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Entwurf

**Navigations- und Funkkommunikationsgeräte und -Systeme für die Seeschifffahrt –
Digitale Schnittstellen –
Teil 1: S 421-Routenplan auf Grundlage von S 100
(IEC 80/895/CD:2018);
Text Englisch**

Maritime navigation and radiocommunication equipment and systems –
Data Interface –
Part 1: S-421 Route Plan Based on S-100
(IEC 80/895/CD:2018);
Text in English

Anwendungswarnvermerk

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Gesamtumfang 125 Seiten

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Nationales Vorwort

Die englische Originalfassung des internationalen Dokuments IEC 80/895/CD:2018 „Maritime navigation and radiocommunication equipment and systems – Data Interface – Part 1: S-421 Route Plan Based on S-100“ (CD, en: Committee Draft) ist unverändert in diesen Norm-Entwurf übernommen worden.

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Nationaler Anhang NA (informativ)

Auszugsweise Übersetzung^{N1}

1 Anwendungsbereich

Dieser Teil des Norm-Entwurfs legt eine S-100-konforme Produktspezifikation für die Routenplanaustauschinformationen fest. Darin werden Inhalt, Struktur und Metadaten festgelegt, die für eine vollständig S-100-konforme Routenplaninformation und deren Darstellung in einer auf S-100 basierenden Anwendung erforderlich sind. Diese Produktspezifikation umfasst Inhaltsmodell, Codierung, Merkmalskatalog, Darstellungskatalog und Metadaten. Die IHO verwaltet alle Nummern für S-100-konforme Produktspezifikationen. IHO hat S-421 für diese Routenplan-IEC-Norm zugewiesen.

[Die Anwendung dieser Datenproduktspezifikation muss eingefügt werden.]

3 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

ISO und IEC stellen Terminologie-Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- IEC Electropedia: unter <http://www.electropedia.org/>
- ISO Online Browsing Platform: unter <http://www.iso.org/obp>

3.1

Akteur

(en: actor)

für die Anwendung dieses Norm-Entwurfs wird der Akteur wie in der vereinheitlichten Modellierungssprache (en: Unified Modeling Language, UML) definiert

3.2

Aktionspunkt

(en: action point)

geographische Position für eine Aktion, z. B. Meldungsübertragung. Die Geometrie kann durch Punkt (und Radius), Linie oder Fläche erzeugt werden

3.3

Merkmal

(en: feature)

Abstraktion eines Phänomens der realen Welt. Ein Merkmal kann als Typ oder Instanz auftreten. Ein Merkmalstyp oder eine Merkmalsinstanz sollte verwendet werden, wenn nur eine gemeint ist

3.4

Merkmalskatalog

(en: feature catalogue)

Katalog mit Definitionen und Beschreibungen des Merkmalstyps, der Merkmalsattribute und der Merkmalsassoziationen, die in einem oder mehreren geographischen Datensätzen auftreten

^{N1} Nationale Fußnote: Die Nummerierung des IEC-Schriftstücks 80/895/CD:2018-07 wurde beibehalten.

3.5**Darstellung**

(en: portrayal)

Präsentation von Informationen für den Menschen. Diese Norm ist auf die Darstellung geographischer Informationen beschränkt

3.6**Darstellungskatalog**

(en: portrayal catalogue)

Sammlungen an definierten Darstellungen für einen Merkmalskatalog. Zu den Inhalten des Darstellungskatalogs gehören Darstellungsfunktionen, Symbole und Darstellungskontext

3.7**Route**

(en: route)

Folge von Wegpunkten, die durch einen oder mehrere Schenkel mit geraden oder gebogenen Teilstücken miteinander verbunden sind

3.8**aktive Route**

(en: active route)

Route, die gerade für die Reise überwacht wird, die den Zeitplan und die aktuelle Reiseinformationen enthalten kann

3.9**Referenzroute**

(en: reference route)

Route, die für die Reise reserviert ist, ohne seefahrzeugspezifische Informationen, in denen die Informationen des Zeitplans nicht enthalten sein dürfen

3.10**geplante Route**

(en: planned route)

potentielle Route für die aktive Route der Reise. Ihr Zeitplan und ihre tatsächlichen Reiseinformationen können vom Schiff festgelegt werden

3.11**empfohlene Route**

(en: recommended route)

Route für die geplante Route der Reise. Ihr Zeitplan und ihre tatsächlichen Reiseinformationen sowie Wegpunkte werden außerhalb des eigenen Schiffs festgelegt

3.12**Kopfinformation der Route**

(en: route header information)

bezeichnet nur das Objekt Routeninformation (RouteInfo)

3.13**Routeninformation**

(en: route information)

bezeichnet alle zusammenhängende Routenobjekte, die in dieser Norm festgelegt sind

3.14**Wegpunkt**

(en: waypoint)

Referenzpunkt im physischen Raum, der zu Navigationszwecken verwendet wird. Er beschreibt die geographischen Komponenten der Route

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION
EQUIPMENT AND SYSTEMS –
Data Interfaces –****Part 1: S-421 Route Plan based on S-100**

FOREWORD

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International Standard IEC 63173-1 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

The text of this standard is based on the following documents:

FDIS	Report on voting
80/XX/FDIS	80/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

52 The committee has decided that the contents of this publication will remain unchanged until
53 the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data
54 related to the specific publication. At this date, the publication will be

- 55 • reconfirmed,
- 56 • withdrawn,
- 57 • replaced by a revised edition, or
- 58 • amended.

59

60 The National Committees are requested to note that for this publication the stability date
61 is 2018

62 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE
63 DELETED AT THE PUBLICATION STAGE.

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – DATA INTERFACES –

Part 1: S-421 Route Plan based on S-100

1 Scope

This part of standard specifies an S-100 compliant product specification for Route Plan Exchange Information. It specifies the content, structure, and metadata needed for creating fully S-100 compliant Route Plan Information and its portrayal within an S-100-based Application. This product specification includes the content model, the encoding, the feature catalogue, portrayal catalogue and metadata. IHO manages all numbers for S-100 compliant product specification. IHO has assigned S-421 for this Route Plan IEC standard.

[Need to include the usage of this data product specification]

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

S-100, *IHO Universal Hydrographic Data Mode*

3 Terms and definitions

The terms and definitions given in this standard are defined as following:

3.1

actor

for the purpose of this standard, actor is defined as in the Unified Modeling Language (UML)

3.2

action point

geographical position to act something for example reporting. Geometry could be generated by point (plus radius), line or area.

3.3

feature

abstraction of real world phenomena. A feature may occur as a type or an instance. A feature type or a feature instance should be used when only one is meant.

3.4

feature catalogue

catalogue containing definitions and descriptions of the feature type, feature attributes, and feature associations occurring in one or more sets of geographic data

3.5

portrayal

presentation of information to humans. This standard is restricted to the portrayal of geographic information.

3.6**portrayal catalogue**

collections of defined portrayals for a feature catalogue. Content of portrayal catalogue includes portrayal functions, symbols, and portrayal context .

3.7**route**

series of waypoints connected by one or more legs including both straight and curved segments.

3.8**active route**

route which is currently monitored for the voyage which may contain the schedule and actual voyage information .

3.9**reference route**

route which is reserved for the voyage without any vessel specific information which may not contain schedule information.

3.10**planned route**

candidate route for the active route of the voyage. Its schedule and actual voyage information may be set by ship.

3.11**recommended route**

route for the planned route of the voyage. Its schedule and actual voyage information as well as waypoints is set by external of own ship.

3.12**route header information**

means only route Information(RouteInfo) object.

3.13**route information**

means all related route object specified in this standard

3.14**waypoint**

reference point in physical space used for purposes of navigation. It describes the geographical components of the route.

4 Abbreviations

ENC	Electronic Navigational Chart
GML	Geography Markup Language
GNSS	Global Navigation Satellite
IEC	International Electrotechnical Commission
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization

150 SOLAS Safety of Life at Sea

151 5 General description

152 5.1 General data product description

153 The data product of Route Plan is described as specified in the Table 1.

154 **Table 1 – General data product description**

Field	Description
Title	Route Plan
Abstract	This data product describes real-world route plan exchange information and its related information.
Content	The Product Specification defines all requirements to which Route Plan Exchange Information data products shall conform. Specifically it defines the data product content in terms of features and attributes within the feature catalogue. The display of features is defined by the symbols and rule sets contained in the portrayal catalogue. Spatial Extent: Description: East Bounding Longitude: 180° West Bounding Longitude: -180° North Bounding Latitude: 90° South Bounding Latitude: -90°
Purpose	The purpose of a Route Plan dataset is to provide official route plan data to an S-100 based Applications for the safe and efficient passage and route of vessels to destinations.

155 5.2 Data product specification metadata

156 Table 2 uniquely identifies this Product Specification and provides information about its
157 creation and maintenance. For further information on dataset metadata see the Clause 12.

158 **Table 2 – Product specification metadata**

Field	Description
Title	Route Plan
S-100 Version	3.0.0 (later version of 2)
S-421 Version	1.0 °
Language	English
Classification	Unclassified
Contact	International Electrotechnical Commission 3, rue de Varembé P.O. Box 131 CH – 1211 Geneva 20 - Switzerland Telephone: +41 22 919 02 11 Fax: + 41 22 919 03 00
URL	www.iec.ch
Identifier	S-421
Maintenance	Changes to the Product Specification S-421 coordinated by IEC TC80

159 5.3 Product specification maintenance

160 This standard for route plan data exchange complies to the maintenance schedule and policy
161 in IEC.

5.4 Specification scopes

The product specification scope of the Route Plan is specified in Table 3.

Table 3 – Route Plan product specification scope

Field	Description
Scope ID	Product
Level	006-Series
Level Name	Route Plan

5.5 Dataset identification

The dataset identification information for this standard is specified in Table 4.

Table 4 – Dataset identification

Field	Description
Title	Route Plan
Alternate Title	Route Plan Exchange
Abstract	The Route Plan for the radiocommunication and navigational equipment and system shall be produced in accordance with the rules defined in this standard. This standard contains all the information necessary to enable users to produce a consistent Route Plan and to use that data efficiently in an application
Topic category	Transportation (ISO 19115 Domain Code 018)
Geographic Description	Areas specific to marine navigation
Spatial Resolution	
Purpose	Route Plan Exchange
Language	English (Mandatory), other (Optional)
Classification	Unclassified
Spatial representation type	Vector
Point of Contact	Producing agency
Use Limitation	

6 Data content and structure

6.1 General

The Route Plan is a feature-based product. The content information is described in terms of a general feature model and a feature catalogue.

IMO has defined in MSC.232(83) minimum requirements for route planning in ECDIS. A route consists of both straight and curved segments. Route includes user selectable limits for checking navigational hazards. Further a route includes user selectable cross track limits for automatic off-track alarm. In this standard curved segments are defined by radius controlled turns in each waypoint, checking limit is defined as routeWaypointLegstarboardCheckLimit and as routeWaypointLegPortCheckLimit, and cross track limit is defined as routeWaypointLegStarboardXTDL and routeWaypointLegPortXTDL.

IMO has defined voyage planning in A.893(21) and A.995(25). The IMO voyage planning goes beyond this standard and therefore this standard does not use 'voyage plan' for a route plan which contain some elements, but not all, required for an IMO voyage plan.

The Route Plan contains elements intended for mandatory implementation and elements for optional implementation. The mandatory implementation is based on IMO ECDIS minimum requirements about Route planning and Route monitoring. The optional elements to implement this standard do not describe all functionality which could be built around them. If a manufacturer wants to implement at least some of the optional elements he can provide a viewer or editor for these elements. This standard specifies standardized transfer format and some use cases are described in ANNEX A.

The Route Plan Information conforms to the General Feature Model (GFM) from S-100 Part 3. The GFM is the conceptual model and the implementation is defined in the Feature Catalogue. The Route Plan Information Application Schema is realized in the feature catalogue and the product specification only contains specific examples.

[illegible]

6.3 Geometry

6.4 Coordinate reference systems

For route specification the horizontal Coordinate Reference Systems is EPSG:4326 (WGS84). The full reference to EPSG: 4326 can be found at www.epsg-registry.org.

212

Table 5 – Route Plan coordinate reference systems

Field	Description
Horizontal coordinate reference system	EPSG:4326 (WGS84)
Projection:	None
Temporal reference system	Gregorian calendar
Coordinate reference system registry	EPSG Geodetic Parameter Registry
Date type (according to ISO 19115):	002- publication
Responsible party:	International Organisation of Oil and Gas Producers (OGP)
URL	http://www.iogp.org

213 **7 Feature catalogue**214 **7.1 General**

215 The Route Plan Feature Catalogue describes the feature types, information types, attributes,
216 attribute values, associations and roles which may be used in a Route Plan dataset.

217 The Route Plan Feature Catalogue is available in a machine-readable printed version which
218 conforms to the S-100 XML Feature Catalogue Schema and can be downloaded from [the IHO](#)
219 [website](#): [TBD]. It is also available in ANNEX [XX] as a human readable version.

220 When there are conflicts in the texts, tables, data model (see Figure 1) or schema, the
221 machine-readable files shall take precedence.

222 **7.2 Feature types**223 **7.2.1 Geographic**

224 Geographic (geo) feature types form the principle content of the dataset and are fully defined
225 by their associated attributes and information types.

226 In the Route Plan domain, a feature type 'Waypoint' is defined with several attributes
227 including geographical attributes such as position.

228 [TBD]

229 **7.2.2 Meta**

230 Meta features contain information about other features within a data set. Information defined
231 by meta features override the default metadata values defined by the data set descriptive
232 records.

233 Meta attribution on individual features overrides attribution on meta features. For example,
234 'DataCoverage' is a meta feature that describe coverage of certain area including geo
235 features.

236 TBD

237 **7.2.3 Aggregated**

238 An Aggregated feature type is a feature which is made up of component features. In this
239 domain, 'Waypoints' and 'Route' are aggregated feature types. [TBD]

7.2.4 Route

Route version has a format X.Y. First value X of **routeFormatVersion** is updated when a significant change(s) were done in route format structure. This includes 1) when the status of some recognizable element (e.g. XTD) was changed from Optional to Mandatory, 2) when new elements to the route format were added, 3) when some elements in the route format were deleted, 4) where there are some changes of XSD schema. The second value Y of **routeFormatVersion** is updated when some “typographical” changes were done, which do not affect the format itself. This includes 1) when there are additional explanations in the description of the format, 2) when some not recognizable extensions were added or deleted.

Table 6 – Route object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeFormatVersion	The version of this route format	String	1	Mandatory	Describe when these numbers are changed, Format: X.Y X: Major version Y: Minor version
routeEditionNo	Route Edition number	Integer	1	Mandatory	This number is updated whenever the route information has major changes
routeUpdateNo	Route Update number	Integer	0..1	Optional	Without update number, the default update number will be zero(0).
routeID	Unique Route Identifier	String	1	Mandatory	
routeExtensions	Additional proprietary information for the route specified by the manufacturer	RouteExtensions	0..1	Optional	

7.2.5 RouteActionPoints

7.2.5.1 General

The feature **RouteActionPoints** shall contain at least one **RouteActionpoint** objects. The order of **RouteActionPoint** objects of the **Route** given in Table 7 shall determine the action order.

Table 7 – RouteActionPoints object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeWaypointExtensions	Additional proprietary information for the waypoints specified by the manufacturer	RouteExtensions	0..1	Optional	

253 **7.2.6 RouteActionPoint**

254 The **RouteActionPoint** is to define actions at some geographical position for example ship reporting. The **RouteActionPoint** may be related with
 255 a waypoint. See Table 8 and Table 9.

256 [TBD]

257 **Table 8 – RouteActionPoint object attributes**

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeActionPointId	Identifier of the action point. The identifier shall be unique in the system	Integer	1	Mandatory	positive integer
routeWaypointID	Reference associated waypoint ID	Integer	0..1	optional	
routeActionPointName	Name of action point	String	0..1	Optional	
routeActionPointPosition	Geographical position of the action point in degrees	GM_Point, GM_Line, GM_Surface	1	Mandatory	For value range see IHO S-100 The minimum resolution is 0.0001°
routeActionPointRadius	Distance from the origin action point	Real	1	Mandatory for GM_Point	Unit: NM Positive real
routeActionPointRequiredAction	Machine readable action required for this action point	Enumeration	1	Mandatory	
routeActionPointRequiredActiontext	The action required for this action point	String	1	Mandatory	
routeActionPointExtensions	Additional proprietary information for the Route ActionPoint specified by the manufacturer	RouteExtensions	0..1	Optional	

258
 259 **Table 9 – Definition of RouteActionPointRequiredAction**

Enumeration Value	Description	Remarks
1	User defined	Action is available in field routeActionPointRequiredAction
2	Report	Report from vessel to shore
3	UKCM	UKCM report

Enumeration Value	Description	Remarks
4	TBD	TBD
5	TBD	TBD
6	TBD	TBD

260 **7.2.7 RouteWaypoints**

261 **7.2.7.1 General**

262 The feature **RouteWaypoints** described in Table 10 shall contain zero or one **RouteWaypointDefault** and two or more **RouteWaypoint** objects.
263 The order of **RouteWaypoint** objects of the **Route** shall determine the sailing order.

264 **Table 10 – Route waypoint object attributes**

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeWaypointExtensions	Additional proprietary information for the waypoints specified by the manufacturer	RouteExtensions	0..1	Optional	

The **routeWaypointTurnRadius** attribute shall contain a non-negative number smaller or equal to 10 NM, since a larger value of this parameter is not practical, whereas the upper limit provides a higher “junk” detection probability. This field shall be accurate to at least two decimal places. This field presentation precision may vary from 0.1 to 0.001 NM. If the **routeWaypointTurnRadius** attribute is not available in both **RouteWaypoint** and in the **RouteWaypointDefault**, the default value of this attribute is equal to 1.0 NM,

NOTE It is essential that this route has a strictly defined geometry, and the turn radius, in its waypoint, has a considerable effect on this geometry, and, therefore, is not indefinite.

The **routeWaypointPosition** shall contain the latitude and longitude values expressed in degrees. Coordinates shall be presented with an accuracy to at least five decimal places. These values presentation precision may vary from 0.0001^0 (with a precision in the order of 10 metres) to 0.0000001^0 (with a precision in the order of 1 cm) depending on the application area. It has been mentioned that each route leg is formed as the shortest of all the possible segments within the framework of the set geometry (Great Circle or Rhumb Line) on the terrestrial ellipsoid. It follows that there is no need to permit entry of arbitrary longitude value, and it would seem reasonable to have the $-180^0 \leq \text{lon} < 180^0$ restriction. With this kind of restriction each point on the terrestrial surface (except for the poles, which can be corrected by setting zero longitudes only for them) can be uniquely correlated with a lat/ lon pair. Moreover, introduction of this restriction permits, just like in the case of the turn radius, quite easy detection of the “junk” longitude values.

7.2.7.2 RouteWaypointDefault

The purpose of this object, see Table 11, and its optionally associated **RouteLeg** object is to provide a template for new **RouteWaypoint** object generated, e.g. as part of an optimization process.

In the **RouteWaypointDefault**, it is preferable to set the parameters that are used by default in creating a new waypoint. Such approach may be useful when, e.g., it is necessary to send a route from the ship to a third party for some minor adjustments; then such party can only set geographic coordinates of new waypoints without specifying any other attributes requiring additional knowledge, and after such addition, the shipboard personnel, with a high degree of probability, will not have to set the necessary additional parameters for each so added waypoint, since we may be quite satisfied with what is available in the **RouteWaypointDefault**. If, however, the geometry of the obtained route proves to be incorrect, this is of no concern for the other party, since the obtained route should anyway be checked on the ship and corrected if required, as the ship personnel is as a rule better aware of their ship parameters and its current condition.

7.2.7.3 RouteWaypoint

The **routeWaypointId**, see Table 12, shall be unique within a route, i.e., there shall be no waypoints with the same id within one route. The **routeWaypointId** attribute for a waypoint may not be necessarily this point number in a route. The waypoints succession order is determined exclusively by their position in the **RouteWaypoints** object, so that the adjacent point identifiers may not correlate at all.

The **routeWaypointId** field for waypoint is not related to the order of waypoints. The waypoint identifier mechanism has been specifically devised to ensure an ability to easily understand which points remained unchanged, which were subjected to changes (by using the revision field), which were deleted and which of them appeared after arbitrary changes in the route geometry. In addition, the waypoint identifiers permit references to the geometry (rather than the succession order) from other Route Plan Data objects, e.g., from the **RouteScheduleElement**. The easiest way is to number waypoints in the order of their appearance in the process of creating and revising a route.

314 **Table 11 – RouteWaypointDefault object attributes**

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeWaypointTurnRadius	Turn radius in nautical miles	Real	1	Mandatory	Unit: NM The value range is 0.0 to 10.0 NM. The minimum resolution is 0.1 NM
routeWaypointDefaultExtensions	Additional proprietary information for the waypoints specified by the manufacturer	RouteExtensions	0..1	Optional	

315 **Table 12 – RouteWaypoint object attributes**

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeWaypointId	Identifier of the waypoints. The identifier shall be unique in the system	Integer	1	Mandatory	positive integer
routeWaypointFixed	Indicator if the route waypoint is fixed or editable	Boolean	1	optional	By default, all waypoints are editable unless it is set to fixed 0 : Editable. Create/delete or update the waypoints including waypoint position 1: fixed. No delete or update of the waypoint position.
routeWaypointRevision	revision number	Integer	1	Mandatory	non-negative integer
routeWaypointName	Name of waypoint	String	0..1	Optional	
routeWaypointPosition	Geographical position of the waypoint in degree	GM_Point	1	Mandatory	For value range see IHO S-100 The minimum resolution is 0.0001°
routeWaypointTurnRadius	Turn radius in nautical miles	Real	1	Optional	The value range is 0.0 to 10.0 NM. The minimum resolution is 0.1 NM In case of absence, the default value is 1.0 NM.
routeWaypointExtensions	Additional proprietary information for the Route waypoints specified by the manufacturer	RouteExtensions	0..1	Optional	

316 The **routeWaypointRevision** attribute shall be updated each time when corresponding
317 **RouteWaypoint** object is modified: changes of a position or some other attribute value
318 (including the extension for a **RouteWaypoint**, the related **RouteWaypointLeg** and its
319 extensions), addition or deleting of some attributes (with the same number of revision). See
320 Figure 2 and Figure 3.

321 When revision is used, it is worthwhile to store separately the next identifier value so as to
322 avoid mixing up the deleted points with recently added ones. Each newly created waypoint is
323 assigned with this identifier with unique value.

324 The **RouteWaypoints** objects contains data related to the geometry of the route.

325 As minimum, it shall contain a sequence of **RouteWaypoint** which has a corresponding leg
326 object (**RouteWaypointLeg**) that describe every leg of the route.

327 The order of the **RouteWaypoint** nodes follows the order of the legs.

328 Before the sequence of **RouteWaypoint** nodes it is possible to insert a
329 **RouteWaypointDefault** node, which defines default values of attributes for newly created
330 legs except for the geometry data.

331 The **routeWaypointPosition** is the geographical waypoint information. For
332 **routeWaypointPosition** each route leg is formed as the shortest of all the possible segments
333 within the framework of the set geometry (Great Circle or Rhumb Line) on the terrestrial
334 ellipsoid. It shall be in the range $-180^{\circ} \leq lon < 180^{\circ}$ and $-90^{\circ} \leq lat \leq 90^{\circ}$.

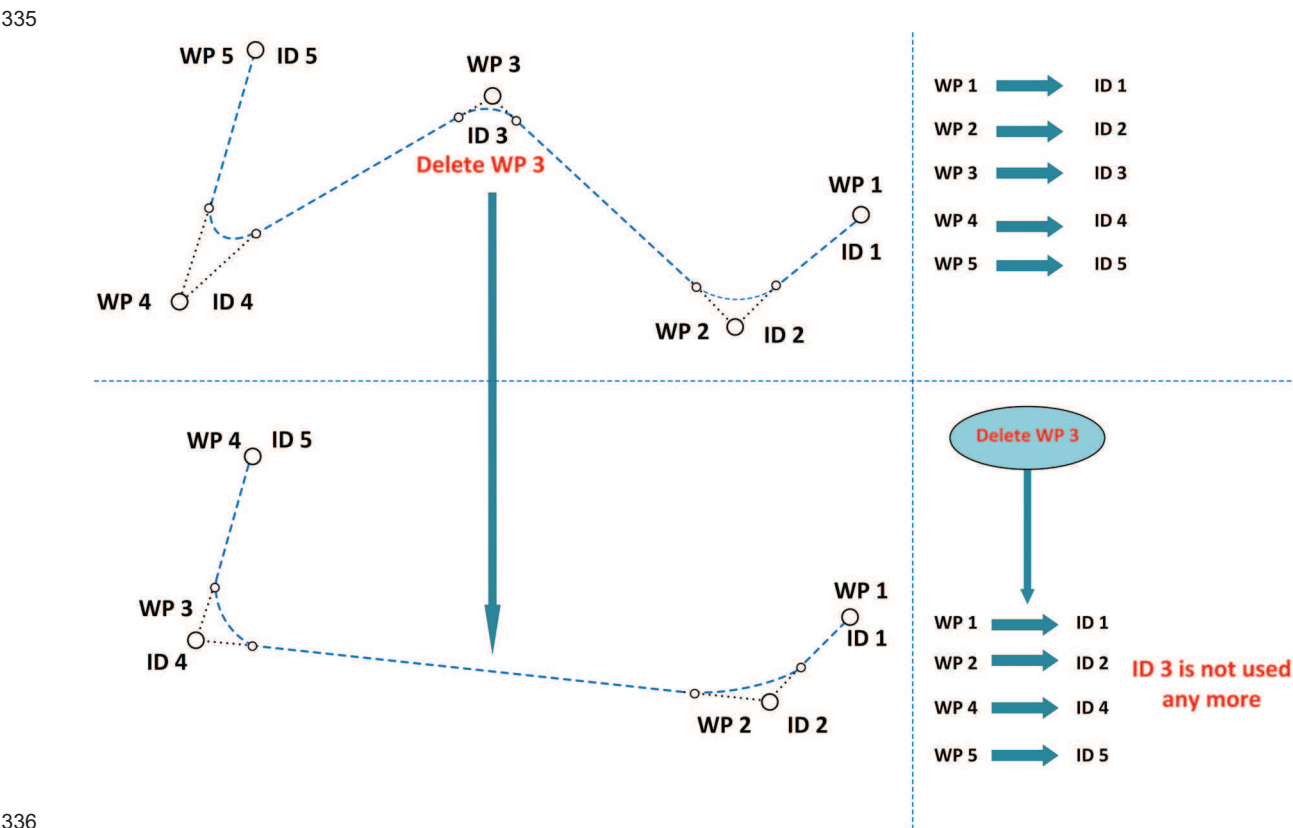


Figure 2 – Route Waypoint ID usage examples : Delete

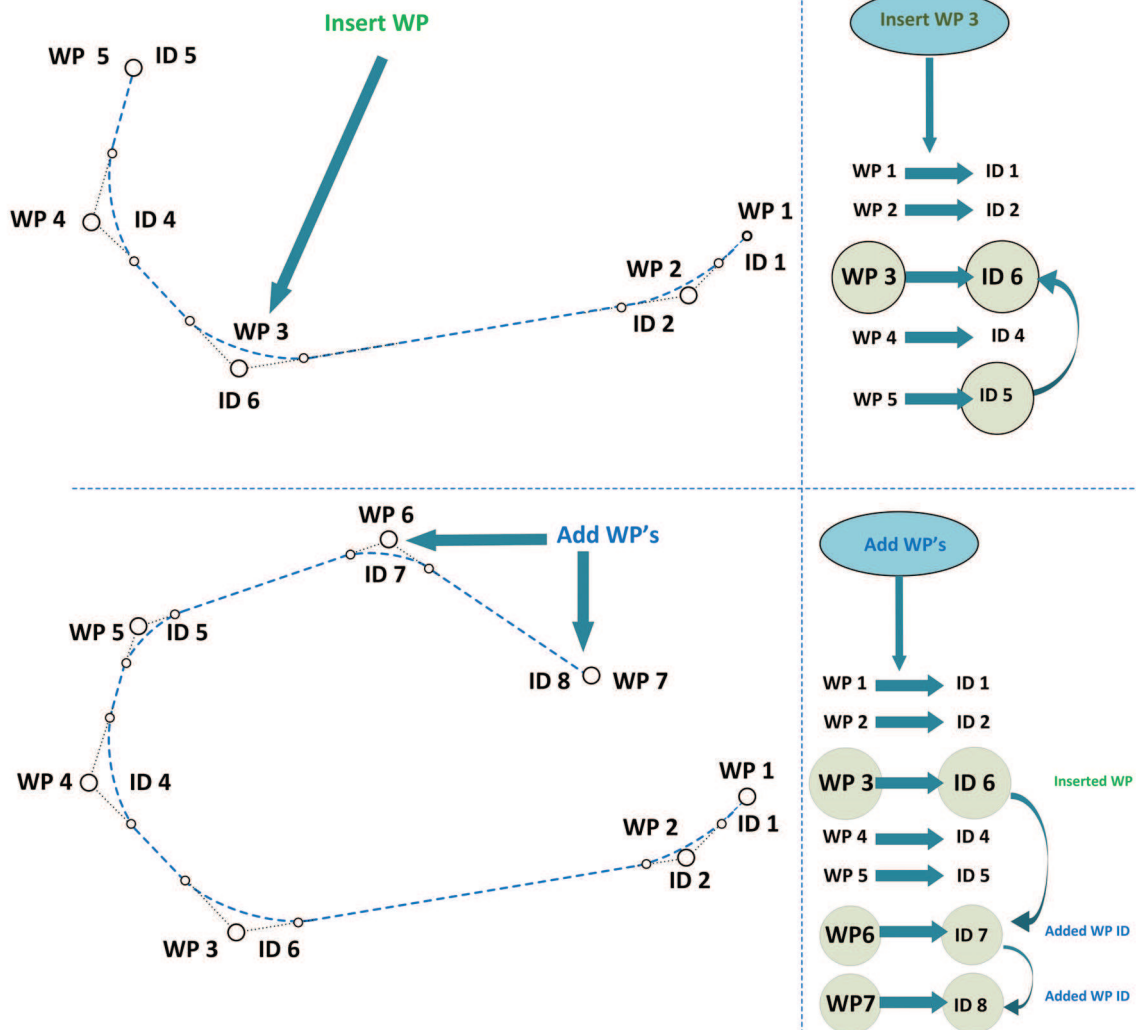


Figure 3 – Route Waypoint ID usage examples : Insert

7.2.8 RouteWaypointLeg

The **RouteWaypointLeg** object, see Figure 4 and Figure 5, is mandatory for a waypoint except the first waypoint for which there is no **RouteWaypointLeg** object.

Each route leg is formed as the shortest of all the possible segments within the framework of the set geometry (Great Circle or Rhumb Line) on the terrestrial ellipsoid. The meridional difference between two waypoints shall be less than 179 degrees.

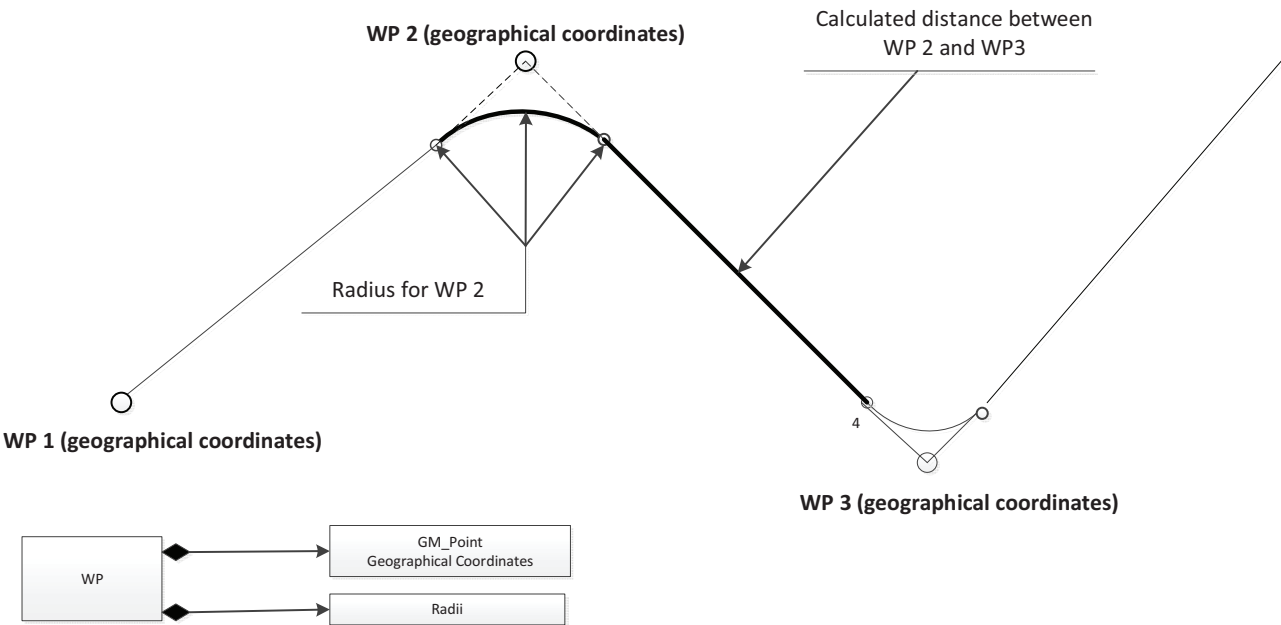


Figure 4 – RouteWaypointLeg parameters belonging to WP3

The **routeWaypointLegStarboardXTDL** and **routeWaypointLegPortXTDL** are mandatory attributes. The default value shall be set to 50 m. The **routeWaypointLegGeometryType** element is also mandatory.

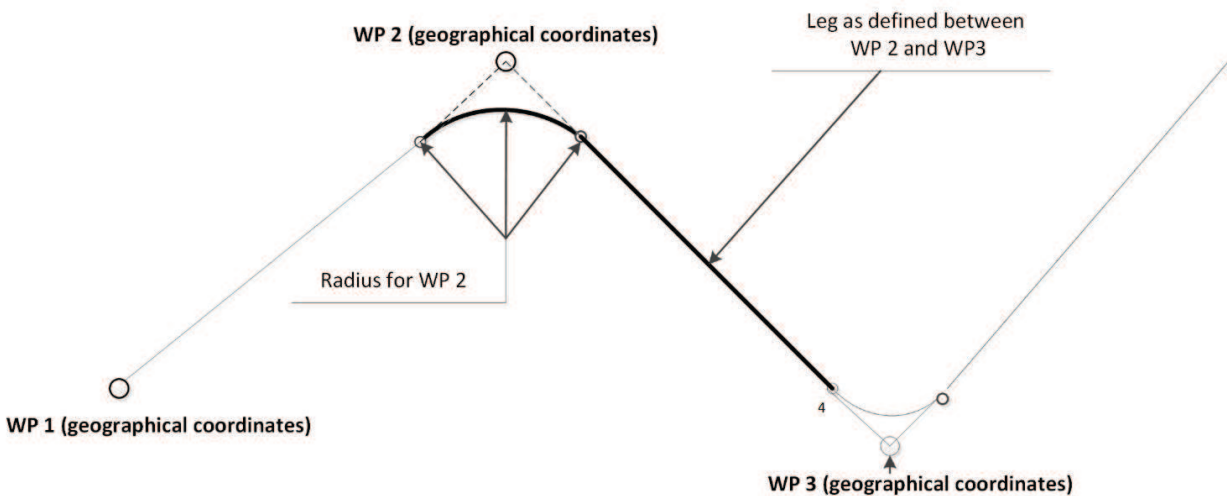


Figure 5 – routeWaypointLegDistance between WP2 and WP3

The under keel clearance, see Figure 6 is a vertical distance between the deepest underwater point of the ship's hull including dynamic draft and safety margin, and charted depth. That clearance shall be sufficient to allow ship's floatability in most unfordable hydrographical and meteorological conditions.

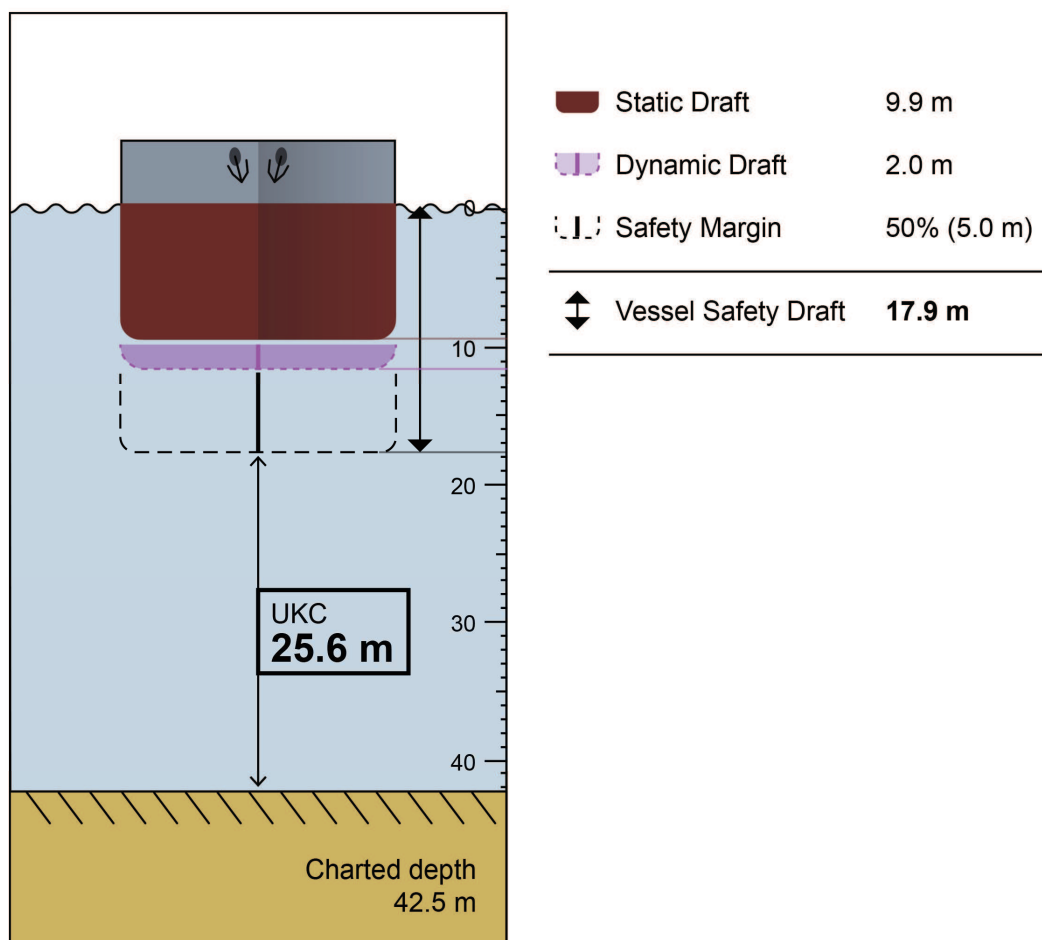


Figure 6 – Under keel clearance example

Static Draft

- the draft when the vessel is not making way or subject to sea and swell influences, i.e. the maximum draft the vessel has loaded to.

Dynamic Draft

- the draft when the vessel is making way and subject to squat, sea and swell state and increase of draft due to heel when turning.

Safety margin the draft component including uncertainties:

- the accuracy of the hydrographic data (references to reliability are often included on charts CATZOC);
- the vessel's size and handling characteristics;
- Changes in the predicted tidal height, caused by wind speed and direction and high or low barometric pressure;
- the nature and stability of the seabed – i.e. sand waves, siltation, pipelines, obstructions etc.

Vessel safety draft

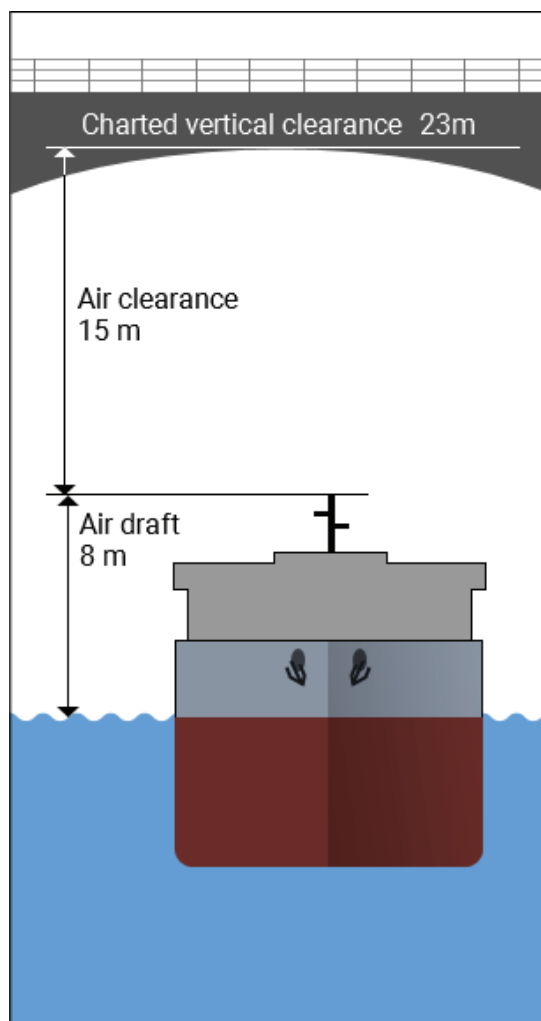
- Static draft + Dynamic draft + Safety margin

Charted depth

- is the level of water displayed on a nautical chart. Charted depths on nautical charts are given relative to chart datum.

Height of masthead from waterline shall be substituted to Air draft

387



388

389

Figure 7 – Air draft and clearance

390 **Charted vertical clearance** (or safe vertical clearance)391 – Vertical distance between water surface in MHW (mean height water) and lowest point of
392 construction over waterway. They mainly consist of:

393 – bridges (road, railway)

394 – cables,

395 – pipelines over waterways See Figure 7 and Figure 8.

396

397 **Air Draft**

398 – the distance from the water line to the highest point on a ship (including antennas)

399

400 **Air clearance**401 – vertical distance from the highest point on the ship to the lowest point of construction over
402 waterway.

403

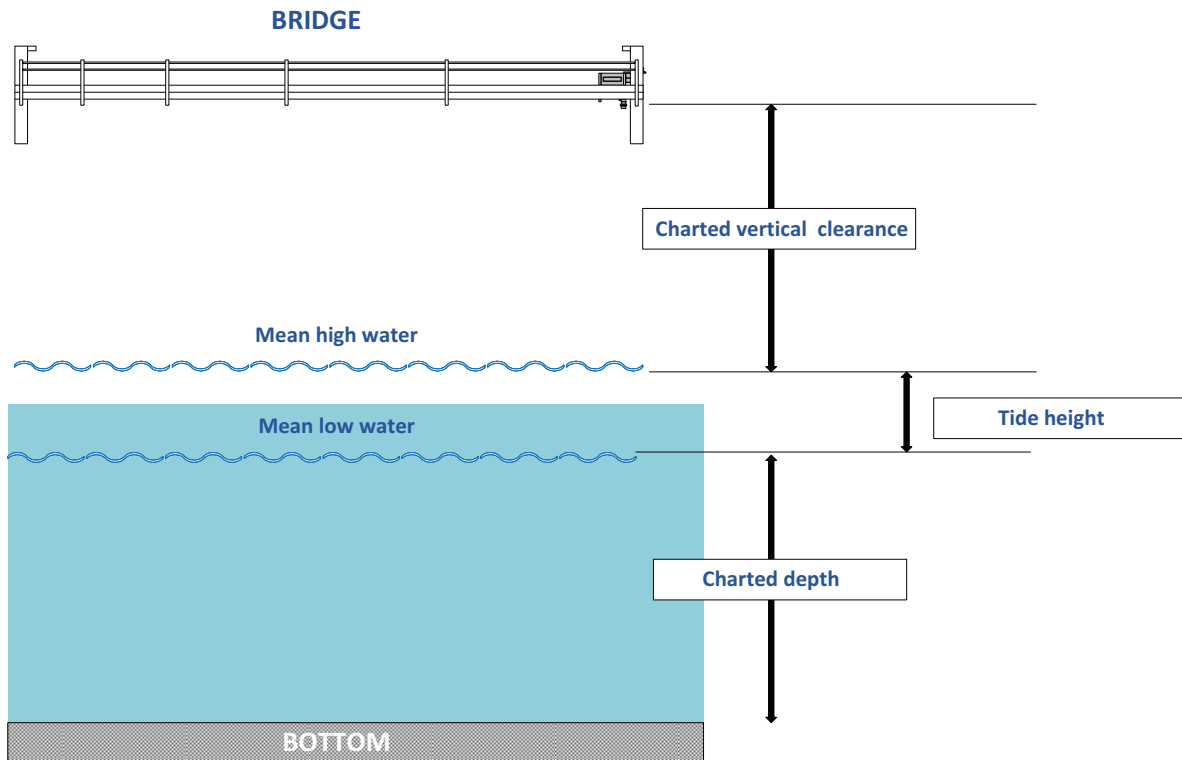


Figure 8 – Charted depth and charted vertical clearance

The **RouteWaypointLegArea** object, see Table 13 and Table 14 is the area around the center line of the leg as specified this `routeWaypointLegStarboardXTDL` and `routeWaypointLegPortXTDL`. In case of crossing 180 degree meridian, there will be multiple instances of the route waypoint leg area.

The **RouteWaypointLegCenterline** object is the center line of the leg. In case of crossing 180 degree meridian, there will be multiple instances of the route waypoint leg center line

413 Table 13 – RoutWaypointLeg object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeWaypointLegStarboardXTDL	Starboard cross track distance limit	Real	1	Mandatory	Unit: meter The value range is 1 to 10000 meter. The resolution is 1 meter The default value is 50 meter
routeWaypointLegPortXTDL	Port cross track distance limit	Real	1	Mandatory	Unit: meters The value range is 1 to 10000 meter. The resolution is 1 meter The default value is 50 meter
routeWaypointLegStarboardCL	Starboard cross track distance check limit	Real	1	Mandatory	Unit: meter The value range is 1 to 10000 meter. The resolution is 1 meter The default value is 50 meter
routeWaypointLegPortCL	Port cross track distance check limit	Real	1	Mandatory	Unit: meters The value range is 1 to 10000 meter. The resolution is 1 meter The default value is 50 meter
routeWaypointLegSafetyContour	Planned safety contour	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegSafetyDepth	Planned safety depth	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter

routeWaypointLegGeometryType	Geometry type of leg	Enum	1	Mandatory	1: Loxodrome (= rhumb line), 2: Orthodrome (= great circle)
routeWaypointLegSOGMin	Regulatory Lowest speed over ground	Real	0..1	Optional	Unit: knots, Speed over ground
routeWaypointLegSOGMax	Regulatory Highest speed over ground	Real	0..1	Optional	Unit: knots, Speed over ground
routeWaypointLegPlanSOGMin	Lowest cruising/service speed over ground	Real	0..1	Optional	Unit: knots, Speed over ground
routeWaypointLegPlanSOGMax	Highest cruising/service speed over ground	Real	0..1	Optional	Unit: knots, Speed over ground
routeWaypointLegSTWMin	Regulatory Lowest speed through water	Real	0..1	Optional	Unit: knots, Speed through water
routeWaypointLegSTWMax	Regulatory Highest speed through water	Real	0..1	Optional	Unit: knots, Speed through water
routeWaypointLegPlanSTWMin	Lowest cruising/service speed through water	Real	0..1	Optional	Unit: knots, Speed through water
routeWaypointLegPlanSTWMax	Highest cruising/service speed through water	Real	0..1	Optional	Unit: knots, Speed through water
routeWaypointLegDraught	Static Draught, maximum	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegDraughtForward	Static Draught Forward	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegDraughtAft	Static Draught Aft	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegStaticUKC	Minimum static UKC on the leg	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegDynamicUKC	Minimum dynamic UKC on the leg	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegSafetyMargin	Draft component including uncertainties	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegVesselSafetyDraft	Static draft + Dynamic draft + Safety margin	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegChartedDepth	Level of water displayed on a nautical chart which are given relative to chart datum	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegChartedVerticalClearance	Vertical distance between water surface in MHW (mean height water) and lowest point of construction over waterway	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegBldOverhang	Building overhanging the waterway	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter

					meter
routeWaypointLegAirDraft	Distance from the water line to the highest point on a ship (including antennas)	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegAirClearance	Vertical distance from the highest point on the ship to the lowest point of construction over waterway	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter
routeWaypointLegMasthead	Height of masthead from the waterline	Real	0..1	Optional	Unit: meters The resolution is 0.1 meter Calculated from keel
routeWaypointLegReport	Reporting information	String	0..1	Optional	Part of annotated route plan
routeWaypointLegInfo	Additional leg information	String	0..1	Optional	Information relevant in approach to harbour or VTS, for example phone numbers and e-mail addresses of some services
routeWaypointLegDistance	Distance to the next waypoint	Real	0..1	Optional	Unit: NM in nautical miles From WOL to WOL with zero "advance and transfer" or "forwarding distance" (see Figure 4)
routeWaypointLegBearing	Bearing to the next waypoint	Real	0..1	Optional	Unit: degree
routeWaypointLegNote1	Notes regarding ETA/ETD	String	0..*	Optional	Information about the arrival and departure as plain text.
routeWaypointLegNote2	Local remarks	String	0..*	Optional	Information as plain text
routeWaypointLegExtensions	Additional proprietary information for the Route waypoint Legs specified by the manufacturer	RouteExtensions	0..1	Optional	

415

Table 14 – RouteNotes object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeNotesSpatialComponent	Select point, line or polygon geometry	PointLineOrPolygon	0..1	Optional	
routeNotesText	Text of Route Note	String	0..1	Optional	Note itself as plain text
routeNotesType	Functional behaviour of the route note	TypeOfRouteNote	0..1	Optional	
routeNotesRadius	Distance from the geometry of route note within which route note is active	Real	0..1	Optional	Unit: NM The minimum resolution is 0.1 NM
routeNotesTemporal	Relative time from the geometry of route note within which to announce route note	DateTime	0..1	Optional	Negative time is for before Positive time is for after

416 7.2.9 RouteNotes

417 The **RouteNotes** are optional geo-allocated text which is introduced to users based on own
418 ship position and position of **RouteNotes** object. The geometry of **RouteNotes** can be point,
419 line or area.

420 The purpose of **RouteNotes** is to enable the extension of the route as an annotated route.

421 7.2.10 RouteSchedules

422 The four main elements of a schedule are: ETA, ETD, speed and stay. These schedule
423 elements can be set manually by operator or calculated by machine. See Tables 16 to 18.

424 The schedule of the route can be **RouteScheduleManual**, **RouteScheduleCalculated** or by
425 any mixture. Each schedule element is associated with a **routeWaypointId**. When a
426 **RouteScheduleManual** is used, at least one of the schedule element values is set by
427 operator. When a **RouteScheduleCalculated** is used, all schedule element values are set by
428 machine. The schedule element in **RouteScheduleManual** only contains the schedule
429 elements set by operator. However, the schedule elements in **RouteScheduleCalculated**
430 includes all schedule elements including the manual elements.

431 If the route geometry changes, all the calculated elements for schedules shall be reset, as the
432 calculation results basically depend on the geometry.

433 When there are several schedules, the first schedule in the **RouteSchedules** object is
434 considered to be active. To change into the active schedule, the new active schedule shall be
435 moved to the beginning of the **RouteSchedules**.

436 Only a complete schedule shall be selectable for monitoring. In a complete schedule each
437 waypoint of a route may have a schedule object referencing it. Expired schedule shall not be
438 selected for monitoring. Expired schedule means that any schedule object in a route to be
439 sailed from the current position to the end of the route has expired.

Table 15 – RouteSchedules object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeSchedulesExtensions	Additional proprietary information for the route schedules specified by the manufacturer	RouteExtensions	0..1	Optional	

Table 16 – RouteScheduleManual object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeScheduleManualExtensions	Additional proprietary information for the route schedule manual specified by the manufacturer	RouteExtensions	0..1	Optional	

Table 17 – RouteScheduleCalculated object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeScheduleCalculatedExtensions	Additional proprietary information for the routeschedule calculated specified by the manufacturer	RouteExtensions	0..1	Optional	

Table 18 – RouteSchedule object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeScheduleId	Identifier of the schedule. This identifier is unique in the system.	Integer	1	Mandatory	positive integer
routeScheduleName	Name of schedule	String	0..1	Optional	Human readable text
routeScheduleExtensions	Additional proprietary information for the route schedule specified by the manufacturer	RouteExtensions	0..1	Optional	

7.2.11 RouteSchedule

The **routeScheduleId**, see Table 19, is intended for machine processing. The **routeScheduleName** is intended for human operator. An unique **routeScheduleId** shall be set for each **RouteSchedule** object. The **routeScheduleName** attribute is optional, and there may be several schedules with the same name within the framework of one route.

NOTE 1 The **routeScheduleName** attribute is intended mainly for making it easier for an operator handling several schedules for one and the same route, to find the necessary schedule and distinguish the schedules one from another.

NOTE 2 It is helpful to use a globally unique identifier (GUID) for a **routeScheduleId** in the **routeSchedule**, which permits avoiding problems associated with the merging of two versions of one and the same route from different sources, schedules added to each, since the GUID guarantees that the schedules would not intersect, and that one could be certain about which schedules are common.

The **RouteScheduleManual** describes user's preferences for the schedule. The **RouteScheduleManual** contains a list of **RouteScheduleElement** nodes that describe time preferences and calculation restrictions for each leg or waypoint of the route. A waypoint shall have only one associated **RouteScheduleElement** within a **RouteScheduleManual**.

RouteScheduleCalculated object contains a sequence of **RouteScheduleElement** objects that store calculations results according to user's preferences available from the **RouteScheduleManual** object. A waypoint shall have only one associated **RouteScheduleElement** within a **RouteScheduleCalculated** object.

If the receiving application uses route information only for display or information purpose, it shall use **RouteScheduleElementCalculated** object since it has all schedule elements.

7.2.12 RouteScheduleManual/RouteScheduleCalculated

The **RouteScheduleCalculated** shall contain both parameters consistent with the manually set ones (presented in the **RouteScheduleManual**), and the calculated values.

Consistency means equal value intervals for the **routeScheduleElementPta**, **routeScheduleElementPtd**, **routeScheduleElementVessISOG** and **routeScheduleElementVessISTW** (with some reservations for this parameter which will be referred to below) and equality of the rest of parameters except for the **routeScheduleElementStay** parameter, as it is essentially dependent on the specific **routeScheduleElementEta**, **routeScheduleElementEtd** values rather than on their intervals.

Consistency for the speed intervals means that an interval in the **RouteScheduleCalculated** shall be completed within the corresponding interval for the **RouteScheduleManual**, and the **routeScheduleElementPtdWindowBefore**, **routeScheduleElementPtdWindowAfter**, **routeScheduleElementPtaWindowBefore**, **routeScheduleElementPtaWindowAfter**, value should be the maximum within the limits in question. For example, when **routeScheduleElementWindSpeed** is set to 24 and **routeScheduleElementWindSpeedWindow** is set to 4 in the **RouteScheduleManualElement**, and after the optimizing **routeScheduleElementWindSpeed** is set to 23, it is necessary to set **routeScheduleElementWind** to 3 in the **RouteScheduleCalculatedElement**.

When **routeScheduleElementPta**, **routeScheduleElementPtd** and **routeScheduleElementSpeed** is changed in the course of optimizing, it is needed to set intervals appropriately by filling in the **routeScheduleElementPtdWindowBefore**, **routeScheduleElementPtdWindowAfter**, **routeScheduleElementPtaWindowBefore**, **routeScheduleElementPtaWindowAfter**, **routeScheduleElementSpeedWindowLow**, **routeScheduleElementSpeedWindowHigh** parameters. This is why, if after the optimizing, the manually set **routeScheduleElementPta**, **routeScheduleElementPtd** or **routeScheduleElementSpeed** values have changed, the appropriate changes should be made to the **routeScheduleElementPtdWindowBefore**, **routeScheduleElementPtdWindowAfter**, **routeScheduleElementPtaWindowBefore**, **routeScheduleElementPtaWindowAfter**, **routeScheduleElementSpeedWindowLow**, **routeScheduleElementSpeedWindowHigh** parameters.

503 **routeScheduleElementPtaWindowAfter**, **routeScheduleElementSpeedWindowLow**,
 504 **routeScheduleElementSpeedWindowHigh** parameters.

505 The schedule is considered to be completed if:

- 506 1) its **RouteScheduleCalculated** element contains PTD parameter values for all the
 507 waypoint except the last one, and the PTA and speed parameter values for all the
 508 waypoint except the first one.
- 509 2) the **RouteScheduleManual** element is not in contradiction to the
 510 **RouteScheuleCalculated** element, and the data for **RouteScheduleManual** is sufficient
 511 for recalculating the schedule.

512 When **routeScheduleElementPtd** is set manually, at least one of
 513 **routeScheduleElementPtdWindowBefore** parameters or
 514 **routeScheduleElementPtdWindowAfter** shall not be equal to zero (when these parameters
 515 are absent, it means that they are equal to zero). **RouteScheduleCalculated**, the
 516 **routeScheduleElementPtd** value for the same waypoint may be different from the initial
 517 value within the range set by the **routeScheduleElementPtdWindowBefore** and
 518 **routeScheduleElementPtdWindowAfter**. A similar statement is applicable to the **eta**. But in
 519 the case of such **routeScheduleElementPtd** or **routeScheduleElementPta** variation, values
 520 for the **routeScheduleElementPtdWindowBefore** and
 521 **routeScheduleElementPtdWindowAfter** or **routeScheduleElementPtaWindowBefore** and
 522 **routeScheduleElementPtaWindowAfter** shall also change, so that the interval of uncertainty
 523 for the **routeScheduleElementPtd** or **routeScheduleElementPta** remains unaltered.

524 Even though all fields in the **RouteScheduleElement** are set manually, the elements
 525 **routeScheduleElementWindSpeed**, **routeScheduleElementWindDirection**,
 526 **routeScheduleElementCurrentSpeed**, **routeScheduleElementCurrentDirection**,
 527 **routeScheduleElementWindLoss**, **routeScheduleElementWaveLoss**,
 528 **routeScheduleElementTotalLoss**, **routeScheduleElementEngineRpm**,
 529 **routeScheduleElementPropellerPitch**, **routeScheduleElementFuelConsumption**,
 530 **routeScheduleElementRelFuelSave**, **routeScheduleElementAbsFuelSave** are set as the
 531 result of the schedule calculations for example the route optimization.

532 7.2.13 RouteScheduleElement

533 All the fields describing a certain time interval
 534 (**routeScheduleElementWaypointPtdWindowBefore**,
 535 **routeScheduleElementWaypointPtdWindowAfter**,
 536 **routeScheduleElementWaypointPtaWindowBefore**,
 537 **routeScheduleElementWaypointPtaWindowAfter**,
 538 **routeScheduleElementWaypointStayTime**) shall have the form of PT15H5M, not comply
 539 with the "HH.MM" format, e.g., "15.05". When the interval length is more than 24 hours, and
 540 comes to, e.g., 37 hours 27 minutes, this shall be expressed as follows: "P1DT13H27M" in full
 541 compliance with requirements for the xds: duration type.

542

543 7.2.14 RouteActualElement

544 The **RouteActualElement**, see Table 20, is to provide the measured or current status
 545 information of the vessel related with schedule or waypoint referencing.

Table 19 – RouteScheduleElement object attributes

Attribute Name	Description	Data Type	Multiplicity	Implementation	Remarks
routeWaypointId	Waypoint identifier of the schedule	Real	1	Mandatory	
routeScheduleElementPtd	Planned Time of departure	DateTime	0..1	Optional	
routeScheduleElementRtd	Recommended Time of departure, usually from the port / VTS to the ship	DateTime	0..1	Optional	
routeScheduleElementPtdWindowBefore	Describes the uncertainty of the predicted ptd before planned time	RouteScheduleDurationTime	0..1	Optional	HHMM to etd
routeScheduleElementPtdWindowAfter	Describes the uncertainty of the predicted ptd after planned time	RouteScheduleDurationTime	0..1	Optional	Days, hours, minutes after etd
routeScheduleElementRtdWindowBefore	Describes the uncertainty of the predicted rtd before recommended time	RouteScheduleDurationTime	0..1	Optional	HHMM to etd
routeScheduleElementRtdWindowAfter	Describes the uncertainty of the predicted rtd after recommended time	RouteScheduleDurationTime	0..1	Optional	Days, hours, minutes after etd
routeScheduleElementPta	Planned time of arrival	DateTime	0..1	Optional	
routeScheduleElementRta	Recommended Time of arrival, usually from the port / VTS to the ship	DateTime	0..1	Optional	
routeScheduleElementPtaWindowBefore	Describes the uncertainty of the predicted pta before planned time	RouteScheduleDurationTime	0..1	Optional	Days, hours, minutes to eta
routeScheduleElementPtaWindowAfter	Describes the uncertainty of the predicted pta after planned time	RouteScheduleDurationTime	0..1	Optional	Days, hours, minutes after eta
routeScheduleElementRtaWindowBefore	Describes the uncertainty of the predicted rta before recommended time	RouteScheduleDurationTime	0..1	Optional	HHMM to etd
routeScheduleElementRtaWindowAfter	Describes the uncertainty of the predicted rta after recommended time	RouteScheduleDurationTime	0..1	Optional	Days, hours, minutes after etd
routeScheduleElementStayTime	Stay time on the waypoint	RouteScheduleDurationTime	0..1	Optional	Days, hours, minutes at waypoint
routeScheduleElementVesselSOG	Vessel ground speed	Real	0..1	Optional	Unit: Knots Speed over