AIDS TO NAVIGATION DIRECTIVE

Short Range Aids Positioning and Checking Directive

1. SCOPE

This directive details the principles, responsibilities and procedures involved in the service checking of Short Range Aids to Navigation (SRA). It outlines all relevant aspects of service checking for aids maintained by the Canadian Coast Guard (CCG) and for CCG aids maintained under contract.

2. BACKGROUND

The Minister of Fisheries & Oceans, through various legislation including the British North America Act, Canada Shipping Act, Oceans Act and the National Transportation Act, is mandated, though not obligated, to provide aids to navigation in Canadian waters in order to facilitate safe and expeditious movement of marine traffic and to protect the marine environment.

The International Maritime Organization's (IMO) Convention for Safety of Life At Sea (SOLAS), chapter 5, Regulation 13, to which Canada is a signatory, states:

Each Contracting Government undertakes to provide, as it deems practical and necessary either individually or in co-operation with other Contracting Governments, such aids to navigation as the volume of traffic justifies and the degree of risk requires.

In order to obtain the greatest possible uniformity in aids to navigation, Contracting Governments undertake to take into account the international recommendations and guidelines* when establishing such aids.

Contracting Governments undertake to arrange for information relating to aids to navigation to be made available to all concerned.

* Refer to the appropriate recommendations and guidelines of IALA and SN/Circ.107 – Maritime Buoyage System

3. DEFINITIONS

See Appendix A.

4. PRINCIPLES

4.1 *Application of Standard Requirements*

The requirements of this standard are applicable to all aids checks whether they are scheduled or unscheduled checks.

The formal aids checking as required by this directive is in addition to the normal surveillance of all aids required of CCG vessels in the course of their regular employment.

4.2 *System Design Review*

In addition to the checking stipulated in this directive, all aids must be reviewed periodically to ensure that they continue to provide the service for which they were established and that there is a continuing requirement for that service. This review shall be carried out in accordance with Directive 2.2600, "Review of Short Range Marine Aids Service".

4.3 *Personnel Qualifications*

The aids checking referred to in this directive, is to be carried out by persons having knowledge of the correct aids characteristics and positions and of the approved methods used in their verification.

4.4 *Specifications of Aids Service Contracts*

The Work Specifications contained in aids service contracts shall describe the checking to be carried out by the contractor, the methods to be used and applicable position fixing data, information and equipment to be used.

4.5 *Buoy Positioning*

4.5.1 Buoy Placement

For buoy placement, the objective is to put the buoy on its primary position. Following placement, a buoy shall be allowed to stabilize under the influence of current, wind, etc. and thus its position shall be checked to determine that it is as close as reasonably possible to its primary position.

4.5.2 Determination of Buoy Position Area

The position area for each buoy shall be determined in accordance with the guidelines in Appendix C and shall be recorded on the Buoy Data Card and/or in the Aids Program Information System (SIPA). The “position area” is to be used for position checking only and not for buoy placement.

This area may be established for certain buoys by the Regional Superintendent, Aids to Navigation and may be determined by calculating the maximum allowable distance that a buoy can be away from its primary position due to the length of its mooring, positioning error and tolerances, tides and any special on-site conditions, without impairing the quality of service provided to the mariner.

Normally its value will be a radius. If the on-position area is not circular, the appropriate tolerances and a description of how they are measured will be stated in distance and bearings.

Notwithstanding, a buoy must always be positioned in such a manner so as to ensure it protects mariners from the hazard it is intended to mark.

4.6 *Checking Frequency*

Aids checking schedules are designed to ensure that aids are adequately monitored. Details of the checking frequency for the various categories of aids are provided in Appendix B of this directive, and must be adhered to.

Scheduled aids checks shall not normally be carried out more often than specified herein. Checks in excess of the specified frequency must be clearly documented in the appropriate checking records.

Unscheduled aids checks precipitated by an incident or situation which may have altered the position, operation or characteristics of an aid to navigation, should be carried out as quickly as possible after such an incident or situation.

4.7 *Checking Methods*

Details of the appropriate checking methods are provided in Section 6.2.2 of this directive.

4.8 *Discrepancy Reports*

If an aid check reveals a discrepancy that cannot be immediately corrected by the checking unit, the discrepancy shall be immediately reported in accordance with Directive 2.2500 (section 5.3).

4.9 *Record Keeping*

Records of aids servicing and checking shall be maintained as described in Appendix G of this directive.

5. RESPONSIBILITIES

5.1 *Canadian Coast Guard*

The CCG is responsible for checking the aids to navigation it provides including those provided under contract (as per Directive 2.3500).

5.2 *Regional Superintendents of Aids to Navigation*

Regional Superintendents of Aids to Navigation are responsible for ensuring that the provisions of this Directive are adhered to.

5.3 *Coast Guard Vessels*

The Commanding Officer is responsible for ensuring that the provisions of this directive are adhered to by ships' personnel.

5.4 *Integrated Technical Services*

ITS is responsible for the life cycle management of the assets that support the aids to navigation program in order to meet CCG reliability targets (As per Directive 2.2500).

The Regional Superintendents (ITS) are responsible for ensuring that the provisions of this directive are adhered to by Technical Services personnel assigned the duties described herein.

6. PROCEDURES

6.1 *Checking Frequency*

Checking frequencies for the position, operation and characteristics of Short-Range Aids to Navigation (SRAN) shall be in accordance with the matrices in Appendix B.

Aids to Navigation shall be checked more frequently if warranted due to storms, ice movement, floods, vandalism, potential for movement, etc. as directed by the Regional Superintendent of Aids to Navigation.

True Bearings of range and sector lights shall be checked whenever the lights are changed, replaced or when movement is suspected or on the report of users.

Following the receipt of a report of shipping incident, all aids in the vicinity of the incident (i.e. those which may have been in use by the vessel(s) involved or that may be implicated in an investigation), shall be checked for correct operation and position as soon as practicable following the incident.

Aids which must be re-located periodically to mark fluctuating river channels shall be checked for proper channel alignment as directed by the Regional Superintendent of Aids to Navigation.

6.2 Checking Methods

6.2.1 Operation and Characteristic Checking

Checking the proper operation and characteristics of SRAN's involves ensuring satisfactory operation of an aid and conducting a visual and/or, aural and / or radar verification of those characteristics (as per Appendix B)

Problems with background lighting, vegetation growth and erection of signs, buildings or any other obstruction that interferes with the visibility of aids to navigation shall be corrected or reported to the Regional Superintendent of Aids to Navigation.

6.2.2 Position Checking

A) Buoys

(I) Authoritative Document

Every buoy shall be checked for position against its primary position as specified in the Fixing Data Tab, Primary Fixing Method in SIPA. A disparity may exist between the CHS charted position and the SIPA Fixing Method position. This disparity may become more apparent once these two positions are shown simultaneously on electronic chart display. It shall remain Coast Guard's Policy that the buoy position shall be checked against the Primary Position and not the charted position. It is the responsibility of Regional Superintendents of Aids to Navigation to resolve discrepancies.

(II) Position Checking Considerations

When placing a buoy or checking the position of a buoy from a vessel, the buoy must be adjacent to the DGPS antenna or observer or at a minimum distance with respect to the safety of the vessel and buoy.

The distance and direction that the observer or DGPS antenna is from the buoy shall be determined as accurately as possible and the corresponding offset applied**.** It is recommended that a sketch of the different offsets between the vessels DGPS antenna, the buoy release points and the observation points be produced (see the example in Appendix I). The sketch produced will serve as a reference for the configuration settings that will be entered in the DGPS equipment.

The largest scale corrected chart shall be used. The observed water depth (corrected only for depth of transducer) and the date and time shall be recorded.

(III) Positioning Methods

Position checking of buoys must always be carried out using the primary method identified on the buoy data card or the most accurate method practicably available, and verified by another method when considered necessary. If the primary method is not used the reason shall be recorded.

- When and where available Differential Global Positioning System (DGPS) must be used as the primary positioning method provided the following conditions are met:

  a) The persons responsible for buoy positioning are using the appropriate equipment and are following the conditions for use of DGPS (as per Appendix D).

  b) The buoy has been approved for DGPS positioning by the Regional Superintendent of Aids to Navigation.

  c) The DGPS reference station(s) used shall be that identified in SIPA.

Refer to Appendix D for the general rules / conditions on the use of DGPS.

IF DGPS IS NOT AVAILABLE OR APPROPRIATE ONE OR MORE OF THE FOLLOWING SHALL BE USED. JUDGEMENT MUST BE USED IN SELECTING THE APPROPRIATE METHODS IN EACH CASE.

- GPS shall be used in conjunction with other positioning tools such as soundings, radar bearings, compass bearings, local knowledge or other methods.

- Two or more horizontal sextant angles between suitably located objects ashore. In choosing objects, the general rules governing this method of fixing shall be observed (see Appendix A – Rules for strong three point fix).

- Two fixed objects in line (ranges) and an adjacent horizontal angle from the line to a third object ashore. The objects may be natural or man-made. The objects in line should be a considerable distance apart and the angle of cut should be between 30 and 150 degrees and as near 90 degrees as possible.

- Two fixed ranges, natural or otherwise. The angle of cut should be between 30 and 150 degrees and as near 90 degrees as possible.

- True bearings of at least three charted, conspicuous and suitably located objects ashore. The subtended angles should be between 30 and 150 degrees and as near 90 degrees as possible and should be applied to and plotted with station pointers as a check on the lines of bearings laid off on the chart.

- Radar distances to three or more charted, identifiable and suitably located targets ashore.

(IV) Local Knowledge

Local knowledge is information about a waterway that local mariners and/or CCG personnel and/or contractors have developed with experience and which is usually not contained in official nautical documents. Local knowledge may be the only available or practical method of buoy positioning in some cases (e.g., when sufficiently accurate charts or reference points are not available). Placement of the buoy may be by means of “sighting” the obstruction to be marked either visually or by sounding. In such a case, the fixing data is a description of the procedure followed. Position checking is by repetition of this procedure. However a DGPS/GPS position should be obtained whenever practical.

(V) Approval of Alternate Methods

Any method of positioning other than those prescribed above must be approved by the Regional Superintendent of Aids to Navigation, prior to its use.

B) Fixed Aids

Fixed Aids shall be checked for position using DGPS or by survey;

I) Ranges

The bearings of range lights must be checked to ensure they agree with the Buoy Data Card (in SIPA). Chart, Light List and other publications should agree with the reference data.

The vertical and horizontal divergence of the range lights should be checked to ensure that optimum light intensity is seen over the usable portion of the range.

The bearing of a range can be checked by using the drift method by ship; by survey method from shore or alternate methods approved by the Regional Superintendent of Aids to Navigation.

Note: The Canadian Hydrographic Service (CHS) has a responsibility for determining the bearings of ranges and the coordinates of range structures for charting purposes.

II) Sector Lights

The bearings of sectors must be checked to ensure they agree with the Buoy Data Card (in SIPA). Chart, Light List and other publications should agree with the reference data. Sector lights must be checked from sea by the drift method (see Appendix A).

The boundary between the white and coloured portions must be checked to ensure the entire white sector is in safe water or as otherwise indicated on the chart. Sector lights with oscillating boundaries must be checked to ensure the white and coloured oscillating boundaries are located within safe water or as indicated on the chart.

6.3 *Records*

6.3.1 Record Retention

All inspection and servicing records shall be retained for a period of at least five years following the date of inspection. This applies to both rough "field" notes and office records including emails. In the event of an accident, a dispute or a claim in which any aids are implicated, the inspection and servicing records for these aids shall be retained until the final resolution of the dispute, claim or suit.

6.3.2 Buoy Record

A complete record of the buoy data, fixing data and servicing performed shall be maintained for each buoy using the SIPA Floating Aid Data Sheet and the SIPA Buoy Service Report.

a. Buoy Data

Buoy Data information shall be kept in SIPA which is the authoritative reference for information concerning aids to navigation (See Appendix F).

b. Buoy Service Report

This form is the field document on which the pertinent details of the checking and servicing performed are recorded. Should a buoy be repositioned after a check, the position in which it was found will be recorded and saved as well as the position to which it was relocated.

A Buoy Service Report or a SIPA Buoy Service report shall be completed after each buoy service or buoy check (scheduled or unscheduled).

The administration and use of the Buoy Service Report or the SIPA Buoy Service Report shall be in accordance with Appendix G.

Further information concerning SIPA may be found in the "SIPA Users Reference Manual".

c. Buoy Service Contracts

Buoy service contracts shall contain the necessary buoy and positioning data pertaining to the buoys specified in the contract. Buoy contractors shall be instructed in the keeping of records of the servicing and position checking done and in submitting reports. The Buoy Service Report shall be used for this purpose.

6.3.3 Fixed Aids Records

A complete record of the fixed aid data and servicing performed shall be maintained for each fixed aid using the SIPA Fixed Aid Data Sheet and the SIPA Fixed Aid Service Report.

a. Fixed Aid Data

Fixed Aid Data information shall be kept in SIPA which is the authoritative reference for information concerning aids to navigation (See Appendix F).

b. Fixed Aid Service Report

A Fixed Aid Service Report or a SIPA Fixed Aid Service report shall be completed after each fixed aid service or fixed aid check (scheduled or unscheduled).

The administration and use of the Fixed Aid Service Report or the SIPA Fixed Aid Service Report shall be in accordance with the minimum requirements contained in Appendix H.

c. Service Contract Requirements

Contractors maintaining fixed aids shall be provided with the details of the aids, of the maintenance and checking required, of the records to be kept and of the reports to be submitted. The contractor shall submit completed signed reports showing the date and time of inspections and noting any deficiencies.

DEFINITIONS

1. Buoy Position Area

The position area of a buoy is the area within which the buoy is considered to be performing its intended function and, therefore, within which the buoy is considered to be "on-position". (See appendix C)

2. Characteristics

As applicable to aids checking, "Characteristics" means the following:

a) the rhythm, colour and period of the light (i.e. FlR4s);
b) the colour and shape of the buoy, daymark, tower, dwelling, or other structures;
c) the type of buoy, light, tower, daymark, etc.;
d) the number, the letter, and/or name of an aid where such identification appears on the aid;
e) the sound emitted by the bell, whistle, horn or other sound apparatus on a buoy;
f) the coded signal emitted by a RACON
g) the length and frequency of fog-signal blasts and the direction of orientation of the fog-signal (when advertised in the List of Lights); and
h) any other advertised feature of an aid which facilitates its identification.

3. Drift Method

Using a vessel, it is necessary to “drift” the range at a minimum of 3 drift lines. One as close as practical; one as far away as practical and one other along the centre line and usable length of the range.

4. Off-Position

If a position check finds a buoy to be outside of its position area, it shall be considered to be off-position.

5. On-Position

If a buoy is found to be inside of its position area, it can generally be considered to be on-position.

An exception can occur when a buoy is slightly within the position area but is influenced by tide, wind or current in such a way that it is apparent that the sinker is some distance outside of the position area. In such a case the buoy should be repositioned.

6. Operation

As applicable to aids checking, "Operation" means the state of functioning of all components in such a manner that the visual representation or signal produced is that which is intended and/or advertised.

7. Operational Checking

Operational checking is determining if an aid is in its advertised position and displaying the proper characteristics. (i.e. that the aid is providing its intended service to the mariner.)

8. Opportunity Check

An opportunity check is an unscheduled check of an aid to navigation by a vessel or person in the vicinity of the aid for other purposes. Such a check is not precipitated by a specific incident or situation. Opportunity checks may replace or eliminate a scheduled check.

9. Position

As applicable to aids checking, "Position" means the following:

a) the geographical coordinates where the aid is placed referencing the datum of the largest scale chart**.** This may include, proximity of hazards and depth of water;
b) the height above higher high water large tides or height above chart datum in non-tidal waters;
c) the geographical description as shown in the List of Lights;
d) the line of bearing of a range;
e) the arc of visibility of a shore light (when advertised in the List of Lights);

f) the arc enclosed by each sector of a sector light and the line of bearing of the division between sectors;
g) the mileage on a waterway, such as the Mackenzie River, when this is the normal means of defining the location of an aid; and
h) any other advertised information which facilitates the location of an aid or its use as a position fixing reference.

10. Primary Position

The primary position is the official position to be used for placing and checking floating aids to navigation. It is specified in the Fixing Data Tab, Primary Fixing Method in SIPA

11. Rules for Strong Three Point Fix

(a) The strongest fix occurs when the observer is inside a triangle formed by the three objects. In such a case the fix is strongest when the three objects form an equilateral triangle with the observer at the center and the objects are close to the observer.

(b) The fix is strong when the sum of the two angles is equal to or greater than 180^{o} and each angle is greater than 30^{o}. The nearer the angles are to each other in size, the stronger the fix

(c) The fix is strong when the three objects are in a straight line and center object is nearest the observer.

(d) The fix is strong when the center object is nearest the observer and lies between the observer and a line joining the other two objects.

12. Scheduled Check

A Scheduled Check is a planned check of a marine aid according to a pre-determined schedule (see appendix B).

13. Seasonal Buoy

A buoy that is placed at the start of the navigation season and removed at the end of said season.

14. Service

For the purpose of this directive, the word "service" is used in a broad sense and includes some or all of the following tasks:

(a) Checking of the aids for proper operation, characteristic and position;
(b) Replacement of components; and
(c) Placing buoys on station and lifting or repositioning them as required.

15. Service Providers

Service providers are individuals, firms, CCG Fleet and Integrated Technical Services (ITS) capable of following the provision of this directive in order to provide the services required in a safe and efficient manner.

16 Summer Buoy

A buoy placed for the summer and replaced with a spar for the winter.

17. Unscheduled Check

An unscheduled check is a check that is not carried out according to a pre-determined schedule. Such checks may be required after a specific incident or when a situation arises which may have altered the position or operation of an aid to navigation or following a shipping accident in the vicinity of the aid.

18. Winter Spar

A buoy that is placed for the winter and replaced with a buoy for the summer.

19. Year Round

A buoy in place and maintained year round.

20. Year Round / Seasonally Maintained

A buoy that is in place year round and only maintained for the navigation season.

DEFINITIONS OF ACRONYMS / DÉFÉNITION DES ACRONYMS

(Please note that some of the fields are blank because there is no official translation)

3D	3 Dimensions	**3D**	3 Dimensions
CHS	Canadian Hydrographic Services	**SHC**	Service hydrographique du Canada
CCGS	Canadian Coast Guard Ship	**NGCC**	Navire Garde côtière canadienne
DGPS	Differential Global Positioning System	**DGPS**	Système de position global différentiel
GPS	Global Positioning System	**GPS**	Système de position global
GSA	GNSS DOP and Active Satellites	**GSA**	DOP et satellites actifs GPS
GGA	Global Positioning System Fixed Data	**GGA**	
BWC	Bearing and Distance to Waypoint	**BWC**	
VTG	Course over Ground and Ground Speed	**VTG**	
MSS	MSK Receiver Signal	**MSS**	
RMC	Recommended Minimum Specific GNSS Data	**RMC**	
ZDA	Time and Date	**ZDA**	
HDOP	Horizontal Dilution of Precision	**HDOP**	Dilution horizontale de précision
IM	Integrity Monitor	**IM**	Moniteur d'intégrité
L1	Frequency 1.57542 GHZ	**L1**	Fréquence 1.57542 GHZ
MSS	Query sentences to a data receiver	**MSS**	Demande de message de donnée du récepteur
NAD	North American Datum	**NAD**	Système de référence nord-américain
NMEA	National Marine Electronics Association	**NMEA**	Association nationale maritime électronique
RACON	Radar Beacon	**RACON**	Balise Radar
RTCM	Radio Technical Commission for Maritime Services	**RTCM**	Commission de radio technique pour services maritimes
SIPA	Aids Program Information System	**SIPA**	Système d'information - Programme des aides
WGS-84	World Global System 1984	**WGS-84**	Système mondial global 1984

Checking Frequency

Fixed and Floating Aids to Navigation

Type	*Position Check*	*Operation & Characteristics Check*
All buoys	When placed, lifted or exchanged.	When placed, lifted or exchanged.
Year Round / Seasonally Maintained buoys	Checked annually if they are affected by ice (at the beginning of the navigation season).	Checked annually if they are affected by ice (at the beginning of the navigation season).
Fixed Aids (Year round)	When problems are suspected.	During service visits in accordance with regional ITS maintenance schedules (as agreed to by Regional Superintendent of Aids to Navigation)
Seasonal Fixed Aids	When problems are suspected.	Checked when commissioning.

Note: This table gives the checking frequency for aids to navigation maintained by service providers e.g. individuals, firms, CCG Fleet and Integrated Technical Services (ITS).

BUOY POSITION AREA

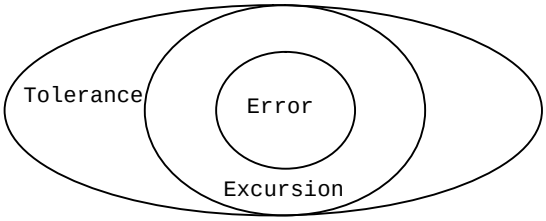
Assuming no movement of its anchor, the area within which a buoy will always be found is determined by the movement permitted by its mooring length and depth of water and by the errors inherent in the positioning method used e.g. 1-5 meters for DGPS. Thus, when these factors are added together they determine the area within which a buoy position must be maintained. After certain basic assumptions are made, the approximate size of this area can be calculated for each buoy using the mooring length, minimum water depth and the fixing data for that buoy.

To reflect the requirements of the site and type of vessels, a third factor is added to determine the operational position area to be used for buoy checking. That factor is the additional distance that the buoy may be from its advertised position without affecting the validity of the information conveyed to the mariner. This tolerance factor should be as large as safety permits to reduce the requirement for needless buoy repositioning.

In some cases the added tolerance factor will be greater in some directions than in others. In such cases the operational position area will not be circular and its limits will have to be defined by both distance and direction from the advertised buoy position. A common example of this is a buoy marking a relatively narrow channel where the allowable buoy movement longitudinally (parallel to the channel) is much greater than the allowable movement laterally (into or away from the channel).

While it will be applicable to most buoys, the concept of a position area will be impractical or impossible to apply in some cases e.g. a buoy that is under the influence of a constant, unidirectional current would maintain a much smaller position area than theoretical calculations would indicate. Thus the operational buoy position area can be determined only by rational application of local knowledge and careful use of the calculations presented in this appendix

Note: Buoy Position Area is defined in the position tab in SIPA.



MAXIMUM BUOY POSITION AREA

(For additional technical information/graphs please refer to Appendix J)

CALCULATIONS

The two factors in the calculation of the radius (r) of the minimum position area are the positioning error (e) and the excursion (s) permitted by the mooring. In some cases it may also be necessary to include a third factor of tolerance (t).

The excursion (s) is calculated by assuming the worst case of the mooring being extended to a straight line and thus becomes:

$s=\sqrt{L^2- d^2}$ where L = mooring length
d = least water depth (e.g.: at low tide)
(See NOTE 1)

When DGPS is used to place a buoy, the positioning error (e) is determined as follows:

$e = 2DRMS = 2 * HDOP * UERE$

where: 2DRMS is the radius of a circle that contains at least 95% of the position bearings obtained by the system for a given site. A circular bearing distribution represents a probability closer to 98%, whereas an ellipsoid distribution represents 95%;

HDOP is the GPS satellite geometry quality index;

UERE (User Equivalent Range Error) is the accuracy of the distance measure between the user and the satellites and depends on the quality of the DGPS receiver being used.

When calculating the 2DRMS, the UERE of the receiver being used must be taken into account. When a high-quality DGPS receiver is used, the UERE factor can be assumed to be 1.25 metres. Consequently, the DGPS positioning error can be simplified by this equation:

e = 2DRMS = 2.5 (or 2 x UERE of 1.25) * HDOP= 5m

Because the HDOP value must be limited to ≤ 2.0 for buoyage operations, the maximum positioning error (e) would be 5.0 metres. When calculating the maximum buoy positioning area radius (r), the excursion (s) is added to the 2DRMS positioning error to give the following equation:

$r = 2.5$ (or 2 x UERE) * 2 (or maximum HDOP) + $\sqrt{L^2 - d^2}$

When a sextant or gyrocompass is used to place a buoy, the positioning error (e) is determined as follows:

The positioning error (e) is the distance error that results from errors in reading and plotting horizontal angles. Trials have found that for these two methods, the average size of this error is:

e = .002D for sextant + 3-arm protractor
e = .006D for gyrocompass + compass rose (SEE NOTE 2)

where D is the distance from the theoretical buoy position to the farthest positioning mark.

Thus the radius (r) of the maximum position area is:

A. $r = .002D + \sqrt{L^2 - d^2}$ For buoys whose positions are checked by sextant angles plus the 3-arm protractor

B. $r = .006D + \sqrt{L^2 - d^2}$ For buoys whose positions are checked by any of the other approved methods (See NOTE 2)

NOTES

1. The assumptions made in the calculation of buoy excursion (s) will result in a calculated movement that is greater than that which can practically occur, i.e. based on the length of the chain which in theory is straight but in practice is not. However, a calculated maximum position area radius (r) that is greater than the movement considered tolerable for that buoy is a potential danger signal. In such a situation:

   (a) In practice, a buoy, its mooring and its position should be checked to ensure that its actual movement is not more than the tolerable limit in accordance with the channel design or proximity to hazards.

   With the arrival of new permanent anchorage systems and straight line moorings, the buoy excursion (s) may have to be revised downward.

2. For simplicity and as a conservative approximation, the calculations for all positioning methods except sextant angles and DGPS positioning should use the error factor (.006) applicable to the use of gyrocompass readings plus the compass rose.

   After the radius (r) has been calculated, any additional tolerance (t) allowed by the site should be added to it to determine the size and shape of the operational position area.

CONDITIONS FOR THE USE OF DGPS

Recommended Practices:

1) CCG Personnel or Contractors shall ensure the DGPS receiver is operating properly prior to positioning an aid to navigation and that the operators are properly trained. They must also periodically check the accuracy of the vessel's DGPS equipment by comparing the antenna position with a marker or known position. These periodic checks must be recorded.

2) DGPS shall not be used to position an aid to navigation when an unhealthy or unmonitored signal is received.

3) DGPS data shall be recorded manually or electronically on a buoy service report: Aid position expressed in Latitude and Longitude, HDOP, service time and date, differential station being used.

4) DGPS shall not be used if the age of the pseudo range correction exceeds 30 seconds.

5) The DGPS receiver's datum conversion feature shall be set at WGS-84.

6) The Horizontal Dilution of Precision (HDOP) reading shall be above 0 and less or equal to 2.0. A reading of 0 indicates that the system is not functioning properly. If more than 2.0 wait a few moments for the system to stabilize before positioning.

7) While positioning aids, the DGPS mode in the receiver shall not be set to automatic. Unless, the electronic positioning system or the DGPS receiver displays an audible and visual alarm to warn the user that the positioning system has switched from DGPS mode to GPS mode or that the station being used is unmonitored or emitting an unhealthy signal.

8) The selection of the Differential station shall be as follow:

1. The closest station from the aids to navigation placed or positioned.
2. If the signal of the closest station is unhealthy or unmonitored, select the next closest station available.
3. Do not use a station outside its advertised coverage zone (according to the official coverage map) unless approved by the Regional Superintendent, Aids to Navigation.

9) While positioning an aid, the DGPS receiver shall be in the 3 dimensional (3D) mode (tracking at least 4 satellites)

Recommended Default Settings on the DGPS Receivers:

1) The limit for the pseudo range correction shall be set at 30 seconds.

2) The datum conversion feature shall be set to WGS-84.

3) The HDOP alarm shall be set to activate at a maximum of 2.0.

4) The mode 3 Dimension (3D) shall be selected.

5) The mask angle shall be set equal or greater than 7.5° but not greater than 10^{o}. For receivers that accept even increments of 5, a value of 10° would be acceptable.

6) The data transfer rate shall be set for 200 bits per second when using a Canadian DGPS station.

Recommended Alarms to be activated on DGPS Receivers:

1) The alarm to display the health status (unhealthy or unmonitored) shall be activated.

2) If available, the alarm for RTCM message shall be activated.

3) If available, the alarm for the age of the pseudo range correction shall be activated.

4) If available, the alarm for HDOP shall be activated.

NOTE: The alarm devices should be audible and visual.

Technical requirements on DGPS receivers:

1) If feasible, the receiver shall alert user of change in station health. If the DGPS broadcast is unhealthy or unmonitored, the receiver shall revert to GPS mode or display an appropriate message preceded by an audible and/or visual alarm.

2) The DGPS receiver shall be able to handle RTCM SC-104 Type 9-3 Corrections.

3) The DGPS receiver shall have the capacity of tracking, continuously and simultaneously, single frequency (L1) from 12 satellites and to up-date the position at a rate of once per second (for NMEA messages).

4) The DGPS receiver shall have a DGPS positioning accuracy of better than 3 m, 95% of the time.

5) It is desirable that the DGPS receiver has a multipath (e.g. deflection) mitigation system and employ a built in reliability algorithm.

6) If DGPS data are recorded electronically, the DGPS receiver shall be able to provide the following NMEA sentences: GGA, GSA, MSS, VTG and BWC. The receiver shall adhere to NMEA 0183 Version 2.1 or better.

7) The position coordinates shall display 3 decimal digits of a minute (XX°XX.XXX'), or better and 4 decimal digits of a minute (XX°XX.XXXX') for NMEA output. Co-ordinates displayed only in degrees, minutes and seconds are acceptable as long as they provide the level of accuracy required, which is 2 decimal digits of a second (XX°XX'XX.XX''), or better.

Information required on Buoy Service Report:

1) When DGPS data are recorded manually, the following information shall be noted:

- Aid position: Latitude, Longitude
- HDOP
- Time and Date
- DGPS Station used (Name and/or frequency)
- Make and model # of DGPS equipment used (for contractors only)

Note: The positions provided must be in the same format as the specified positions provided by the Aids to Navigation office e.g. DDD MM SS.ssss or DDD MM.mmmm

2) When DGPS data are recorded electronically the following information shall be transmitted to the service report (or SIPA):

- Recorded Aid position (3 decimal digits of a minute or better required)
- HDOP
- Time and Date (RMC or ZDA)
- Make and model # of DGPS equipment used
- DGPS position (at the location of the DGPS antenna) - (if available)
- DGPS fixing information: that includes the 5 NMEA sentences: GGA, GSA, MSS, VTG, and BWC (if available).
- Antenna Offset Information (if available)
- Ship-Heading (if available)
- Range and bearing between the specified position and the recorded position BWC

Table of DGPS Reference Stations in Canada

Station Name	ID No. of reference stations	DGPS Station ID	Geo. Position Latitude Longitude	Frequency [khz]	Bit/s
Cape Race, NFLD	338,339	940	46 46 N 53 11 W	315	200
Cape Ray, NFLD	340,341	942	47 38 N 59 14 W	288	200
Cape Norman, NFLD	342,343	944	51 30 N 55 49 W	310	200
Rigolet, NFLD	344,345	946	54 11 N 58 27 W	299	200
Partridge Island, NB	326,327	939	45 14 N 66 03 W	295	200
Pt. Escuminiac, NB	332,333	936	47 04 N 64 48 W	319	200
Fox Island, NS	336,337	934	45 20 N 61 05 W	307	200
Hartlen Point, NS	330,331	937	44 36 N 63 27 W	298	200
Western Head, NS	334,335	935	43 59 N 64 40 W	312	200
St.-Jean-sur-Richelieu, QC	312,313	929	45 19 N 73 19 W	296	200
Lauzon, QC	316,317	927	46 49 N 71 10 W	309	200
Riviere du Loup, QC	318,319	926	47 46 N 69 36 W	300	200
Moisie, QC	320,321	925	50 12 N 66 07 W	313	200
Wiarton, ON	310,311	918	44 45 N 81 07 W	286	200
Cardinal, ON	308,309	919	44 47 N 75 25 W	306	200
Alert Bay, BC	300,301	909	50 35 N 126 55 W	309	200
Amphritrite Pt., BC	302,303	908	48 55 N 125 33 W	315	200
Richmond, BC	304,305	907	49 06 N 123 11 W	320	200
Sandspit, BC	306,307	906	53 14 N 131 49 W	300	200

AIDS TO NAVIGATION DATA

The following instructions are in addition to those contained in sections 6.3.2 and 6.3.3.

The SIPA buoy and fixed aid data information is the authoritative reference for all information concerning each aid, its mooring (buoy), its characteristics, its position and its fixing data (buoy) and chart datum.

1. BUOY OR FIXED AID DATA CARD

Every Canadian Coast Guard aid shall have a corresponding SIPA Data Card completed. Aids owned by other departments, governments, corporations, or private individuals may also have a SIPA Data Card depending on the completeness and timeliness of the information available.

The following procedure shall be followed when filling a buoy or fixed aid data card:

A. Data Card Position (Advertised Position)

The Data Card Position (Advertised Position) is located on the Position tab in SIPA. The position is expressed in relation to the largest scale chart showing the aid and to the chart datum of this chart (e.g., North American Datum 1983).

Advertised position shall be recorded to the following accuracy:

Chart Scale	Accuracy to the Nearest
up to 1:60,000	0.5 sec.
over 1:60,000 to 1:120,000	1.0 sec.
over 1:120,000	30 sec.

It is possible that once a position has been determined using the chart, an on-site position reading may be more accurate. In this situation, the reading shall become the new reference position and the degree of accuracy (see the following paragraph) may be modified.

For each position recorded, a comment specifying the method (chart plotting, GPS, DGPS, etc.) and the degree of accuracy (approximate or exact) shall be entered in the “Determined by/Method” field on the "Position" tab. The note "approximate" shall be used when buoys are positioned with local knowledge (see paragraph D), buoys are relocated, or because the channel shifts because of the nature of the bottom. In all such cases or when the buoy is not shown on the chart (usually because the scale is too small), the reference latitude and longitude shall be entered to the closest accuracy possible.

B. Chart With No Grid

When buoys are established in areas where the chart does not have a grid, the charted position must be referred to by such methods as bearing and distance from a well-defined charted object, a set of sextant angles, etc. In such cases leave the Latitude and Longitude fields blank or enter the DGPS position if known. Then click the “No Grid Chart” button and enter the relevant bearing and distance from a reference point.

When the Buoy Data Card position (Advertised Position) is the same as that used to position the buoy, it shall be entered on the Fixing Method tab.

C. Uncharted Waters

When a buoy is placed in uncharted waters, select “None” in the list for “Reference Chart No Main”. Leave the Latitude and Longitude fields blank or enter the DGPS position if known.

D. Fixing Data (Fixing Method tab)

An unlimited number of fixing data can be entered in the Fixing Method tab. The DGPS position, the landmarks, sextant angles, ranges, bearings, depths, radar distances and targets, shall be fully described so as to permit easy understanding and use. The primary method of position determination is by DGPS.

If the positioning method selected is "Local Knowledge" because the buoys are placed by local knowledge of the channel or hazard only, with no precise reference to charts or shore marks, the information for the buoy position (e.g., position subject to change due to sedimentation of the sea floor) shall be entered in the "Description" field. In addition, data for the procedure used to determine the position shall be described in detail.

Although satellite positioning shall not be the final method used, the Buoy Data Card for all buoys placed by the CCG or a contractor shall contain a reference position from a GPS reading, at the very least, and a DGPS reading at best. This can be done during an inspection or through a request to a third party (fishers, CHS, etc.)

E. Remarks

This section of the card is to be used to add additional information if required.

SIPA VERSION

Canadian Coast Guard / Garde côtière canadienne

BUOY DATA CARD List of Lights Number: Aid Id:

Name of Buoy :
Location :
Latitude (N) :
Longitude (W) :
Determined by / Method :
Period Of Service : Begins (mm/dd) : Ends (mm/dd) :
Maintained By : Owned By :
Serial # :
File No :
Year Established :
LOS Area :
Light Exhibited :
Importance :
Chart No :
Chart Datum :
Vehicle :

Buoy Specification

Drawing No :
Type :
Bell / Whistle :
Topmark :
Lantern Type :
Lantern Size :
Lens Colour :
Bulb Size : Bulb Colour :
Bulb Changer :
Flasher :
Power Type :
Battery Type : No.:

Canadian Buoyage System

Function :
Buoy Colour :
Characteristics :
Rhythm :
Period :

Solar

Panel Wattage : No. of Panel:
Regulator Type :

Radar Reflector

Type :
Size :

Racon

Characteristic : Type:
Radar Band :

Depth (Chart Datum) : Bottom Type : Rock **On Position Radi** (1)
Tide Range : (2)

POSITION DATA
Primary Positioning Method :

Size : Radar Band :

Depth (Chart Datum) : Bottom Type : Rock **On Position Radi** (1)
Tide Range : (2)

POSITION DATA
Primary Positioning Method :
1:
2:
3:
4:

Alternative Positioning Method 1 :
1:
2:
3:
4:

Alternative Positioning Method 2 :
1:
2:
3:
4:

Mooring
Mooring:
Anchor:
Counterweight:

Comments:

Canadian Coast Guard / Garde côtière canadienne

FIXED AID DATA SHEET List of Lights Number : Aid Id :

Aid Name :
Location :
Latitude (N) :
Longitude (W) :
Determined by / Method:
CHS charted position.

File No. :
Year Established :
LOS Area :
Maintained by :
Light Exhibited :
Importance :
Chart No. :
Chart Datum :
Vehicle :
Owned By :

Period of Service :
Function :
Station Monitored :

STRUCTURE

Type :
Shape :
Colour :
Identifying Features :
Tower Height :
Height Base to Vane :

Lantern House :

Daymark Type .
Shape :
Colours :
Size :

Radar Reflector Type :
Size :

Primary Power : Hydro Secondary Power : Battery Type : No. :

LIGHTS

	Type	Size	Amps/Watts	Colour	Characteristics	Bulb Changer	Flasher
Main							

Main Light
Nominal Range : NM Main Light intensity : NM Main Focal Height :
Arc Visibility :

OTHER AID DATA

Racon Type :
Characteristic :
Band :

Radio Beacon Type : Characteristics :

Fog Signal Period of Service Begin (yyyy/mm/dd) : 0000/00/00 End (yyyy/mm/dd) : 0000/00/00
Characteristics :
Signal Direction :
Nominal Range :
Monitored :

Date of last modification :
Modified By : Signature :

BUOY SERVICE REPORT

There are two systems in place: the conventional paper system and the electronic system, SIPA. Either system may be used. It is preferable that SIPA and SIPA mobile be used.

The Buoy Service Report is the “field” document used by the person(s) responsible for the servicing and position checking of buoys. Service providers are to complete all sections of the report that apply to the service performed.

The primary and secondary methods used to check the buoy position are to be noted with a complete description of the applicable fixing data. Details for entries such as “un-repaired damage” shall be entered in the remarks section. Soundings and times shall also be recorded.

The completed report shall be signed manually or electronically by the service provider responsible to verify the maintenance performed and the data used to position the buoy.

When a buoy is moved to a new position "buoy moved to new position" shall be noted in the “remarks” area and a “Notice to Shipping” issued. In the case of a permanent change, a "Draft Notice to Mariners will be promulgated.

1. Buoy Service Report (Conventional)

One copy of the completed form is to be retained by the service provider. The original is to be forwarded to the aids to navigation office where it may be checked against the SIPA Buoy Data Card to ensure that the fixing data is accurate and that the buoy characteristics are maintained. Water depth is an important indicator of correct buoy position, the sounding recorded on the Buoy Service Report shall be checked against the Buoy Data Card sounding. The information on the completed Buoy Service Report shall then be transferred to SIPA.

1.1 Glossary and Instructions

1.1.1 Reason for Service

(a) **Scheduled:** Routine servicing as required by Directive 2.2400 to ensure proper characteristics and position. Normally included in the written service program or contract issued to the service provider.

(b) **Unscheduled:** Servicing of a buoy that is in response to a reported discrepancy or observed malfunction or off-position may be included in the service provider's program or contract but normally is in response to:

- A Notice to Shipping;
- A call received by the ship;
- A problem discovered in passing.

The reason for service is to be entered as unscheduled on the Buoy Service Report form.

(c) **Call:** Servicing as a result of the service provider receiving a call reporting an unsatisfactory condition. Normally this will also be entered as an unscheduled service on the form. Details regarding the source of the call, etc., may be entered in the Remarks section.

(d) **Seasonal Change:** A buoy replaced with winter buoy or vice-versa, buoy lifted for winter or placed at the opening of the navigation season. Normally included in the service provider's program or contract.

(e) **Dredging:** Service in support of dredging operations.

(f) The blank space in the Reason for Service section may be used to enter a Notice to Shipping number or to enter any other reason not listed (e.g. R&D project).

1.1.2 Service Performed

(a) **Placed:** Buoy, mooring and anchor deployed to established position (as per Buoy Data Card).

(b) **Lifted:** Buoy, mooring and anchor removed from water.

(c) **Replaced:** Buoy on-station lifted, new buoy placed.

(d) **Position Verified:** Position of buoy checked and found to be within the "on-position" area shown on the Buoy Data Card.

(d) **Repositioned:** Buoy found off-position, lifted and placed on specified position shown on the Buoy Data Card.

(f) **Buoy moved to new position:** Buoy lifted and placed on new position shown on revised data card.

Note: When a buoy is repositioned, the location and fixing data of the "as found position" will be recorded and saved (on a separate Buoy Service Report if necessary) as well as the fixing data and position to which it was relocated.

2. SIPA Buoy Service Report

SIPA Service Report shall be transmitted to the Aids to Navigation Office at the end of each work program. Once the buoy service reports are transmitted, the Aids to Navigation Office is responsible to verify and accept them.

2.1 Glossary and Instructions

2.1.1

Some fields in Service Reports are pre-filled. Only the blank section (if applicable) shall be entered. Pre-filling depends on how the report is generated. If it is generated through a compatible electronic positioning program such as Alderbaran, a number of fields will be populated. If it is generated through the SIPA Work Program, another set of fields will automatically be populated. To minimize entry requirements, use both the SIPA Work Program and Alderbaran.

1. **Alert Office Check Box:**
   If changes are required on the buoy data information in SIPA, or if other important information must be transmitted to the designated Office, this check box shall be marked and detailed information shall be noted in the Remarks section.

2. **NOTSHIP Text Box:**
   If the service of an aid is pertinent to an existing Notice to Shipping or if a new Notice to Shipping was issued after servicing, this field shall be populated with the NOTSHIP number and detailed information shall be noted in the Remarks section.

3. **Unscheduled Check Box:**
   Check this box if the service provided was not part of a pre-determined schedule.

4. **Work Boat Check Box:**
   If the aid was serviced using a small work boat (which includes: barge, FRC, other work boat), this check box shall be marked.

5. Void Check Box:

In a case of an error while creating or editing a buoy service report, it is possible to void the buoy service report by marking this check box. If the box is checked you will be prompted to write a comment in the Remarks box explaining why you voided the report. Note: In SIPA Mobile service reports can be deleted; after being deleted, the reports are no longer visible and are not included in the files transferred to SIPA Web.

6. Reason for Service:

(a) Buoy recovery program	Service performed within the Buoy recovery Work program.
(b) Call	Service performed in response to a request; to a call.
(c) Contractor Check:	CCG personnel verifying contracted work.
(d) De-icing	Service performed in de-icing of the buoy
(e) Discrepancy	Service performed in response to a reported or observed malfunction or aid off-position
(f) Dredging:	Service in support of dredging operations.
(g) Ice movement:	Service required when an aid has been affected by ice movement.
(h) Lift	Service performed to remove the buoy, mooring and anchor from water.
(i) Mooring Check	Service performed to verify the state of the buoy, mooring and anchor.
(j) Opportunity:	Service is performed while in the vicinity of an aid, when convenient or cost-effective; It is not normally included in service providers program.
(k) Place	Service performed in placing the buoy, mooring and anchor moved from ship to established position (as per Buoy Data Card

(l) Post Collision: Service of an aid required after a collision incident.

(m) Post Grounding: Service required after a collision incident.

(n) Remove Lantern Service performed in removing the lantern.

(o) Discrepancy Service performed in response to a reported or observed malfunction or aid off-position

(p) Scheduled Maintenance Service performed as part of a scheduled maintenance program.

(q) Scheduled Relief Service performed as part of a scheduled relief program. Buoy and / or mooring are removed and new buoy and / or mooring are placed.

(r) Seasonal Change Lighted buoy replaced with winter spar or vice-versa, buoy lifted for winter or placed at the opening of the navigation season. Normally included in the ship's program.

(s) Seasonal Place / Lift / Exchange: Service performed in the Seasonal Place / Lift / Exchange

(t) Storm Activity: Service required after severe weather that may have altered the operation and/or position of an aid.

(u) System Design Change Changes made to an aid as a result of an L.O.S. review.

(v) Verify position Service performed in verifying the position

2.1.2 Tasks:

The following tasks completed can be selected:

1. **Brush:** Trees and branches cut to ensure aid is visible
2. **Check:** Components inspected (whether the components are operating properly or not is explained in the Equipment section).
3. **Commission:** Established, activated or operation verified at beginning of season

4. **De-Commission:** Buoy removed or de-activated for season.
5. **De-Ice:** Ice removed from a buoy.
6. **Environmental Cleanup:** Old equipment, materials, chemicals removed. (Ex: We check this box when we remove old batteries from aid sites.)
7. **Inspection Annual:** Inspection occurring once a year.
8. **Inspection Bi-Annual:** Inspection occurring every two years
9. **Inspection Quarterly:** Inspection occurring four times a year
10. **Inspection Semi-Annual:** Inspection occurring twice a year".
11. **Lantern placed:** Lantern is installed for the season or when establishing a new aid.
12. **Lantern removed:** Lantern is removed for the season or when discontinuing an aid.
13. **Lift:** Buoy, mooring and anchor removed from water.
14. **Mooring Change:** Mooring system modified or replaced.
15. **Mooring Check:** State of the mooring and anchor inspected
16. **Other:** Any task different then what is available from the list
17. **Paint:** A new coat of paint or touch-ups were applied.
18. **Place:** Buoy, mooring and anchor placed on position.
19. **Position Verification:** Position of buoy checked against the tombstone data.
20. **Range Bearing Change:** Range Bearing modified.
21. **Refuel:** Aid refuelled
22. **Relight:** The lamp was repaired or replaced to return the light to its normal operating state.
23. **Relocate:** Buoy moved, repositioned to other than its advertised position.

24. **Relocate: System Revised:** Buoys repositioned subsequent to LOS revision. NOTE: When a buoy is relocated or repositioned, the location and fixing data of the "as found position" shall be recorded and saved (on a separate Buoy Service Report if necessary) as well as the fixing data and position to which it was relocated.

25. **Removed Daymark:** Daymark removed from the Aid

26. **Replace:** Buoy on-station lifted, new buoy placed.

27. **Replace with Summer Buoy:** Substitute winter spar with a summer buoy

28. **Replace With Winter Spar:** Substitute summer buoy with a winter spar.

29. **Reposition to Advertise:** Buoy found off-position, repositioned (see Note under item 25).

30. **Scheduled Maintenance:** Planned maintenance activities intended to keep the aid functional or to restore it to a state in which it can perform a required function.

31. **Clean:** Lens, daymarks, buoy, and designators cleaned to ensure light and aid colour and characteristics are identifiable.

2.1.3 Equipment:

The users shall mark the applicable check box for the equipment serviced. The four options available are the following:

1) Checked
2) Replaced
3) Fixed, Repaired
4) Left Damaged: used when a component is damaged and cannot be replaced or fixed. Detailed information shall be noted in the Comment section of this screen menu.

2.1.4 Fixing Method:

If SIPA is interfaced with an electronic positioning system, (e.g. ECDIS, ECS) the fixing data captured electronically will be transferred automatically into the DGPS fixing method section.

If SIPA users are not connected to this system or if they are using a fixing method other than DGPS, the data shall be entered manually in this section. Users shall select the method used from the list given (list in accordance with Aids Checking Standard 6.2.2).

2.1.5 Electronic Signature and SIPA system safety procedures:

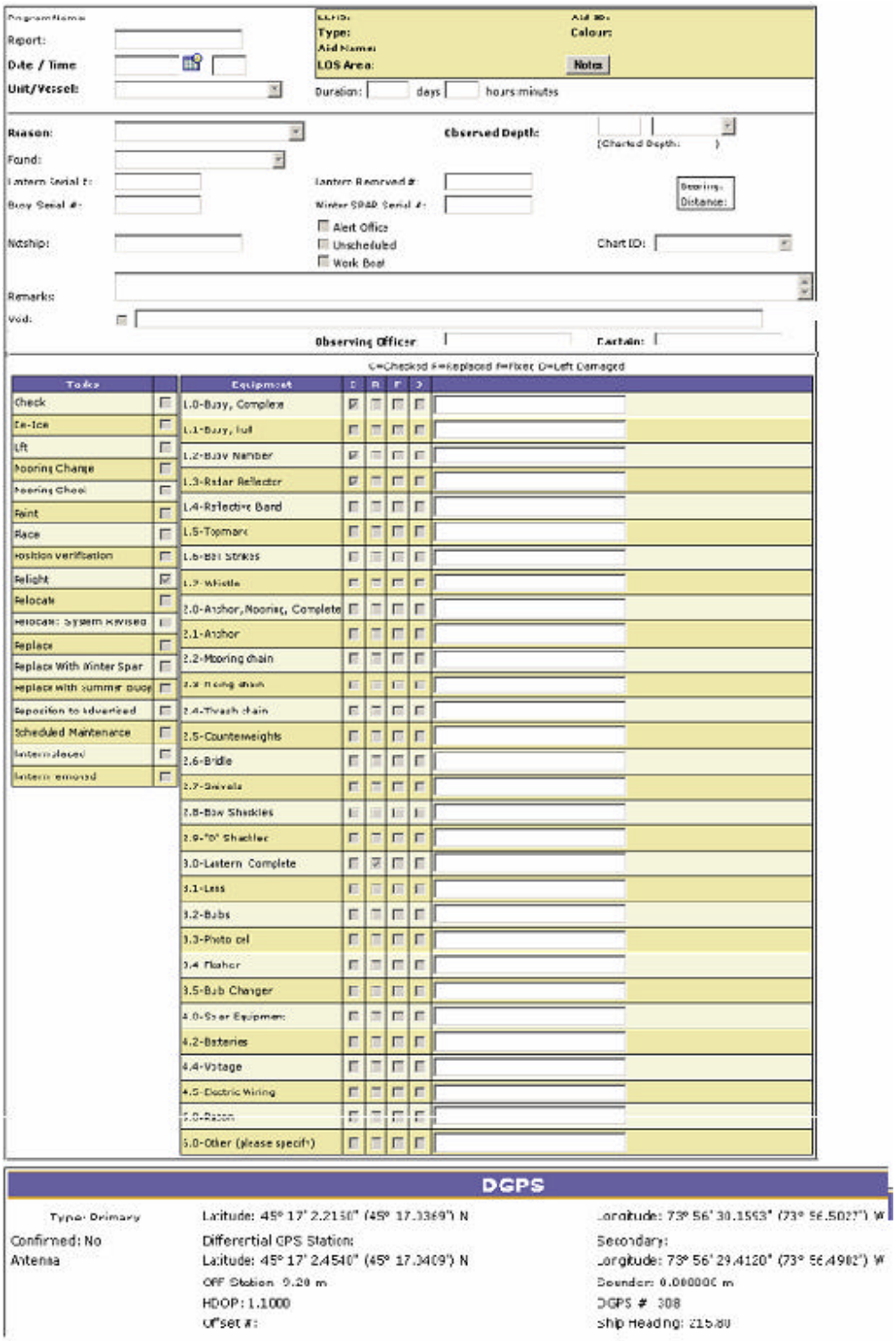
Buoy service reports created in SIPA are signed electronically. In order to complete a report, both the observing officer and commanding officer fields must be completed.

In SIPA Mobile, the action of transferring the report automatically signs the captain field with the current user name – only users with Captain permissions can transfer reports. ONCE THE COMMANDING OFFICER HAS SIGNED THE SERVICE REPORT, THIS DOCUMENT CANNOT BE MODIFIED.

Erroneous or incomplete service reports that have been signed by the commanding officer have to be either replaced or completed with a new service report. An erroneous report being replaced with a new one should be voided (or deleted when using SIPA Mobile) by the commanding officer. A new report complementing an incomplete report should contain all the missing information. Observing Officers and Commanding Officers creating SIPA service reports are responsible for entering their signature and keeping their user Id's and passwords confidential. Once the electronic signatures have been added to a service report, it becomes an official government document.

The Director, Navigation Systems, CCG, approves of this means of digitizing reports and signatures.

SIPA BUOY SERVICE REPORT



CONVENTIONAL VERSION

Canadian Coast Guard / Garde côtière canadienne

BUOY SERVICE REPORT - RAPPORT D'ENTRETIEN DE BOUÉES

WORK PROGRAM NO. / No. DU PROGRAMME		LLNO / NUM L.F.		Summer / été	BUOY TYPE - S/M / TYPE DE BOUÉE - NUM. DE SÉRIE		WATER DEPTH / PROFONDEUR D'EAU (METRES)
DATE/TIME (Local Time) / DATE/HEURE - (Heure locale) (YY/MM/DD - HH/MN)		BUOY NO. (Aid ID) / CODE DE L'AIDE		Winter / hiver	BUOY TYPE - S/M / TYPE DE BOUÉE - NUM. DE SÉRIE		CHART NO. / No DE LA CARTE
VESSEL - NAVIRE		COLOUR - COULEUR		LANTERN TYPE - TYPE DE LANTERNE			BUOY DATA CARD DATE / DATE DE LA FICHE DE DONNÉES
BUOY NAME - NOM DE BOUÉE				LANTERN SERIAL # / NUM. SÉRIE DE LA LANTERNE			

REASON FOR SERVICE - MOTIF DE LA VISITE

- Reported Discrepancy - Panne signalé
- Seasonal place/lift/exchange - Saisonnier placée/Enlevée/Échangée
- Scheduled maintenance - Entretien prévu
- Contractor Check - Vérification par l'entrepreneur
- NOTSHIP NO. - No. AVNAV
- Other (please specify) - Autre (Indiquez S.V.P.)

FOUND - TROUVER

- Demolished - Démolie
- Malfunction - Dérogé
- Partially submerged - Submergée partiellement
- Vandalized - Vandalisée
- Extinguished - Éteinte
- Operating properly - Fonctionnement normalement
- Submerged - Submergée
- Gone from position - Disparue de sa position
- On position - En position
- Off position - Hors position

POSITION WHERE BUOY WAS FOUND - POSITION OU LA BOUÉE A ÉTÉ TROUVÉE

SERVICE PERFORMED - GENRE DE SERVICE

- Equipment Check - Vérifiée
- Replace with summer buoy - Remplacée par une bouée d'été
- Replace with winter spar - Remplacée par un espar d'hiver
- Replace buoy - Bouée Remplacée
- Mooring Change - Ancrage modifié
- De-Ice - Déglacée
- Lift - Enlevée
- Position to advertised - Remplacée à la position annoncée
- Place - Mouillée
- Mooring Check - Ancrage vérifiée
- Paint - Peinturée
- Other - Autre
- Relocate - Remplacée
- Position verification - Vérification de la Position
- Relight - Rallumée

BUOY POSITION ON DEPARTURE - POSITION DE LA BOUÉE LORS DU DÉPART

- DGPS (NAD 1983)
- Ranges/Transits alignements
- Sounding - Sondage
- Local knowledge - Connaissance des lieux
- GPS
- Distance
- Bearings - Relèvements
- Horizontal Angles - Angles Horizontaux
- Radio Navigation/ Navigation Radio
- Radar

BUOY POSITION ON DEPARTURE - POSITION DE LA BOUÉE LORS DU DÉPART

REMARKS - REMARQUES

EQUIPMENT CHECK - VÉRIFICATION DE L'ÉQUIPMENT

C = CHECKED/VÉRIFIÉ R = REPLACED / REMPLACÉ F = FIXED/RÉPARÉ D = LEFT DAMAGED/LAISSÉ ENDOMMAGÉ

	C	R	F	D
1.0 - Buoy, complete - Bouée complète				
1.1 - Buoy, hull - Corps de la bouée				
1.11 - Buoy cage - cage de la bouée				
1.2 - Buoy number - Numéro de la bouée				
1.3 - Radar reflector - Réflecteur radar				
1.4 - Reflective band - Band rétro-réfléchissante				
1.5 - Topmark - Voyant				
1.6 - Bell strikers - Battants de la cloche				
1.7 - Whistles - Sifflet				
2.0 - Lanterns, complete - Lanterne complète				
2.1 - Lens - Lentille				
2.2 - Bulbs - Ampoules				
2.3 - Photocell - Valve solaire				
2.4 - Flasher - Éclipseur				
2.5 - Auto changer - Changeur d'ampoules				
3.0 - Self contained light - Lumière autonome				
8.0 - Racon				
9.0 - Other (please specify) - Autre (Indiquez S.V.P.)				

	Summer/Year Round	Winter
Anchor weight - Poids de l'ancre		
Chain Size/Length (metres) - Grosseur/Longeur de la chaine		
Anchor material - Matériel d'ancrage		

2.0 - Anchor, mooring, complete - Ancre et orin au complet	C	R	F	D
2.1 - Anchor - Ancre				
2.2 - Ground chain - Chaine d'ancrage				
2.3 - Riding chain - Chaine flottante				
2.4 - Thrash chain - Chaine de marrage				
2.5 - Counterweights - Contrepoids				
2.6 - Bridle - Patte d'oie				
2.7 - Swivels - Émerillon				
2.8 - Bow shackles - Manille en U				
2.9 - "D" shackles - Manille "D"				
4.0 - Solar equipment - Équipment solaire au complet				
4.1 - Solar panels - Panneau solaire				
4.2 - Regulator - Régulateur				
4.3 - Batteries - Piles				
4.4 - Refuge				
4.5 - Electric wiring - Câblage électrique				

REMARKS - REMARQUES

OBSERVING OFFICERS / OFFICIERS OBSERVATEURS		MASTER - CAPTAINE	
CONTRACTOR NAME (please print) / NOM DE L'ENTREPRENEUR (lettre détachée)		CONTRACTOR SIGNATURE - ENTREPRENEUR	

FIXED AID SERVICE REPORT

There are two systems in place: the conventional paper system and the electronic system, SIPA, both systems can be used, but it is preferable that SIPA and SIPA mobile be used.

1. SIPA Fixed Aid Service Report

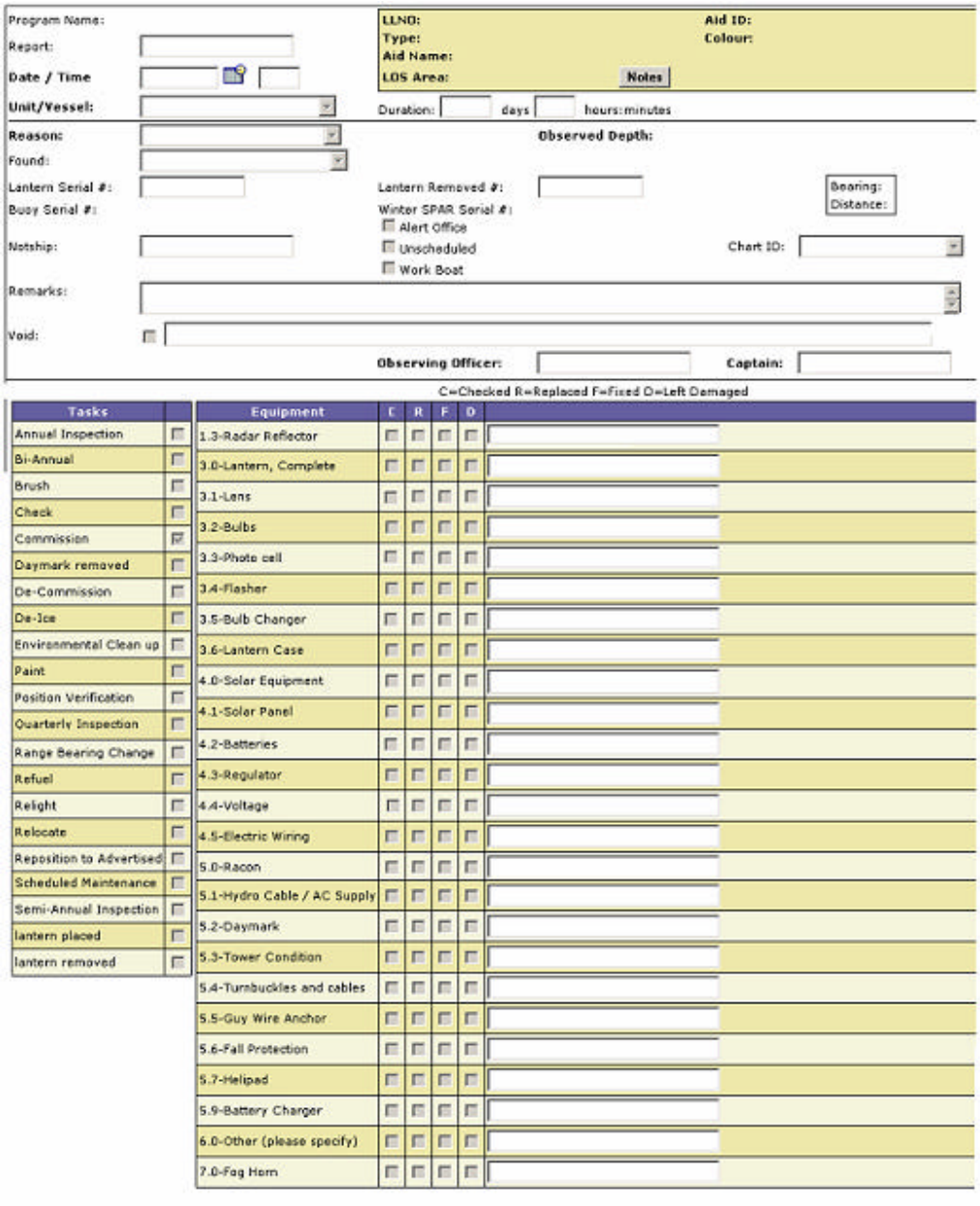
The Fixed Aid Service Reports shall be completed in SIPA for each aid serviced. At the end of a work program the service reports shall be downloaded to SIPA.

2. Fixed Aid Service Report (paper version)

The regional fixed aid Service Reports (or Inspection Sheets) shall meet the following minimum requirements:

- identify the aid (by L.L. Number if and when possible);
- collect all data necessary to confirm all fixed aid information regarding Operation. Characteristics and Position indicated in the SIPA database;
- collect maintenance data that affects the operation of the aid, e.g. bulbs, batteries, daymarks replaced, faults found etc.;
- indicate the reason for the check, scheduled or unscheduled;
- note any changes made, discrepancies found, uncorrected faults left;
- indicate if a notice was issued or requires issue;
- indicate time and date of inspection and be signed by the checking officer.

SIPA FIXED AID SERVICE REPORT



Program Name:
Report:
Date / Time
Unit/Vessel:
Reason:
Found:
Lantern Serial #:
Buoy Serial #:
Notship:
Remarks:
Void:

LLNO:
Type:
Aid Name:
LOS Area:
Notes
Aid ID:
Colour:
Duration: days hours:minutes
Observed Depth:
Lantern Removed #:
Winter SPAR Serial #:
Alert Office
Unscheduled
Work Boat
Bearing:
Distance:
Chart ID:
Observing Officer:
Captain:

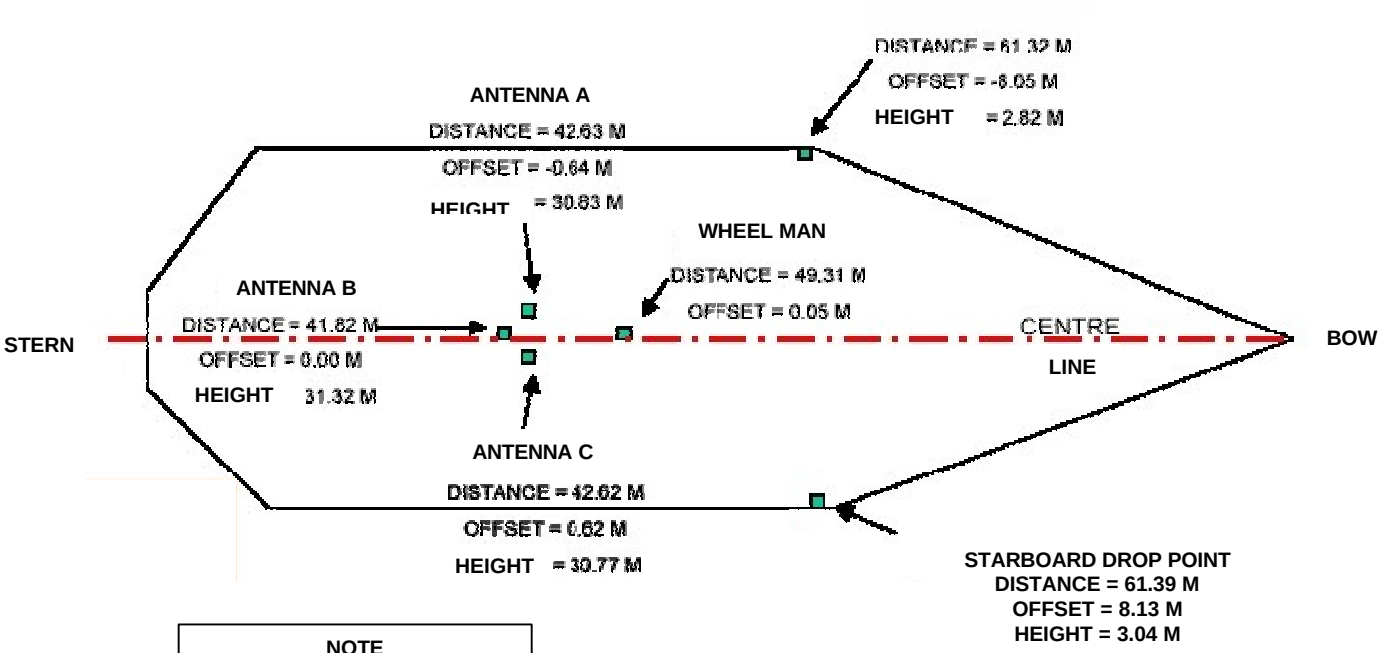
C=Checked R=Replaced F=Fixed D=Left Damaged

Tasks	
Annual Inspection	☐
Bi-Annual	☐
Brush	☐
Check	☐
Commission	☑
Daymark removed	☐
De-Commission	☐
De-Ice	☐
Environmental Clean up	☐
Paint	☐
Position Verification	☐
Quarterly Inspection	☐
Range Bearing Change	☐
Refuel	☐
Relight	☐
Relocate	☐
Reposition to Advertised	☐
Scheduled Maintenance	☐
Semi-Annual Inspection	☐
lantern placed	☐
lantern removed	☐

Equipment	C	R	F	D	
1.3-Radar Reflector	☐	☐	☐	☐	
3.0-Lantern, Complete	☐	☐	☐	☐	
3.1-Lens	☐	☐	☐	☐	
3.2-Bulbs	☐	☐	☐	☐	
3.3-Photo cell	☐	☐	☐	☐	
3.4-Flasher	☐	☐	☐	☐	
3.5-Bulb Changer	☐	☐	☐	☐	
3.6-Lantern Case	☐	☐	☐	☐	
4.0-Solar Equipment	☐	☐	☐	☐	
4.1-Solar Panel	☐	☐	☐	☐	
4.2-Batteries	☐	☐	☐	☐	
4.3-Regulator	☐	☐	☐	☐	
4.4-Voltage	☐	☐	☐	☐	
4.5-Electric Wiring	☐	☐	☐	☐	
5.0-Racon	☐	☐	☐	☐	
5.1-Hydro Cable / AC Supply	☐	☐	☐	☐	
5.2-Daymark	☐	☐	☐	☐	
5.3-Tower Condition	☐	☐	☐	☐	
5.4-Turnbuckles and cables	☐	☐	☐	☐	
5.5-Guy Wire Anchor	☐	☐	☐	☐	
5.6-Fall Protection	☐	☐	☐	☐	
5.7-Helipad	☐	☐	☐	☐	
5.9-Battery Charger	☐	☐	☐	☐	
6.0-Other (please specify)	☐	☐	☐	☐	
7.0-Fog Horn	☐	☐	☐	☐	

Page 1 of 5	Directive#: 2.2400 Appendix I
Issue Date: April 11 2006	Amend #: Original Amend Date:
Short Range Aids Positioning and Checking Directive	

Martha L. Black



NOTE

The distances are measured from the stern of the ship.

The offsets are given in relation to the centre line of the ship.

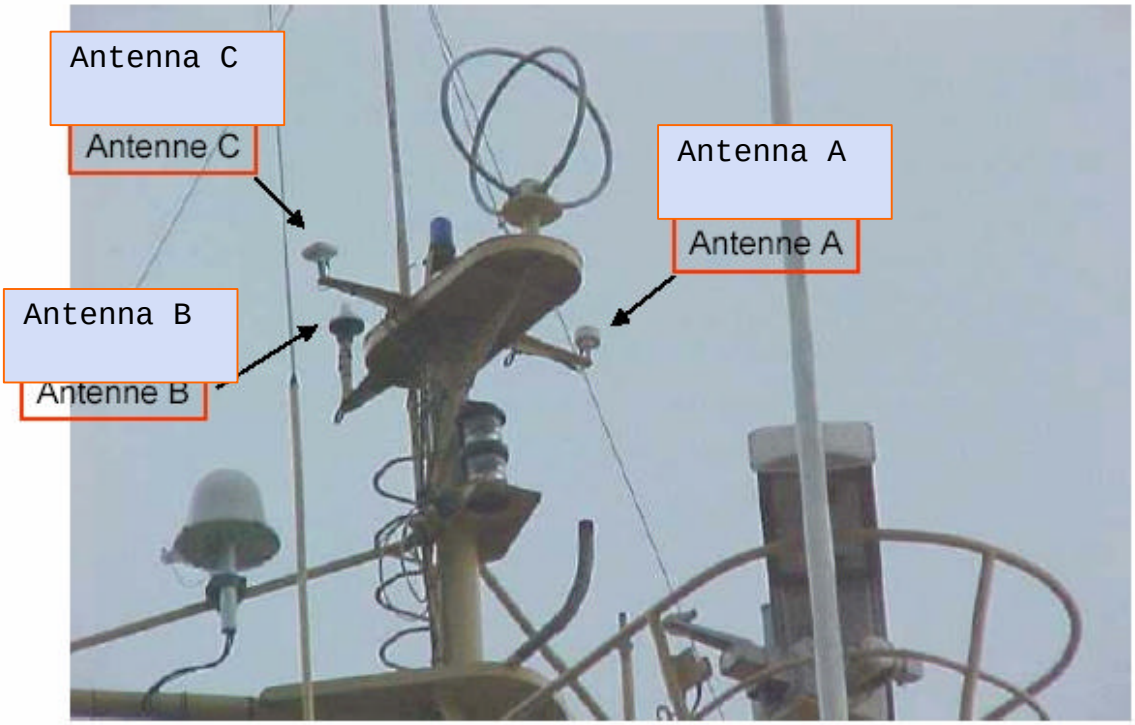
The heights are in relation to the water line of the ship.

The sketch is not to scale.

JULY 23 2001

Martha L. Black

Martha L. Black



Martha L. Black

Martha L. Black

HDOP can be broken into the north and east components as follows:

$$\mathrm{HDOP} = \sqrt{\mathrm{NDOP}^2 + \mathrm{EDOP}^2}$$

where NDOP is the north dilution of precision
EDOP is the east dilution of precision

The 2DRMS positioning error has an associated probability greater than 95%, which varies with the ratio of EDOP and NDOP as shown in Figure B-1.

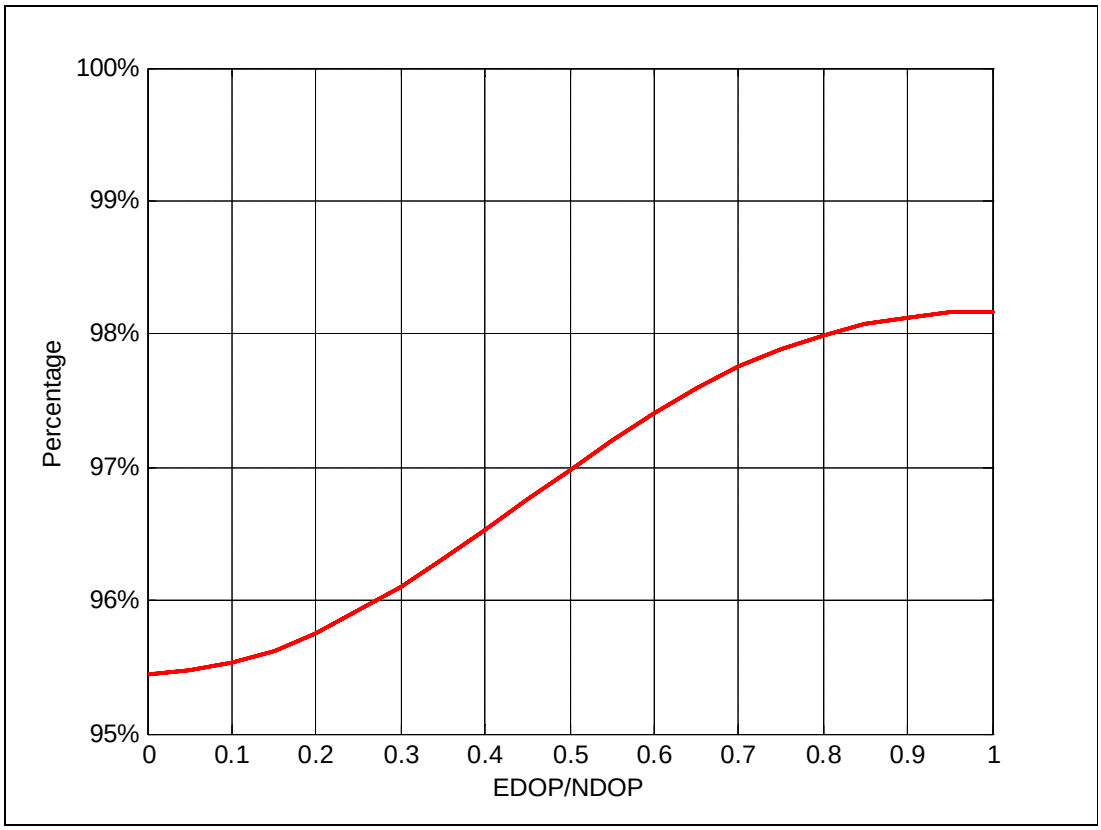


Figure B-1 2DRMS Positioning Probability vs Ratio of EDOP and HDOP

Figure B-1 shows that the positioning probability varies from 95.5% to 98.2% depending on the ratio of EDOP and NDOP. NDOP is normally larger than the EDOP due to the configuration of the GPS constellation. Figure B-2 gives an example of the HDOP, NDOP, and EDOP for a location in Canada for a 24 hour period, using a mask angle of 10°. The resulting ratio of EDOP and NDOP is shown in Figure B-3 and for this example is normally > 0.6, which from Figure B-1 gives a positioning probability of > 97%.

To calculate the 2DRMS, the UERE of the DGPS receiver must be used. Assuming that a good quality DGPS receiver is being used, a UERE of 1.25 m can be assumed. Thus the DGPS positioning error can be simplified to:

$$e = 2DRMS = 2.5 * HDOP$$

For buoy operations only HDOP's = 2.0 are allowed, which will give a maximum position error of 5.0 m.

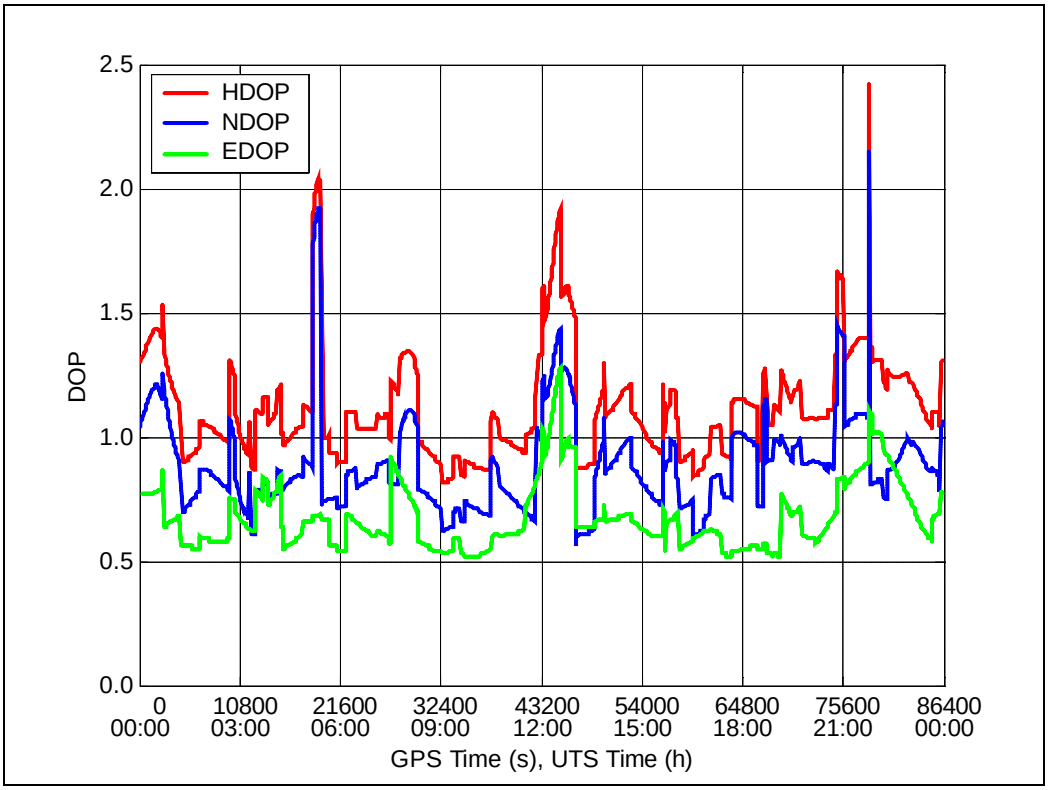


Figure B-2 HDOP, NDOP, and EDOP, using a mask angle of 10°, for a typical location

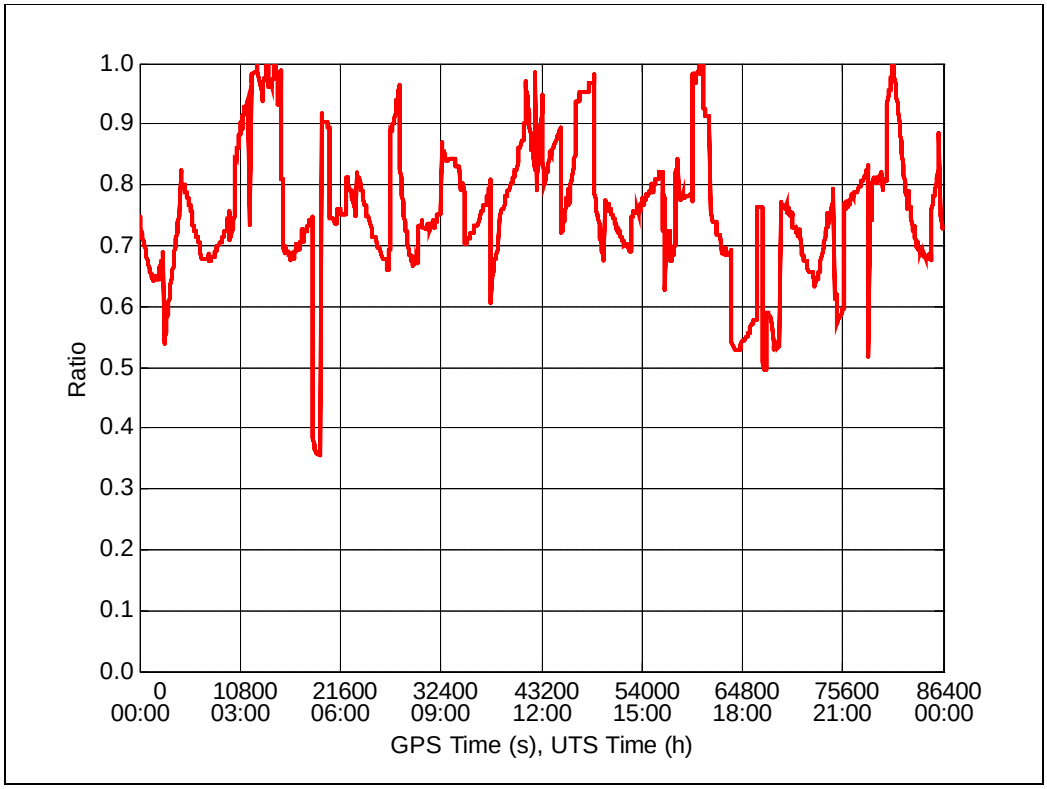


Figure B-3 Ratio of NDOP and EDOP vs Time

To calculate the radius (r) of the minimum position area, the excursion (s) is added to the 2DRMS positioning error. Thus the equation becomes:

$$r = 2.5 * HDOP + \sqrt{L^2 - d^2}$$

The resulting positioning error probabilities for the calculated radius are plotted in Figure B-4 for morning excursions from 0 to 50 m and for the two extreme cases of EDOP and HDOP ratios.

When the excursions are greater than or equal to 5 m the resulting probability will be between 97.7% and 99.7%.

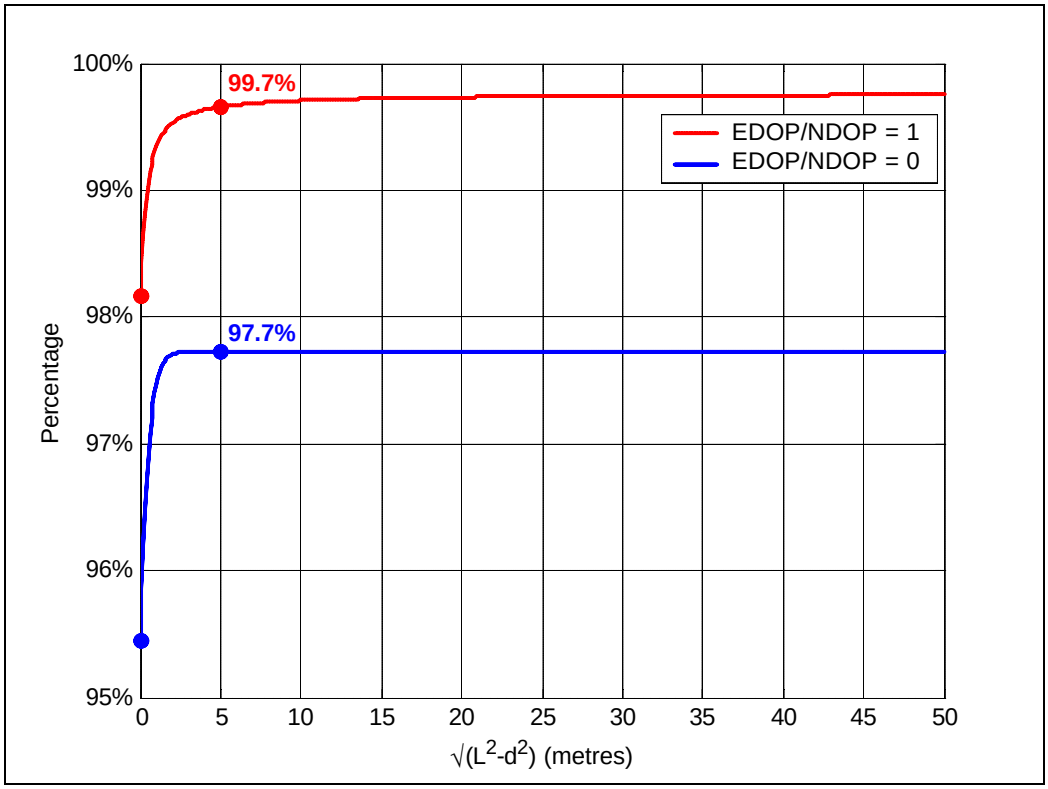


Figure B-4 Ratio of NDOP and EDOP vs Time