

## Practical Accuracy Standards for Positioning

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The accurate positioning of a ship in relation to geographical and hydrographical features is fundamental to safe navigation. This is recognised by Chapter V of the 1974 SOLAS Convention, as amended, which requires:

- Contracting Governments to arrange for the collection and compilation of hydrographic data and publications, dissemination and keeping up to date of all nautical information necessary for safe navigation
- All ships to carry adequate and up-to-date charts, sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyage
- All ships to carry means of receiving transmissions from suitable radio navigation systems throughout their intended voyage

The accuracy of a position can be referred to in terms of 'absolute', 'predictable', 'relative' or 'repeatable' accuracy. However, in the definitions of these terms only 'predictable accuracy' relates the position solution with the chart. It therefore follows that for purposes of navigation, the mariner's greatest need is for predictable accuracy.

Predictable accuracy depends on:

- The geodetic datum of the positioning system used for navigation being either the same as, or capable of being related to, the geodetic datum used on the chart
- The accuracy of the survey, or surveys, on which the chart is based
- The absolute accuracy of the positioning system being used for navigation
- The effects of the limitations of manual and electronic cartography

### Geodetic Datums

Safety of Navigation Circular, SN/Circ.213 of IMO 'Guidance on chart datums and the accuracy of positions on charts' contains a definition of a geodetic datum, which recognises that positions referred to different geodetic datums can differ by several hundreds of metres. In some regions the increased use of WGS-84 is improving the situation. However, in regions where this is not happening, the problem of different geodetic datums is becoming more complex for the following reasons:

Originally ships were involved only with the geodetic datum used on the charts they carried. All positional information was obtained with reference to the visual/radar environment or local radio navigation system and was therefore related to the geodetic datum of the charts in use.

With the introduction of radio navigation systems using a specific geodetic datum as the basis of their transmissions, a second datum was introduced on ships. The significance of this and its possible effect is described in SN /Circ.213. However, the use of such radio navigation systems will shortly be a mandatory requirement and the introduction of this second geodetic datum into the positioning equation has substantially limited the possibility of using 'predictable accuracy' as a means of defining navigational accuracy requirements for ships.

With the forthcoming introduction of the Automatic Identification System (AIS), until such time as the AIS information is presented on an ECDIS or radar/ARPA display, a number of geodetic datums may be involved in the safety of navigation equation. For example, where several ships are close together the AIS information (based on WGS-84) may be transmitted and received by ships using charts that are based on geodetic datums that differ from WGS-84 and from each other.

SN/Circ.213 sets out clearly the problem caused by having a number of different geodetic datums and indicates the actions being taken by Hydrographic Offices to minimise the effects of the problem. However, no indication is given of any actions being taken to:

- Quantify the extent of the problem in regions where the use of WGS-84 is not increasing
- Prioritise the actions of the Hydrographic Offices to overcome it
- Identify the transformation formulae for geodetic datums that are used by countries which are not members of the IHO

Resolution A.572(14), as amended, General Provisions on Ships' Routeing, requires (paragraph 3.11.6) Governments to furnish all relevant information, in particular with regard to the number, edition and where possible the geodetic datum of the reference chart used for the delineation of the routeing system.

## **Surveys**

Regulation 9, Hydrographic services, of the 1974 SOLAS Convention, as amended, will require, inter alia, Contracting Governments to:

- Ensure that hydrographic surveying is carried out, as far as possible, adequate to the requirements of safe navigation
- Co-ordinate their activities to the greatest possible degree in order to ensure that hydrographic and nautical information is made available on a world-wide scale as timely, reliably and unambiguously as possible

SN/Circ.213 explains the current situation on surveys in a general sense. It states (Section 20) that the situation for mariners is improving with recent surveys referred directly to WGS 84 datum or the equivalent. It also states that unfortunately it will be many years before all areas are re-surveyed and all charts revised.

However, no indication is given of any actions being taken to:

- Expedite the revision of charts, or the provision of transformation formulae for them, and the re-surveys that are needed in many areas
- Consider implementing means of indicating chart accuracy
- Quantify the extent of the problem in respect of those areas of the world for which no member of the IHO has responsibility; and
- Consider and recommend arrangements that could be made for the conduct of surveys in waters for which no member of IHO has responsibility. Many of these waters have not been surveyed for 100 years or more

## **Summary**

With the increase in the number of different geodetic datums involved in the navigational equation onboard ships the determination of predictable accuracy is becoming more important. SN/Circ.213 advises mariners on the effect of the geodetic datum of a radio navigation system being different from the Ship's chart datum. However, it does not look forward to the situation when the geodetic datum in use on charts of other ships might need to be taken into account nor does it quantify the extent of the problem or propose means by which it might be mitigated.

Similarly, the need to have accurate hydrographic surveys on which to base chart information is inferred in the 1974 SOLAS, Chapter V as amended, and SN/Circ. 213. This is becoming very important because in many areas of the world the accuracy of satellite navigation systems used by shipping is significantly more accurate than the methods that were used to survey the areas.

## **Recommendations**

It is recommended that the IHO:

1. *Promote means of increasing further the awareness of mariners to the problems concerning the use of predictable accuracy in situations where two or more geodetic datums need to be taken into consideration as well as the effect of the limitations of cartography*
2. *Either independently or in conjunction with IMO, study means by which a programme could be developed for the survey of waters that have not been surveyed to Special Publication No. 44. The study should specifically include those waters for which no member of IHO has responsibility; and*
3. *Propose to IMO that a requirement be included in the General Provisions of Ships Routeing that information about a new or revised Routeing System or Traffic Separation Scheme be provided to WGS-84 in addition to any local datum in use*

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