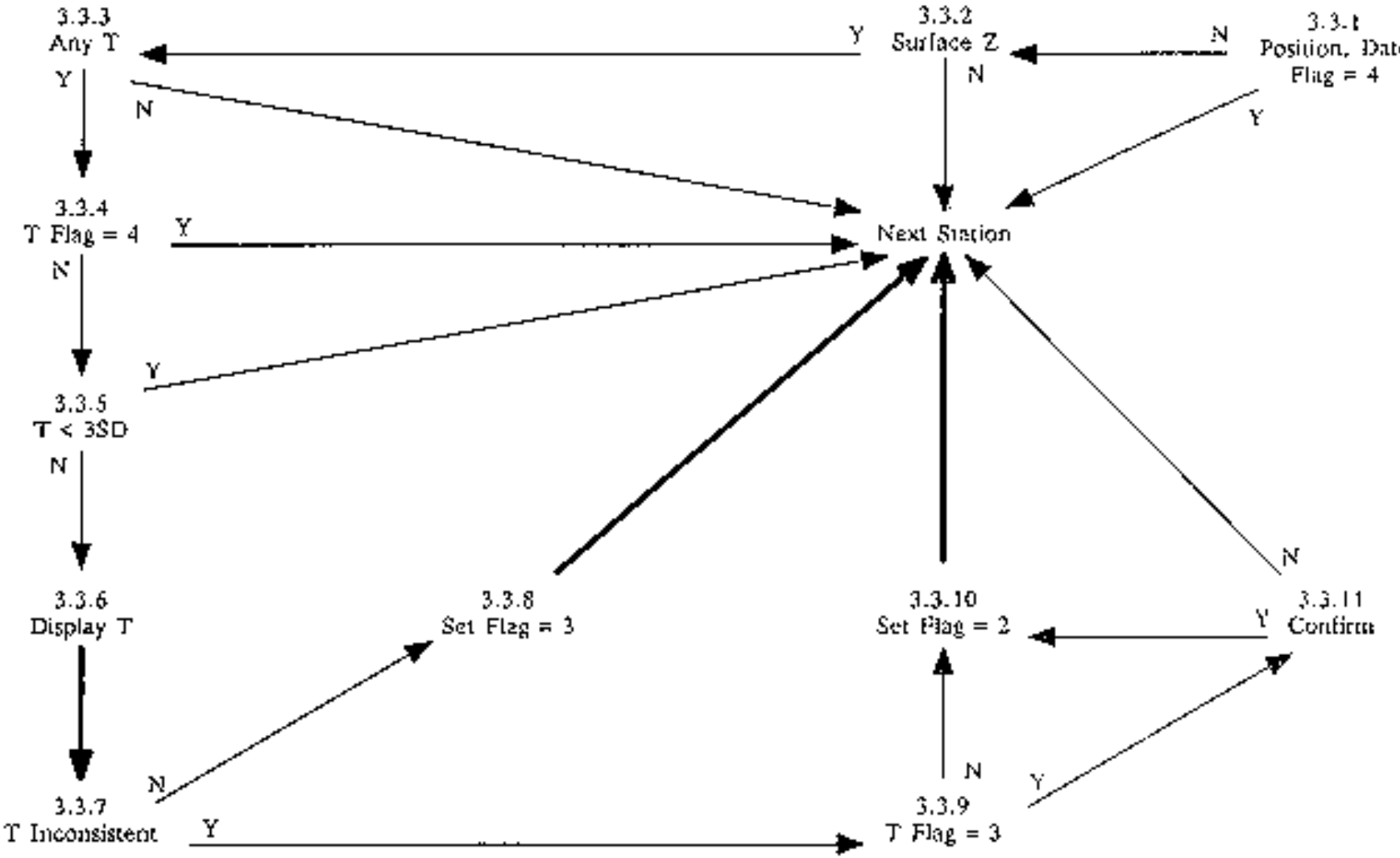
ELSE : 3.3.8

3.3.8 : Notify the user that the quality flagon the temperature will beset to be doubtful
: Set the quality flag on the temperature to "3", doubtful
: Test the next station

3.3.9 IF: The quality flag on the temperature is already set to be doubtful
THEN : 3.3. 11
ELSE : 3.3.10

3.3.10 : Set the quality flag on the temperature to be "2", inconsistent
: Test the next station

3.3.11 IF: The user confirms the quality flag should be changed from doubtful to inconsistent
THEN : 3.3.10
ELSE : Test the next station


3.3.3
Any T
Y
N
3.3.2
Surface Z
Y
N
N
3.3.1
Position, Date
Flag = 4
Y
3.3.4
T Flag = 4
Y
N
Next Station
Y
3.3.5
T < 3SD
N
N
3.3.6
Display T
3.3.8
Set Flag = 3
3.3.10
Set Flag = 2
Y
3.3.11
Confirm
N
Y
N
3.3.7
T Inconsistent
Y
3.3.9
T Flag = 3

TEST NAME: 3.4 LEVITUS MONTHLY CLIMATOLOGY

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
The stations are sorted by latitude and longitude.

Description:

This test compares the mean and standard deviations of an observed profile to that of the Monthly Levitus climatology of temperature and salinity. If the values derived from the observations lie within a specified threshold then the observed profile is considered to have passed. The thresholds are given in table 3.4 below.

The test begins by ensuring that the quality flag on the latitude, longitude and month are not set to be erroneous. If any one is, the next station is tested. If not, the first depth is examined and the parameter under consideration is set to be temperature, or salinity if there is no temperature. The quality flag on the depth is tested to determine if it is set to be erroneous. If so, the depth is tested to see if it is the deepest. If it is not the deepest, the depth is set to be the next in the profile, the parameter to be the temperature or salinity as before and the flag tested on the depth. If the depth is the deepest, profile properties are tested as will be described later.

If the quality flag on the depth is not set to be erroneous. the quality flag on the parameter under consideration is examined If the flag is set to be erroneous, the station is examined to determine if there is another parameter (salinity) available. If there is, the parameter value is set to be that for the next parameter and the quality flag tested as just described. If there are no more parameters, the depth is tested to see if it is the deepest in the profile and processing proceeds as described before.

If the depth is the deepest in the profile, the mean and standard deviation of the observed profile parameters are calculated and the same properties for the climatological profiles at the same location and month. Then if the absolute difference between the observed mean and the climatological mean of a given parameter exceeds the threshold set in table 3.4, display the information as will be described. If not, test if the absolute difference of the standard deviation of the observed profile from its mean to the same quantity as for the climatological profile exceed the threshold given in table 3.4. If not, repeat these tests for the next parameter at the station, or if there is no other, test the next station.

If the threshold is exceeded, display both the observed parameter profile, and the climatological mean. The user may then choose to set the quality flag on the parameter profile to be inconsistent. If the user denies this, the quality flag is set to be doubtful. If the user confirms the flag should be set to be inconsistent, but the flag is already set to be doubtful, the user must confirm the flags be changed. If confirmed, the flag on the parameter profile is changed from doubtful to inconsistent. If denied, no change of the quality flag is made. If the flag was not set to be doubtful, it is set to be inconsistent as the user chose to do. The next parameter is then tested or if there is no other parameter, the next station is tested.

Table 3.4 Thresholds (set on 20 April, 1990)

Parameter	Threshold
Mean temperature	0.5 degrees C
Mean salinity	0.2 PSU
Standard deviation of temperature	TBD
Standard deviation of salinity	TBD

Note: TBD = to be determined

History: None

Rules:

3.4.1 IF: Any one of the latitude, longitude or month has the quality flag set to be erroneous
THEN : Test the next station

ELSE : 3.4.2

3.4.2 : Set DEPTH to be the shallowest depth in the profile
: Set VALUE to be the temperature at DEPTH, or salinity if temperature is not present
: 3.4.3

3.4.3 IF: The quality flag on DEPTH is set to be erroneous
THEN : 3.4.4
ELSE : 3.4.6

3.4.4 IF: DEPTH is the deepest in the profile
THEN : 3.4.10
ELSE : 3.4.5

3.4.5 : Set DEPTH to be the next deeper in the profile
: Set VALUE to be the temperature at DEPTH, or the salinity if temperature is not present
: 3.4.3

3.4.6 IF: The quality flag on VALUE is set to be erroneous
THEN : 3.4.8
ELSE : 3.4.7

3.4.7 : Calculate the summed value of VALUE over the profile Calculate the summed difference of the value at DEPTH from the climatological mean over the profile
: Sum the number of observations and means over the profile
: 3.4.8

3.4.8 IF: There is another parameter observed at DEPTH
THEN : 3.4.9
ELSE : 3.4.4

3.4.9 : Set VALUE to the value of the next parameter at DEPTH
: 3.4.6

3.4.10 : Set the summed value under consideration to be that for the first parameter
: Set the summed difference value under consideration to be that for the first parameter
: Set the number of values under consideration to be that for the first parameter
: 3.4.11

3.4.11 IF: The difference between the mean value of the observations of the parameter and the mean value of the climatology is less then a specified threshold value, and the difference between the standard deviation of the observations of the parameter and the standard deviation of the climatology is less then a specified threshold value
THEN : 3.4.12
ELSE : 3.4.14

3.4.12 IF: There are summed values and summed differences for other parameters in the profile
THEN : 3.4.13
ELSE : Test the next station

3.4.13 : Set the summed value under consideration to be that for the next parameter
: Set the summed difference value under consideration to be that for the next parameter
: Set the number of values under consideration to be that for the next parameter
: 3.4.11

3.4.14 : Display the observed profile
: Display the climatological profile from the same location and month
: 3.4.15

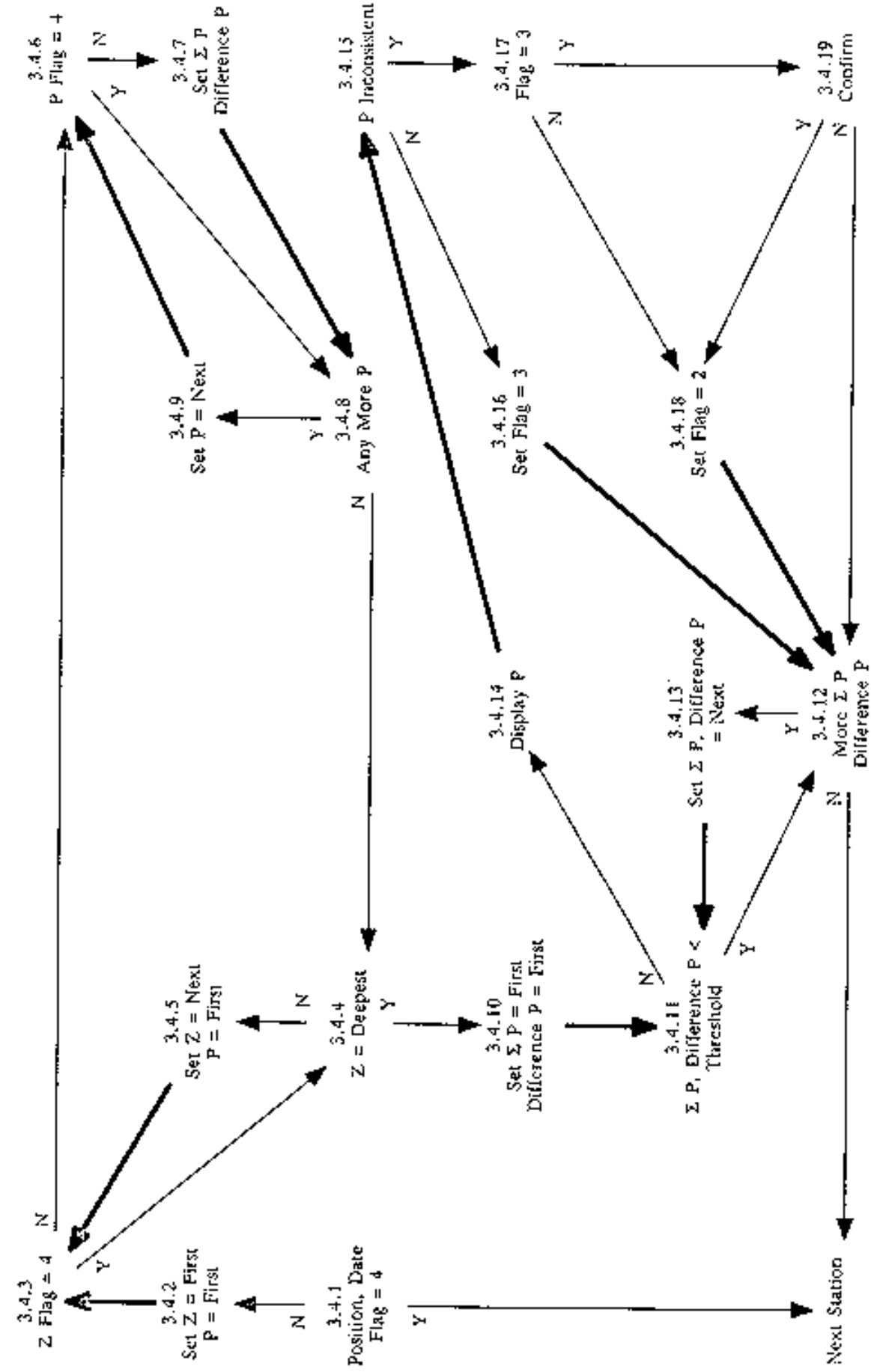
3.4.15 IF: The user chooses to flag the parameter profile as inconsistent
THEN : 3.4.17
ELSE : 3.4.16

3.4.16 : Notify the user that the profile flag will be set to doubtful
: Set the quality flag on the profile to "3", doubtful
: 3.4.12

3.4.17 IF: The profile flag is already set to be doubtful
THEN : 3.4.19
ELSE : 3.4.18

3.4.18 : Set the quality flag on the profile to "2", inconsistent
: 3.4.12

3.4.19 IF: The user confirms that the quality flag on the profile should be changed from doubtful to inconsistent
THEN : 3.4.18
ELSE : 3.4.12


3.4 Levitus Monthly Climatology
3.4.1 Position, Date Flag = 4
3.4.2 Set Z = First P = First
3.4.3 Z Flag = 4
3.4.4 Z = Deepest
3.4.5 Set Z = Next P = First
3.4.6 P Flag = 4
3.4.7 Set Σ P Difference P
3.4.8 Any More P
3.4.9 Set P = Next
3.4.10 Set Σ P = First Difference P = First
3.4.11 Σ P, Difference P < Threshold
3.4.12 More Σ P Difference P
3.4.13 Set Σ P, Difference P = Next
3.4.14 Display P
3.4.15 P Inconsistent
3.4.16 Set Flag = 3
3.4.17 Flag = 3
3.4.18 Set Flag = 2
3.4.19 Confirm
Next Station
Y
N

TEST NAME: 4.1 WATERFALL

Prerequisites: All of Stage 1 tests.
Global Impossible Parameter Value test.
Sort the stations in the incoming file by identifier and date and time for each identifier

Description:

This test examines adjacent profiles in an incoming file to determine if they are similar in form. It does so by computing the difference of each profile from its mean and then comparing these differences. If they lie below a given threshold, the profiles pass the test. In order to do this test, the profiles must be interpolated to the same set of depths. The Reineger-Ross interpolation scheme is used and only those points and depths with quality flags not set to be erroneous are used. As well, it is considered that the two profiles must be collected within 500 kilometers and 5 days of each other.

The test begins with the first identifier in the file. All of the stations with this identifier are examined to compose a list of the available parameters. Then, the first parameter is selected. The first station is tested to determine if a profile exists for the parameter under consideration. If it does not exist, the station is checked to see if it is the last for the identifier. If it is not, the next station is tested to see if a profile for the parameter exists.

If the station is the last for the identifier, the parameter is checked to determine if it is the last of the list of available parameters. If not, the parameter to be considered is set to be the next on the list, a marker (used to indicate a first profile of a pair has been found) is cleared and the station under consideration set to be the first for the identifier. The station is tested to see if a profile exists for the parameter and processing continues as already described.

If the parameter was the last on the list for a particular identifier, then the identifier is checked to see if it is the last in the file. If not, the identifier under consideration is set to be the next in the file. Then the list of available parameters for this identifier is composed and processing continues as already described. If it was the last identifier, this test is complete.

If a profile exists for the parameter in question, the marker is checked to see if it is set. If not, the marker is set and the profile is assigned to be the first in the pair to be considered. Then, the station is checked to see if it is the last for the identifier and processing continues as already described.

If the marker was already set, the profile being considered is assigned to be the second in the pair to be considered. The two profiles are then tested to determine if they have been collected within 500 kilometers and 5 days of each other. If not, the first profile is discarded and the second profile is assigned to be the first of a new pair. The station is then checked to see if it was the last for that identifier and processing continues as described above.

If the two profiles were collected sufficiently close together in time and space they will be interpolated in depth to the same set of standard depths. If quality flags on the individual depths of parameter values are set to be erroneous, then they are not used in the interpolation. Once the interpolation is complete, the mean of each profile is calculated. The test proceeds by examining one depth at a time beginning with the shallowest. The mean is subtracted from the interpolated value for each profile respectively and then the two differences are subtracted. This absolute value of the result is checked against the threshold for the parameter, given in table 4.1 below. If it lies below the threshold, the depth is examined to see if it is the deepest in the profiles. If it is not, the values at the next depth are examined as described above. If it is the deepest, the first profile is discarded, the second set to be the first in the pair and processing proceeds as already described.

If the result exceeds the threshold, the two profiles are displayed as well as any other from the same identifier that lie within 500 kilometers and 5 days of either of the two profiles in the pair. Also displayed are the interpolations to the two profiles. The user can then choose to set the quality flag on the second profile. If not, the quality flag on the first may be set. If not, the depth is tested to determine if it is the deepest and processing continues as previously described.

If the user chooses to set the quality flag on either of the profiles, the same process is followed. First the user can choose to set the flag to be inconsistent. If so, the flag is checked to ensure it is not already set to be doubtful. If not, the flag is set to be inconsistent and the depth tested to be the deepest. If the flag was already set to doubtful, the user must confirm that it be changed from doubtful to inconsistent. If confirmed, the change is made. If not confirmed, or if the user chose not to flag the profile as inconsistent, the user can now choose to flag it as doubtful. If denied, the flag remains unaltered. If accepted, the flag is set to doubtful, and the depth tested to determine if it is the deepest in the profiles. Further processing from here has already been described.

Table 4.1 Thresholds for absolute differences between parameter values in a pair of profiles.

Parameter	**Threshold**
Temperature	0.5 degrees C
Salinity	0.3 PSU

References:

1 . Reiniger, R.F. and C.K. Ross, 1968. A method of interpolation with application to oceanographic data. Deep Sea Research, V15, pp185-193.

History: None

Rules:

4.1.1 : Set ID to the first identifier in the list in the incoming file
: 4.1.2

4.1.2 : Derive the list of parameters for all of the stations with the given identifier
: Set PARM to be the first in the list of parameters
: 4.1.3

4.1.3 : Set the station under consideration to be the first
: 4.1.4

4.1.4 IF: There is a profile of the given PARM for this station
THEN : 4.1.11
ELSE : 4.1.5

4.1.5 IF: The station is the last with this identifier
THEN : 4.1.7
ELSE : 4.1.6

4.1.6 : Set the station under consideration to be the next for this identifier
: 4.1.4

4.1.7 IF: PARM is the last of the list of parameters for the given identifier
THEN : 4.1.9
ELSE : 4.1.8

4.1.8 : Set PARM to be the next in the list for the given identifier
: Clear MARK
: 4.1.3

4.1.9 IF: The identifier under consideration is the last one in the file
THEN : Test the next station
ELSE : 4.1.10

4.1.10 : Set ID to be the next identifier in the incoming file
: 4.1.2

4.1.11 IF: The profile has the quality flag set to be erroneous
THEN : 4.1.5
ELSE : 4.1.12

4.1.12 IF: MARK has been set
THEN : 4.1.14
ELSE : 4.1.13

4.1.13 : Set MARK
: Set PROFILE1 to be the present profile
: 4.1.5

4.1.14 : Set PROFILE2 to be the present profile
: 4.1.15

4.1.15 IF: PROFILE1 is within 500 kilometers and 5 days of PROFILE2
THEN : 4.1.17
ELSE : 4.1.16

4.1.16 : Set PROFILE2 =PROFILE 1
: 4.1.5

4.1.17 :Interpolate the data for both PROFILE1 and PROFILE2 so that the data are represented at the same depths Calculate the mean of each profile
: Set DEPTH to be the first in the profiles
: 4.1.18

4.1.18 : Calculate the difference between the mean and the value at DEPTH for PROFILE1, call it DIFF1
: Calculate the same quantity for PROFILE2, call it DIFF2
: 4.1.19

4.1.19 IF: The absolute value of DIFF1 minus DIFF2 is less than a given threshold
THEN : 4.1.20
ELSE : 4.1.22

4.1.20 IF: DEPTH is the deepest in the profiles
THEN : 4.1.16
ELSE : 4.1.21

4.1.21 : Set DEPTH to be the next in the profiles
: 4.1.18

4.1.22 : Display PROFILE1
: Display PROFILE2
: Display profiles of the same parameter for the same identifier that are within 500 kilometers and 5 days of either PROFILE1 or PROFILE2
: 4.1.23

4.1.23 IF: The user chooses to set the quality flag on PROFILE2
THEN : 4.1.25
ELSE : 4.1.24

4.1.24 IF: The user chooses to set the quality flag on PROFILE1
THEN : 4.1.25

ELSE : 4.1.20

4.1.25 IF: The user chooses to set the quality flag on the profile to be inconsistent
THEN : 4.1.26
ELSE : 4.1.29

4.1.26 IF: The quality flag on the profile is already set to be doubtful
THEN : Notify the user how the flag is presently set
: 4.1.28
ELSE : 4.1.27

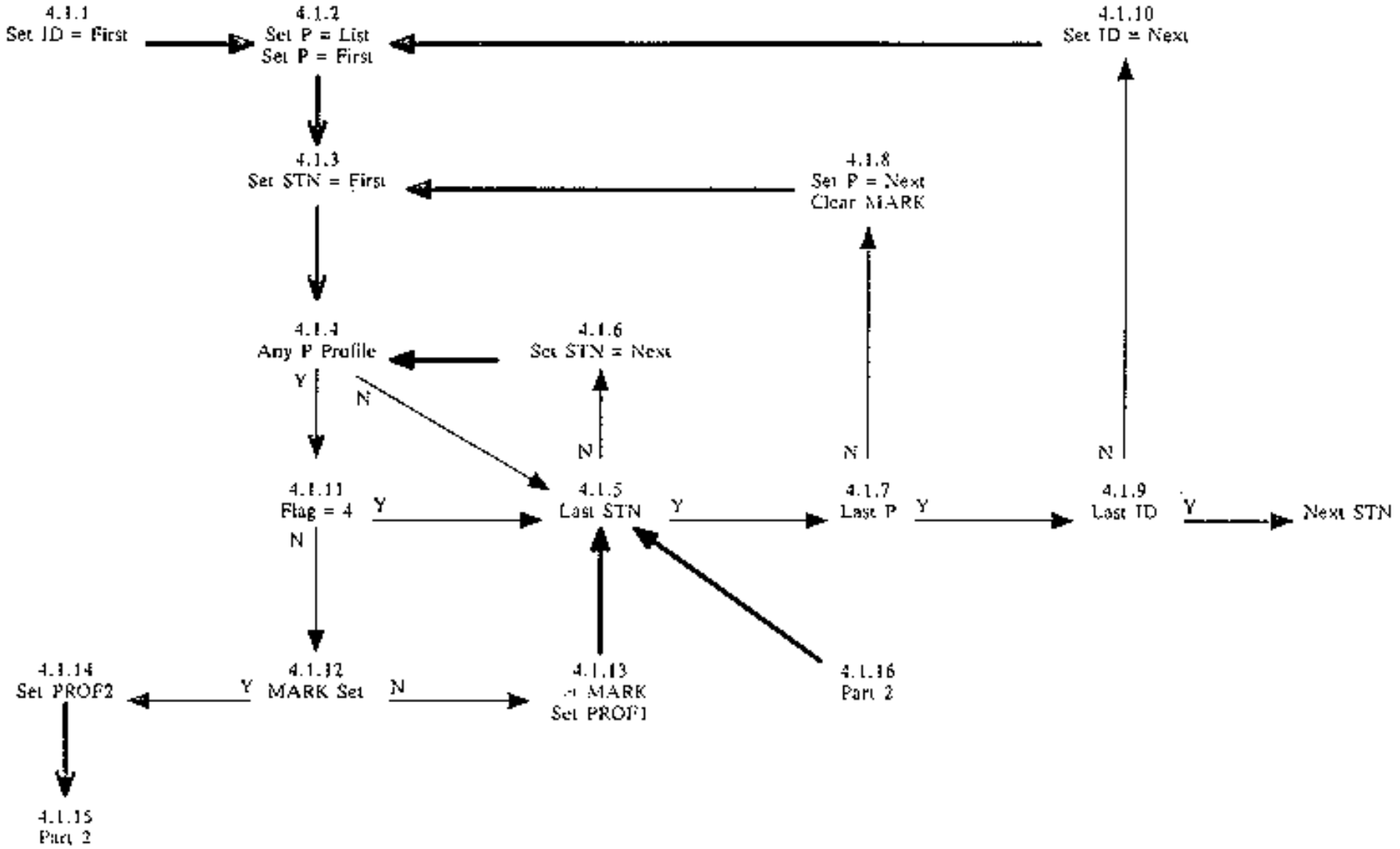
4.1.27 : Set the quality flag on the profile to be "2", inconsistent
: 4.1.16

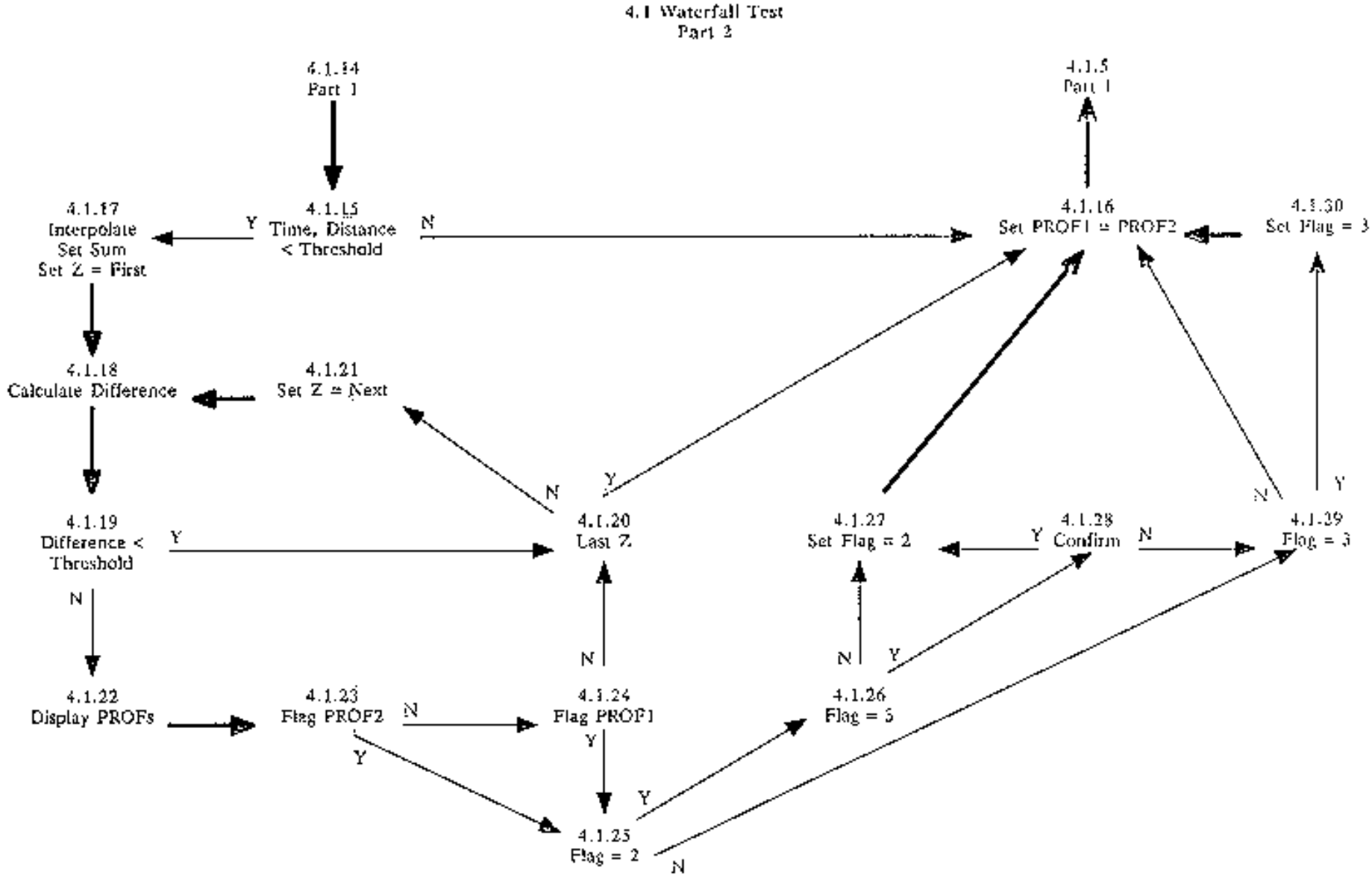
4.1.28 IF: The user confirms that the quality flag should be changed
THEN : 4.1.27
ELSE :4.1.29

4.1.29 IF: The user chooses to set the quality flag on the profile to be doubtful
THEN : 4.1.30
ELSE : 4.1.16

4.1.30 : Set the quality flag on the profile to be "3", doubtful
: 4.1.16

4.1 Waterfall Test
Part 1




4.1 Waterfall Test
Part 2
4.1.14
Part 1
4.1.5
Part 1
4.1.17
Interpolate
Set Sum
Set Z = First
Y
4.1.15
Time, Distance
< Threshold
N
4.1.16
Set PROF1 = PROF2
4.1.30
Set Flag = 3
4.1.18
Calculate Difference
4.1.21
Set Z = Next
N
Y
N
Y
4.1.19
Difference <
Threshold
Y
4.1.20
Last Z
4.1.27
Set Flag = 2
Y
4.1.28
Confirm
N
4.1.29
Flag = 3
N
N
Y
4.1.22
Display PROFs
4.1.23
Flag PROF2
N
4.1.24
Flag PROF1
4.1.26
Flag = 3
Y
Y
Y
Y
4.1.25
Flag = 2
N

TEST NAME: 5.1 CRUISE TRACK

Prerequisites: None

Description:

This test involves the visual inspection of the data as received at the processing centre. The stations of observations should be arranged in what constitute "cruises". For data received in real-time, a cruise would be the collection of stations from a single ship and arranged in chronological order of collection. The cruise track for each is plotted showing the location of each station and a coastline map of the region. The person reviewing it should satisfy themselves that the stations do not appear to follow in an appropriate sequence and relationship to each other.

History: None

Rules: None

TEST NAME: 5.2 PROFILES

Prerequisites: None

Description:

The profiles of the observations should be viewed at each station. This review will identify any questionable variations in the parameters and set quality flags as appropriate. In special cases, where further information is available, or where the error and necessary correction are beyond doubt, the person conducting the review may alter the data value. Should this occur, the quality flag must be set to "5" to indicate the value was changed, and the original value is retained elsewhere in the record.

Processing centres may choose to calculate other variables based on those received in order to help assess the observed values. For example, a calculation of the density profile based on temperature and salinity, will help to determine if the observed values are reasonable. There are numerous other possibilities. Processing centres should be prepared to supply written documentation of the procedures employed in this stage of processing.

History: None

Rules: None

ANNEX C: SUGGESTED ADDITIONAL TESTS

This annex contains a brief description of other tests to be considered in future versions of the Quality Control Manual. Contributions have come from various sources. They are presented in no particular order.

1. When information is available, use forecast fields to compare to incoming data. Those data mismatching the forecast require closer looks.

2. AODC check that sea surface reference temperature agrees to XBT surface value to within 3 degrees.

3. AODC suggests additions to Impossible Parameter Values.

PARAMETER	MIN	MAX
Cloud Code	0	9
Air Pressure	950	1050mb
Weather Code	0	9
Wave Period Code	0	20
Wave Height Code	0	60

4. We could use a test that takes the position of a profile and uses the fact that it is near a source of freshwater to refine the permissible salinity limits. This would be a refinement of range tests based on regions.

5. VNIIGMI-WDC suggests the use of statistical criteria on data accumulated over one month, in a region of 5 or 10 degrees squares and at standard depths. The individual observations are then tested to see if they exceed 3 standard deviations based on the distribution of values. It is suggested that either the Tukey or Dickson criteria could be used. These are described in "Exploratory Data Analysis" by J.W. Tukey, Addison and Wesley, 1977, pp693 and in "Statistische Auswertungsrnethoden" by L.Sachs, Springer, 1972, pp598.

6. DHI has suggested that a water mass test be employed. This could either be a comparison of TS curves to a climatology (as is partly done in test 3.2) or as a comparison to volumetric analysis compiled for various ocean areas.