JCOMM
Expert Team on Sea Ice

Electronic Chart Systems
Ice Objects Catalogue

Version 4.1
(DRAFT)
February 12, 2010

Not Yet Approved

Canadian Ice Service
Environment Canada
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RECORD OF CHANGES

Version 4.0 Initial version approved 30 March 2007

Version 4.1 Draft

- S-57 Marine Ice Object (MOI) numeric codes have been assigned to all sea ice objects and attributes
- Amended definition of Code 91 for ICEACT and ICEAPC to include "9+/10" ice concentration
- Added Brash Ice Code 70 to Ice Objects ICESOD and ICESLO
- Added Ice Attribute ICEBRS
- Minor typographical and formatting errors fixed
- Amended references to more accurate citations
- "Remarks" updated for most ice features to indicate specific changes from Version 4.0

ECDIS Ice Objects

1. INTRODUCTION

A number of northern nations, particularly, Canada, the United States, Germany and those bordering on the Baltic Sea, maintain Ice Services, and issue ice charts on a regular basis during winter months. These ice charts are used on ships as an aid to navigation in ice infested waters, and as ECDIS becomes more widely available on ships navigating these northern waters, it will be important to provide ice data in a form that can be used in those systems.

Several workshops have been held in order to investigate how ice objects should be handled for ECDIS, An initial meeting held in Ottawa on June 26-29, 1995, addressed many of the potential issues. For that first meeting, a report was prepared by SevenC's, a German ECDIS company, which proposed a potential set of new S-57 compliant ice objects. A second report was subsequently prepared by IDON Corporation, which included a review of the level of ice object support in the existing S-57 version 2, and the DIGEST Standard Feature and Attribute Catalogue (FACC), Version 1.2. This report was reviewed by the ice experts from those nations present at the initial meeting (Germany, the United States and Canada), following which IDON Corporation formatted the ice objects into the form required for S-57 and produced Version 1.0 of the Ice Object Catalogue.

A second workshop held in Hamburg, May 21-23, 1996 included participation of ice experts from most of the Baltic nations as well as the US, Canada, and Argentina. This group reviewed and approved the Ice Object Catalogue with minor changes that were incorporated into Version 2.0 of the specifications.

SevenC's proposed further modifications to the ice objects at a third workshop held in St. John's, Newfoundland, June 5, 6th, 2000. Terraqueous Technologies and IDON Technologies integrated these recommendations into Version 3.0.

Little work has been done on the Ice Objects Catalogue itself since the release of Version 3.0 in June, 2000. However, Dr. Paul Birkel, of the MITRE Corporation in the U.S., performed an analysis of the catalogue and identified specific issues and internal consistencies that should be addressed. Additionally, within the International Hydrographic Organization (IHO), the Digital Geospatial Information Working Group (DGIWG) has set up an ice register within the Feature and Attributes (FAD) Registry. The Expert Team on Sea Ice (ETSI) of JCOMM/WMO has been named "register owner".

The Ice Register was presented to the 2005 meeting in Ottawa of the International Ice Charting Working Group (IICWG). At that meeting, it was recommended that a review by ice experts was needed to ensure harmonization with present ice community standards, including WMO Nomenclature and Symbology, and SIGRID-3 data transfer format. The U.S. National Ice Center took that action. The NIC presented the results of that review to the 2006 meeting of the IICWG in Helsinki, Finland. At the Helsinki meeting, an action was taken to prepare a new draft of the ECDIS Ice Objects for submission to the WMO and the IICWG. The Canadian Ice Service (CIS) took on this review, which has resulted in this updated Ice Object Catalogue – Version 4. Version 4 will be presented to the next meeting of ETSI in March, 2007.

Subsequent to adoption at the meeting of the Expert Team on Sea Ice (ETSI) in March, 2007 and final approval by the International Hydrographic Organization (IHO), Version 4.0 was officially released. Since that time, S-57 Marine Ice Object (MOI) numeric codes have been assigned to all sea ice objects and attributes, using the numeric range approved at the 4th meeting of the IHO-IEC IEC Harmonizing Working Group on Marine Information Overlays (HGMIO4) in May, 2007.

ECDIS/ENC BACKGROUND

An Electronic Navigational Chart (ENC) provides the data component of an Electronic Chart Display Information System (ECDIS), which is under review in many countries as an approved aid to navigation, and as the legal equivalent of a paper chart**.** However, a paper chart is not the only aid to navigation and in ice infested waters, Ice Charts are also used. It is therefore a natural extension to the ECDIS to incorporate ice data.

The presentation of ice data on an ECDIS is not necessarily a simple matter. One major difficulty is the potential clutter that the addition of ice data could cause on an ECDIS display. It may be that a chart display system can only operate as a true ECDIS without the ice information, and that the inclusion of an additional thematic group (layer) of ice information would downgrade an ECDIS to the lower status of an Electronic Chart System (ECS). However, it is still important for ice information to be fully compatible with an ECDIS system, because in certain waters it is vital for safety to be able to see the ice conditions integrated with the navigational chart data. This is an issue that requires further discussion by the ECDIS Colours and Symbols Working Group.

The second issue is the management of the frequent updates required for ice data. However, in order to begin to understand the scope of the problem, it is necessary to identify what are the potential ice objects and how they would be expressed in the S-57 standard.

The International Hydrographic Organization (IHO) has approved version 3.0 of the S-57 exchange standard for hydrographic information, with a minor upgrade to version 3.1 in November, 2000. This exchange standard consists of three primary parts. The first is the IHO S-57 Catalogue of Objects and Attributes. The second component is the specification of the S57 Exchange Format, and the third component is the Product Specification for Electronic Navigational Charts (ENCs). These three components, together with a mechanism for dynamic update, define an Electronic Navigational Chart Product. By designing the ice objects in a manner compatible with S-57, it should be possible to make use of the update mechanism designed for ECDIS for ice information.

The International Hydrographic Organization (IHO) and the Digital Geographic Information Working Group DGIWG, have worked on the harmonization of the DIGEST standard and the S-57 standard, and although the specification of ice objects is also of interest to the DGIWG the DIGEST Feature and Attribute Catalogue Committee (FACC) felt that the subject of ice objects was outside of their scope of interest.

The International Organization for Standardization (ISO) Technical Committee on Geographic Information and Geomatics is also examining object/feature coding. This standard (ISO 19110) is now at the draft international standard (DIS) stage. It establishes the method of describing an object catalogue such as the S-57 Object Catalogue in a universal manner. The IHO Transfer Standard Maintenance and Application Development Working Group (TSMADWG) is considering following this standard in future revisions of the IHO S-57 standard.

Finally, TSMADWG is presently developing the next IHO digital data transfer standard, to be called Special Publication S-100. Since this new standard is not yet finalized, the Features and Attributes described in this document are based upon S-57 Version 3.1.

2. APPROACH TO HARMONIZATION

The Features and Attributes described in this document have, to the extent possible, been harmonized with the following ice community standards:

- "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989 which includes:
  - Sea-Ice Nomenclature, Suppl. No. 5; and,
  - International System of Sea Ice Symbols, Suppl. No. 4
- "SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004

WMO standards are quite outdated, and are internally inconsistent. The Nomenclature provides descriptive definitions designed to aid in visual observation of ice information. The System of Sea Ice Symbols was designed to standardize symbology that appears on ice charts which, at the time of publication, were primary produced in hardcopy. The main element of the WMO symbolization for ice information is the "Egg Code". Attributes are described in the form of an egg-shaped (oval) symbol that contains four horizontal rows to express up to 12 numerical values for different ice parameters. Other symbols are also included, to represent ice parameters at a particular location, either precisely or in the near vicinity.

SIGRID-3 is the vector data exchange format for ice chart information among ice services and with the Global Digital Sea Ice Data Banks for archival information. Polygons and associated attribute codes are supported, but line and point information is not. Thus, SIGRID-3 equates well to S-57 "area" Feature Objects, but not to "line" and "point" Feature Objects. However, since SIGRID-3 is a more recently developed standard than WMO, its attribute codes better represent the ice information (e.g.: ranges of concentrations, strips and patches) within the "Egg Code" used on International ice charts.

Thus, the harmonization of the Ice Objects Catalogue with WMO and SIGRID-3 standards, which resulted in this document, used the following approach:

- For the most part, WMO Symbology was used as a basis to develop S-57 Ice Feature Objects. This will enable Internationally-accepted symbology to be used for any ECDIS/ENC-displayed ice products.

- Because of internal inconsistencies within WMO ice symbol tables, and in order to support "Strips and Patches", SIGRID-3 attribute codes are used as a basis for those Attributes related to the standard "Egg Code".

- Since SIGRID-3 attribute codes do not support them, this version of the Ice Objects Catalogue does not support the "Double-Egg" sub-attributes which would be required with the Attribute "Strips and Patches" within the SEAICE and LACICE "area" Objects.

- For simplicity, Ice Feature Objects are defined as "area", "point" or "line" only. For those point symbols in WMO Symbology that relate to either a "Specific Location", or a "Presence in the Area", a new "Ice Location" Attribute is defined.

- Neither WMO nor SIGRID-3 support line-type Objects. Additionally, there is no support for Iceberg information products produced by IIP or CIS, or for "Stage of

of Development" Attributes for Lake Ice (LACICE). These particular Ice Feature Objects have thus been harmonized with *"MANICE – Manual of Standards Procedures for Observing and Reporting Ice Conditions", 8th Edition, 1984, Canadian Ice Centre, Ottawa, Canada.*

- During this harmonization process, some of the Attributes have been moved up to become Ice Feature Objects, so that the associated WMO attributes can be better accommodated without having to define "sub-attributes". These include: Ice Fracture, Ice Compacting, Snow Cover, Stage of Melt, etc.

- Many of the Attributes associated with "point" Ice Feature Objects have also been added as Attributes to the SEAICE and LACICE "area" Feature Objects. This is done to provide S-57 support to future map-type/polygon-based ice information products, such as an ice lead product, ice drift products, etc.

- The following "regional" item has been included: "ICELVL (Level ice)" as an attribute to the SEAICE and LACICE objects. This is supported by WMO Symbology for use in the Baltic, for hatching or colouring of ice charts.

- Through discussion with Dr. Paul Birkel of The MITRE Corporation, and with Paul Seymour of NIC, Dr. Birkel's comments from his analysis of October, 2003, have been included into this version of the Ice Objects Catalogue.

3. ICE OBJECT CLASSES

The proposed Ice Feature Object Classes are described in accordance with the format specified in:

- "IHO Transfer Standard for Digital Hydrographic Data", Special Publication No. 57, International Hydrographic Organization, Monaco, Edition 3.1 – Appendix A, *IHO Object Catalogue*, November 2000.

All Objects are of type "*geo*", meaning "carries the descriptive characteristics of a real world entity.

ICE OBJECT SUMMARY:

Ice Object Class	Acronym	Code
Polygon		
Sea Ice	SEAICE	30 300
Lake Ice	LACICE	30 301
Iceberg Area	BRGARE	30 302
Polyline		
Ice Edge	ICELNE	30 320
Iceberg Limit	BRGLNE	30 321
Limit of Open Water	OPNLNE	30 322
Limit of All Known Ice	LKILNE	30 323
Point		
Ice Compacting	ICECOM	30 350
Ice Lead	ICELEA	30 351
Iceberg	ICEBRG	30 352
Floeberg	FLOBRG	30 353
Ice Thickness	ICETHK	30 354
Ice Shear	ICESHR	30 355
Ice Divergence	ICEDIV	30 356
Ice Ridge/Hummock	ICERDG	30 357
Ice Keel/Bummock	ICEKEL	30 358
Ice Drift	ICEDFT	30 359
Ice Fracture	ICEFRA	30 360
Ice Rafting	ICERFT	30 361
Jammed Brash Barrier	JMDBRR	30 362
Stage of Melt	STGMLT	30 363
Snow Cover	SNWCVR	30 364
Strips and Patches	STRPTC	30 365

Deleted: Ice Object Class . Acronym . ¶
¶
. Sea Ice . SEAICE¶
. Lake Ice . LACICE¶
. Iceberg Area . BRGARE¶
. Ice Edge . ICELNE¶
. Iceberg Limit . BRGLNE¶
. Limit of Open Water . OPNLNE¶
. Limit of All Known Ice . LKILNE¶
. Ice Compacting . ICECOM¶
. Ice Lead . ICELEA¶
. Iceberg . ICEBRG¶
. Floeberg . FLOBRG¶
. Ice Thickness . ICETHK¶
. Ice Shear . ICESHR¶
. Ice Divergence . ICEDIV¶
. Ice Ridge/Hummock . ICERDG¶
. Ice Keel/Bummock . ICEKEL¶
. Ice Drift . ICEDFT¶
. Ice Fracture . ICEFRA¶
. Ice Rafting . ICERFT¶
. Jammed Brash Barrier . JMDBRR¶
. Stage of Melt . STGMLT¶
. Snow Cover . SNWCVR¶
. Strips and Patches . STRPTC¶

Ice Object Class:	**Sea Ice**
Acronym:	**SEAICE**
Code:	30300
subset 'Attribute_A':	NOBJNM; OBJNAM; ICEACT; ICEAPC; ICESOD; ICEFLZ; ICESPC; ICELVL; ICECST; ICEFTY; ICEDSP; ICEDDR; ICERCN; ICERFQ; ICERMH; ICERXH; ICERDV; ICEKCN, ICEKFQ, ICEKMD, ICEKXD, ICEFCN; ICETCK; ICEMAX; ICEMIN; ICETTY; ICEMLT; ICESCN; ICESCT; ICEDOS; ICELST; ICELFQ; ICELOR;ICELWD
subset 'Attribute_B':	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset 'Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Area
Definition:	Sea Ice is an area at sea that is covered, in whole or in part, with ice.
References:	"Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States. "Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada. "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989 "SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004
Distinction:	LACICE
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New – attributes added to support potential new map-based products. Attributes themselves realigned to support SIGRID-3 tables of values.¶
¶
Egg codes, including Strips and Patches can can be supported, as well as colour schemes, schemes, cross-hatching and potential new map-based products.¶

Ice Object Class:	**Lake Ice**

Acronym:	**LACICE**
Code:	30301
subset 'Attribute_A':	NOBJNM; OBJNAM; ICEACT; ICEAPC; ICELSO; ICEFLZ, ICESPC; ICELVL; ICECST; ICEFTY; ICEDSP; ICEDDR; ICERCN; ICERFQ; ICERMH; ICERXH; ICERDV; ICEKCN, ICEKFQ, ICEKMD, ICEKXD, ICEFCN; ICETCK; ICEMAX; ICEMIN; ICETTY; ICEMLT; ICESCN; ICESCT; ICEDOS; ICELST; ICELFQ; ICELOR; ICELWD
subset 'Attribute_B':	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset 'Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Area
Definition:	Lake Ice is an area on a lake that is covered, in whole or in part, with ice.
References:	"Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States. "Ice in ECDIS Workshop," June 3, 4, 2000, St. John's, Canada. "Canadian Ice Service MANICE", 9th edition, June, 2005
Distinction:	SEAICE
Remarks:	
Change from Version 4.0:	Numeric code added

Deleted: New – attributes added to support potential new map-based products. Attributes themselves realigned to support SIGRID-3 tables of values.¶
¶
Lake Ice Stages of Development are not supported by WMO Symbology. The values for this attribute are taken from the "Canadian Ice Service MANICE, 9th edition, edition, June, 2005". ¶
¶
Egg codes, including Strips and Patches can can be supported, as well as colour schemes, schemes, cross-hatching and potential new map-based products¶

Ice Object Class:	**Iceberg Area**

Acronym:	**BRGARE**
Code:	30302
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICEBNM
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Area
References:	"Workshop on International Standards for Ice Information in ECDIS,"June 27-29, 1995, Canada/Germany/United States. “Ice in ECDIS Workshop,” June 3, 4, 2000, St. John’s, Canada. “Canadian Ice Service MANICE”, 9th edition, June, 2005
Definition:	An Iceberg Area is an area at sea in which icebergs, bergy bits, or growlers are present.
Distinction:	
Remarks:	
Change from Version 4.0:	Numeric code added

Deleted: Since a “Floeberg” is, by WMO definition, composed of sea ice and not glacial ice, floebergs have been exclude from the above definition of “Iceberg Area”. Area”. Floebergs are not included in the associated IIP or CIS area product.¶
¶
Distinction: ¶
¶

Ice Object Class:	**Ice Edge**

Acronym:	**ICELNE**
Code:	30320
subset ‘Attribute_A’:	NOBJNM; OBJNAM
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Line
Definition:	The demarcation at any given time between the open sea and sea ice of any kind and in any concentration, whether fast or drifting.
References:	”WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989 "Workshop on International Standards for Ice Information in ECDIS,” June 27-29, 1995, Canada/Germany/United States. “Ice in ECDIS Workshop,” June 3-4, 2000, St. John’s, Canada. “Canadian Ice Service MANICE”, 9th edition, June, 2005
Distinction:	BRGLNE, OPNLNE, LKILNE
Remarks:	Note the distinction from OPNLNE
Change from Version 4.0:	Numeric code added References amended

Deleted: Definition: . The demarcation at any given time between the open sea and sea sea ice of any kind and in any concentration, concentration, whether fast or drifting.¶
¶

Deleted: New – intent of this Object is now strictly to support a line feature delineating the demarcation between the open sea, and sea ice of any kind and in any concentration.¶

Ice Object Class:	**Iceberg Limit**

Acronym:	**BRGLNE**
Code:	30321
subset ‘Attribute_A’:	NOBJNM; OBJNAM;
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
References:	“Canadian Ice Service MANICE”, 9th edition, June, 2005.
Geometric Primitive:	Line
Distinction:	ICELNE, OPNLNE, LKILNE
Definition:	Limit of all known Icebergs
Remarks:	
Change from Version 4.0:	Numeric code added

Deleted: New – intent of this Object is strictly to support a line feature delineating the limit of all Icebergs.¶

Ice Object Class:	**Limit of Open Water**
Acronym:	**OPNLNE**
Code:	30322
subset 'Attribute_A':	NOBJNM; OBJNAM
subset 'Attribute_B':	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP:
subset Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Line
Definition:	The demarcation at any given time between sea ice and freely navigable water, in which sea ice is present in concentrations less than 1/10.
References:	"Canadian Ice Service MANICE", 9th edition, June, 2005.
Distinction:	ICELNE, BRGLNE, LKILNE
Remarks:	Note the distinction from ICELNE
Change from Version 4.0:	Numeric code added

Deleted: New – intent of this Object is strictly to support a line feature delineating the limit of sea ice with concentrations of less than 1/10th. ¶

Ice Object Class:	**Limit of All Known Ice**

Acronym:	**LKILNE**
Code:	30323
subset ‘Attribute_A’:	NOBJNM; OBJNAM
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP:
subset Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Line
Definition:	The limit of all known ice, including both sea ice of any kind and icebergs.
References:	“Canadian Ice Service MANICE”, 9th edition, June, 2005.
Distinction:	ICELNE, BRGLNE, OPNLNE
Remarks:	This line is a key product of the International Ice Patrol (IIP), to support safe navigation in the Northwest Atlantic under the UN Convention on Safety of Life at Sea (SOLAS).
Change from Version 4.0:	Numeric code added Remarks amended

Deleted: limit of all know

Deleted: New – intent of this Object is strictly to support a line feature delineating the limit of all known ice, including both sea sea ice and icebergs. ¶
¶

Ice Object Class:	**Ice Compacting**
Acronym:	**ICECOM**
Code:	30350
subset “Attribute_A’:	NOBJNM; OBJNAM; ICECST
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	Pieces of ice are said to be compacting when they are subjected to a converging motion, which increases ice concentration and/or produces stresses which may result in ice deformation.
References:	“International System of Sea-Ice Symbols, WMO No. 259, TP. 145, Supplement No. 4, 1970.”
Distinction:	ICESHR, ICEDFT, ICEDIV
Remarks:	
Change from Version 4.0:	Numeric code added

Deleted: New Object – to support WMO Symbology.

Ice Object Class:	**Ice Lead**

Acronym:	**ICELEA**
Code:	30351
subset 'Attribute_A':	NOBJNM; OBJNAM; ICELOC; ICELST; ICELWD
subset 'Attribute_B':	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset 'Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	Ice Lead identifies any fracture(s) or passage-way(s) through ice which is (are) navigable by surface vessels.
References:	"Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States. "Ice in ECDIS Workshop," June 3, 4, 2000, St. John's, Canada.
	"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICEFRA
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New Object – to support WMO Symbology.¶
¶
Distinction: . ICEFRA¶
. ¶

Ice Object Class:	**Iceberg**

Acronym:	**ICEBRG**
Code:	30352
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICEBSZ; ICEDSP; ICEDDR
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS, PICREP
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	An Iceberg is a massive piece of ice, greatly varying in shape and showing more than 5 meters above the sea surface which has broken away from a glacier, and which may be afloat or grounded. This Object Class also includes smaller forms of glacial ice, known as “Bergy Bits” and “Growlers”, which are defined by their size Attribute.
References:	"Workshop on International Standards for Ice Information in ECDIS,"June 27-29, 1995, Canada/Germany/United States. “Ice in ECDIS Workshop,” June 3-4, 2000, St. John’s, Canada. “WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	FLOBRG
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: This object has been revised to represent the location of an individual berg, as per WMO Symbology. Other Objects are now available to represent bergs in an area, or the limit of known bergs.¶
¶
Presently, large tabular Antarctic icebergs are not well supported by WMO Symbology. Any future changes to WMO Symbology in this regard should be reflected reflected in subsequent changes to the Ice Objects Catalogue in order to ensure compatibility.¶
¶

Ice Object Class:	**Floeberg**

Acronym:	**FLOBRG**
Code:	30353
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICEDSP; ICEDDR
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	A Floeberg is a massive piece of sea ice composed of a hummock or a group of hummocks, frozen together and separated from any ice surroundings. They typically protrude up to 5 meters above the sea surface.
References:	"Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States. “Ice in ECDIS Workshop,” June 3-4, 2000, St. John’s, Canada. “WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICEBRG
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: Note: The convention used by the "Manual of Standard Procedures for Observing and Reporting Ice Conditions" April 1994 concerning the spelling of “Floe” “Floe” instead of “Flow” has been adopted.¶

Ice Object Class:	**Ice Thickness**
Acronym:	**ICETHK**
Code:	30354
subset ‘Attribute_A”:	NOBJNM; OBJNAM; ICETCK; ICEMAX; ICEMIN; ICETTY
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	Ice Thickness provides a measure or estimate of ice thickness.
References:	"Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States. “Ice in ECDIS Workshop,” June 3, 4, 2000, St. John’s, Canada.
	“WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: This Object represents ice thickness only. Revised to conform to WMO Symbology.¶

Ice Object Class:	**Ice Shear**
Acronym:	**ICESHR**
Code:	30355
subset 'Attribute_A':	NOBJNM; OBJNAM
subset 'Attribute_B':	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset 'Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	An area of drift ice is subject to shear when the ice motion varies significantly in the direction normal to the motion, subjecting the ice to rotational forces
References:	"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICEDFT, ICEDIV, ICECOM
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New Object – to support WMO Symbology.¶

Ice Object Class:	**Ice Divergence**
Acronym:	**ICEDIV**
Code:	30356
subset ‘Attribute_A’:	NOBJNM; OBJNAM
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	Ice fields or floes in an area are subject to diverging or dispersive motion, thus reducing ice concentration and/or relieving stresses in the ice.
References:	“WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICEDFT, ICESHR, ICECOM
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: Revised Object – to support WMO Symbology.¶

Ice Object Class:	**Ice Ridge/Hummock**
Acronym:	**ICERDG**
Code:	30357
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICERCN; ICERFQ; ICERMH; ICERXH, ICERDV
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	An Ice Ridge is a line or wall of broken ice forced up by pressure. A Hummock is a hillock of broken ice which has been forced upward by pressure.
References:	"Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States. “Ice in ECDIS Workshop,” June 3-4, 2000, St. John’s, Canada
	“WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICEKEL, ICERFT
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: The Attributes have been revised revised to conform to WMO Symbology.¶
¶
Distinction: . ICEKEL, ICERFT¶

Ice Object Class:	**Ice Keel/Bummock**

Acronym:	**ICEKEL**
Code:	30358
subset 'Attribute_A':	NOBJNM; OBJNAM; ICEKCN; ICEKFQ; ICEKMD; ICEKXD
subset 'Attribute_B':	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset 'Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	From a submariner's point of view, a Keel is a downward projecting ridge on the underside of the ice canopy - the counterpart of a Ridge. A Bummock is the counterpart of a hummock on the underside of the ice canopy.
References:	"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICERDG, ICERFT
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: submariners

Deleted: Note that there is no established WMO symbol to depict "Keel/Bummock". It is recommended that the WMO symbol for Ridges/Hummocks be inverted, so the straight line representing the water surface is at the top - and used for Keels/Bummocks. This discrepancy can be corrected in a future revised edition of the referenced WMO documents.¶

Ice Object Class:	**Ice Drift**

Acronym:	**ICEDFT**
Code:	30359
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICEDSP; ICEDDR
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	Motion of an ice field or floe as a result of forces such as wind and currents.
References:	“WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICESHR, ICEDIV, ICECOM
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New Object – to support WMO Symbology.¶

Ice Object Class:	**Ice Fracture**
Acronym:	**ICEFRA**
Code:	30360
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICEFTY, ICELOC
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	Any break or rupture through the ice pack, or a single floe, resulting from deformation processes. Length may vary from a few metres to many kilometres.
References:	”WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICELEA
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: Note that there is no established WMO symbol to depict “Fracture”. It is recommended that the symbol for “Crack” be used in the interim, until this discrepancy discrepancy is corrected in a future revised edition of the referenced WMO documents.¶
¶
Distinction: ICELEA¶

Ice Object Class:	**Ice Rafting**
Acronym:	**ICERFT**
Code:	30361
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICEFCN
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	Pressure processes whereby one piece of ice overrides another.
References:	“WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	ICERDG, ICEKEL
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New Object – to support WMO Symbology.¶
¶
Distinction: . ICERDG, ICEKEL¶

Ice Object Class:	**Jammed Brash Barrier**
Acronym:	**JMDBRR**
Code:	30362
subset 'Attribute_A':	NOBJNM; OBJNAM
subset 'Attribute_B':	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset 'Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	A strip or narrow belt of new, young or brash ice (usually 100-500 metres wide) formed at the edge of either drift or fast ice.
References:	"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New Object – to support WMO Symbology.¶

Ice Object Class:	**Stage of Melt**
Acronym:	**STGMLT**
Code:	30363
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICEMLT
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	A description of the stage of melt of the ice; i.e. whether it has formed puddles on the surface and whether these have frozen.
References:	“WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New Object – to support WMO Symbology.¶

Ice Object Class:	**Snow Cover**
Acronym:	**SNWCVR**
Code:	30364
subset ‘Attribute_A’:	NOBJNM; OBJNAM; ICESCN; ICESCT; ICEDOS
subset ‘Attribute_B’:	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset ‘Attribute_C’:	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	A description of the amount of snow covering the ice.
References:	“WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989
Distinction:	
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New Object – to support WMO Symbology.¶

Ice Object Class:	**Strips and Patches**
Acronym:	**STRPTC**
Code:	30365
subset 'Attribute_A':	NOBJNM; OBJNAM; ICESPC
subset' Attribute_B':	INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP;
subset 'Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Point
Definition:	A strip is a long narrow area of floating ice, about 1 kilometre or less in width, usually composed of small fragments detached from the main mass of ice, and run together under the influence of wind, swell or current. If the area of ice becomes more rounded in shape, it is referred to as a patch.
References:	"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989"
Distinction:	
Remarks:	
Change from Version 4.0:	Numeric code added References amended

Deleted: New Object – to support WMO Symbology.¶

4. FEATURE ATTRIBUTES FOR ICE OBJECTS:

The proposed Attributes for Ice Objects are described in accordance with the format specified in:

- "IHO Transfer Standard for Digital Hydrographic Data", Special Publication No. 57, International Hydrographic Organization, Monaco, Edition 3.1 – Appendix A, Chapter 2 - *Attributes*, November 2000.

All Attributes are intended to be of type "*feature*", meaning "carries the description characteristics of a feature".

ICE FEATURE ATTRIBUTE SUMMARY:

Ice Feature Attribute	Acronym	Version
Ice Attribute Total Concentration	ICEACT	30 300
Ice Attribute Partial Concentration	ICEAPC	30 301
Ice Stage of Development	ICESOD	30 302
Lake Ice Stage of Development	ICELSO	30 303
Floe Sizes	ICEFLZ	30 304
Melt Stage	ICEMLT	30 305
Concentration of Strips and Patches	ICESPC	30 306
Number of Icebergs in Area	ICEBNM	30 307
Level Ice	ICELVL	30 308
Compacting Strength	ICECST	30 309
Ice Fracture Type	ICEFTY	30 310
Ice Lead Status	ICELST	30 311
Frequency of Leads or Fractures	ICELFQ	30 312
Orientation of Leads or Fractures	ICELOR	30 313
Ice Lead or Fracture Width	ICELWD	30 314
Ice Location Information	ICELOC	30 315
Iceberg Size	ICEBSZ	30 316
Ice Drift Direction	ICEDDR	30 317
Ice Drift Speed	ICEDSP	30 318
Ice Average Thickness	ICETCK	30 319
Maximum Ice Thickness	ICEMAX	30 320
Minimum Ice Thickness	ICEMIN	30 321
Ice Thickness Type	ICETTY	30 322
Snow Depth	ICESCT	30 323
Snow Cover Concentration	ICESCN	30 324
Direction Of Sastrugi	ICEDOS	30 325
Ice Ridge Concentration	ICERCN	30 326
Ice Ridge Classification	ICERDV	30 327
Ice Ridge Mean Height	ICERMH	30 328
Ice Ridge Frequency	ICERFQ	30 329

Ice Ridge Maximum Height	ICERXH	30 330
Ice Keel Concentration	ICEKCN	30 331
Ice Keel Frequency	ICEKFQ	30 332
Ice Keel Mean Depth	ICEKMD	30 333
Ice Keel Maximum Depth	ICEKXD	30 334
Ice Rafting Concentration	ICEFCN	30 335

Deleted: - **Ice Feature Attribute** - **Code**¶
¶
- Ice Attribute Total Concentration - ICEACT - ¶
- Ice Attribute Partial Concentration - ICEAPC - ¶
- Ice Stage of Development - ICESOD - ¶
- Lake Ice Stage of Development - ICELSO - ¶
- Floe Sizes - ICEFLZ¶
- Melt Stage - ICEMLT - ¶
- Concentration of Strips and Patches - ICESPC¶
- Number of Icebergs in Area - ICEBNM¶
- Level Ice - ICELVL¶
- Compacting Strength - ICECST¶
- Ice Fracture Type - ICEFTY - ¶
- Ice Lead Status - ICELST¶
- Frequency of Leads or Fractures - ICELFQ¶
- Orientation of Leads or Fractures - ICELOR¶
- Ice Lead or Fracture Width - ICELWD - ¶
- Ice Location Information - ICELOC - ¶
- Iceberg Size - ICEBSZ - ¶
- Ice Drift Direction - ICEDDR - ¶
- Ice Drift Speed - ICEDSP - ¶
- Ice Average Thickness - ICETCK - ¶
- Maximum Ice Thickness - ICEMAX - ¶
- Minimum Ice Thickness - ICEMIN - ¶
- Ice Thickness Type - ICETTY¶
- Snow Depth - ICESCT¶
- Snow Cover Concentration - ICESCN¶
- Direction Of Sastrugi - ICEDOS¶
- Ice Ridge Concentration - ICERCN - ¶
- Ice Ridge Classification - ICERDV - ¶

Ice Ridge Mean Height - ICERMH¶
Ice Ridge Frequency - ICERFQ - ¶
Ice Ridge Maximum Height - ICERXH¶
Ice Keel Concentration - ICEKCN¶
Ice Keel Frequency - ICEKFQ¶
Ice Keel Mean Depth - ICEKMD¶
Ice Keel Maximum Depth - ICEKXD¶
- Ice Rafting Concentration - ICEFCN¶
- Concentrations of Brash Ice - ICEBRS¶

¶

Ice Attribute:	**Total Concentration**

Acronym: **ICEACT**

Code: 30300

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	Ice Free
02	Open Water (< 1/10 ice)
03	Bergy Water
10	1/10 ice
12	1/10 to 2/10 ice
13	1/10 to 3/10 ice
20	2/10 ice
23	2/10 to 3/10 ice
24	2/10 to 4/10 ice
30	3/10 ice
34	3/10 to 4/10 ice
35	3/10 to 5/10 ice
40	4/10 ice
45	4/10 to 5/10 ice
46	4/10 to 6/10 ice
50	5/10 ice
56	5/10 to 6/10 ice
57	5/10 to 7/10 ice
60	6/10 ice
67	6/10 to 7/10 ice
68	6/10 to 8/10 ice
70	7/10 ice
78	7/10 to 8/10 ice
79	7/10 to 9/10 ice
80	8/10 ice
81	8/10 to 10/10 ice
89	8/10 to 9/10 ice
90	9/10 ice
91	9/10 to 10/10 or 9+/10 ice
92	10/10 ice
99	Undetermined/Unknown

Definition: ICEACT specifies the total concentration of ice in an area. It represents the ratio expressed in tenths describing the total area of the water surface covered by ice as a fraction of the whole area.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989"

"SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004

"Proposed Changes to Harmonize the WMO Sea Ice Nomenclature and Symbology, the SIGRID-3 Coding Standard and the ENC Ice Objects Catalogue"; JCOMM Expert Team on Sea Ice Meeting IV, Document 2.6.1; March 2010.

Remarks: Corresponds to "C" in International System of Sea Ice Symbols.
Corresponds to "CT" in SIGRID-3

Change from Version 4.0: Numeric code added
Code 91 amended
References added
Remarks amended

Deleted: ('Ct')

Deleted: New – expected input values based upon JCOMM Technical Report No. 23, "SIGRID-3: A Vector Archive Format for Sea Ice Charts", 2004, Code Table 4.1

Deleted: ¶
This attribute represents the ratio expressed in tenths describing the total area of the water surface covered by ice as a fraction of the whole area.¶
¶
The codes above are not fully in alignment with JCOMM SIGRID-3 codes. In order to achieve full alignment, it is recommended to to update the JCOMM SIGRID-3 Code Table 4.1 as follows:¶
¶
<#>in order to avoid a "00" code value, change the code of "Ice Free" to "01"; "open water" to "02" and Bergy Water" to "03".¶
<#>at present, neither code set supports the Canadian use of "9+". Recommended to amend the concentration definition of code "91" to include both "9/10-10/10 and "9+/10" in both code sets.¶
<#>change the definition of code value "99" "99" from "unknown" to "unknown/undetermined".¶

Ice Attribute:	**Partial Concentration**

Acronym: **ICEAPC**

Code: 30301

Attribute Type: List

Expected Input:

ID	Meaning
01	Ice Free
02	Open Water (< 1/10 ice)
03	Bergy Water
10	1/10 ice
12	1/10 to 2/10 ice
13	1/10 to 3/10 ice
20	2/10 ice
23	2/10 to 3/10 ice
24	2/10 to 4/10 ice
30	3/10 ice
34	3/10 to 4/10 ice
35	3/10 to 5/10 ice
40	4/10 ice
45	4/10 to 5/10 ice
46	4/10 to 6/10 ice
50	5/10 ice
56	5/10 to 6/10 ice
57	5/10 to 7/10 ice
60	6/10 ice
67	6/10 to 7/10 ice
68	6/10 to 8/10 ice
70	7/10 ice
78	7/10 to 8/10 ice
79	7/10 to 9/10 ice
80	8/10 ice
81	8/10 to 10/10 ice
89	8/10 to 9/10 ice
90	9/10 ice
91	9/10 to 10/10 or 9+/10 ice
92	10/10 ice
99	Undetermined/Unknown

Definition: ICEAPC specifies the partial concentrations of ice in an area. ('C_a, C_b and C_c').

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

"SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004

"Proposed Changes to Harmonize the WMO Sea Ice Nomenclature and Symbology, the SIGRID-3 Coding Standard and the ENC Ice Objects Catalogue"; JCOMM Expert Team on Sea Ice Meeting IV, Document 2.6.1; March 2010.

Remarks: Partial concentrations of ice are reported in order of decreasing thickness and are represented as an S-57 List (or repeating) attribute. Values are separated by a comma.
When only one ice type is present the partial concentration shall not be indicated.
Missing values are represented by the absence of any value of the attribute, which in ISO 8211 encoding of S57, would be adjacent commas.

Corresponds to "C_a, C_b, C_c " in International System of Sea Ice Symbols.
Corresponds to "CA, CB, CC" in SIGRID-3

Change from Version 4.0: Numeric code added
Code 91 amended
References added
Remarks amended

Deleted: New – expected input values based upon "SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004, Code Table 4.1.¶
¶

Deleted: The codes above are not fully in alignment with JCOMM SIGRID-3 codes. In order to achieve full alignment, it is recommended to update the JCOMM SIGRID-3 Table 4.1 as follows:¶
¶
<#>in order to avoid a "00" code value, change the code of "Ice Free" to "01"; "open water" to "02" and Bergy Water" to "03".¶
<#>at present, neither code set supports the Canadian use of "9+". Recommended to amend the concentration definition of code "91" to include both "9/10-10/10 and "9+/10" in both code sets.¶
<#>change the definition of code value "99" "99" from "unknown" to "unknown/undetermined".¶

Ice Attribute:	**Ice Stage of Development**

Acronym: **ICESOD**

Code: 30302

Attribute Type: List

Expected Input:

ID	Meaning
01	Ice Free
70	Brash Ice
80	No stage of development
81	New Ice (<10 cm)
82	Nilas Ice Rind (<10 cm)
83	Young Ice (10 to <30 cm)
84	Grey Ice (10 to <15 cm)
85	Grey – White Ice (15 to <30 cm)
86	First Year Ice (30 to 200 cm)
87	Thin First Year Ice (30 to <70 cm)
88	Thin First Year Ice Stage 1 (30 to <50 cm)
89	Thin First Year Ice Stage 2 (50 to <70 cm)
90	*Code not currently assigned*
91	Medium First Year Ice (70 to 120 cm)
92	*Code not currently assigned*
93	Thick First Year Ice (>120 cm)
94	*Code not currently assigned*
95	Old Ice
96	Second Year Ice
97	Multi-Year Ice
98	Glacier Ice (Icebergs)
99	Undetermined/Unknown

Definition: Ice Stage of Development describe the ages and thicknesses of the ice ('S_o,S_a,S_b,S_c and S_d').

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

"SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004

"Proposed Changes to Harmonize the WMO Sea Ice Nomenclature and Symbology, the SIGRID-3 Coding Standard and the ENC Ice Objects Catalogue"; JCOMM Expert Team on Sea Ice Meeting IV, Document 2.6.1; March 2010.

Remarks: Ice Stages of Development may be reported as a single enumerated value or as a set of values of thicknesses. The set of values is represented as an S-57 List (or repeating) attribute.

Corresponds to "S_o, S_a, S_b, S_c, S_d" in International System of Sea Ice Symbols.
Corresponds to "SO, SA, SB, SC, SD" in SIGRID-3

In conformity with the International System of Sea Ice Symbols, Stage of Development is reported in order from the thickest to the thinnest. The following categories are defined:

- S_o – Stage of Development of ice thicker than S_a but having a concentration of less than 1/10.
- S_a - Thickest/oldest; Stage of Development of ice concentration C_a.
- S_b - Second thickest/oldest; Stage of Development of ice concentration C_b.
- S_c - Third thickest/oldest; Stage of Development of ice concentration C_c.
- S_d – Stage of Development of any other remaining class.

Missing values are represented by the absence of any value of the attribute, which in ISO 8211 encoding of S57, would be adjacent commas.

Change from Version 4.0: Numeric code added
Code 70 added
References added
Remarks amended

Deleted: New – expected input values based upon "SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004, Code Table 4.2.¶
¶

Deleted: Partial concentration

Deleted: The codes above are not fully in alignment with JCOMM SIGRID-3 codes. In order to achieve full alignment, it is recommended to update the JCOMM SIGRID-3 Code Table 4.2 as follows:¶
¶
<#>in order to avoid a "00" code value, change the code of "ice free" to "01".¶
<#>In order to remove ambiguities in range values, add "<" and ">" symbols as appropriate to conform to the definitions above.¶
<#>"Brash" is not supported. Amendements Amendements to SIGRID-3 Code Proposal 2007-4 will be tabled at an upcoming ETSI meting in Geneva. If this is accepted, recommend reviewing the above codes to ensure full alignment.¶

Ice Attribute:	**Lake Ice Stage of Development**

Acronym: **ICELSO**

Code: 30303

Attribute Type: List

Expected Input:

ID	Meaning
01	New Lake Ice (<5cms)
02	Thin Lake Ice (5-<15cms)
03	Medium Lake Ice (15-<30cms)
04	Thick Lake Ice (30-70cms)
05	Very Thick Lake Ice (>70cms)
70	Brash Ice
99	Undetermined/Unknown

Definition: Lake Ice Stages of Development describe the ages and thicknesses of lake ice. ('S_o,S_a,S_b,S_c and S_d')

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada

"Canadian Ice Service MANICE", 9th edition, June, 2005

"SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004

"Proposed Changes to Harmonize the WMO Sea Ice Nomenclature and Symbology, the SIGRID-3 Coding Standard and the ENC Ice Objects Catalogue"; JCOMM Expert Team on Sea Ice Meeting IV, Document 2.6.1; March 2010.

Remarks: Lake Ice Stages of Development may be reported as a single enumerated value or as a set of values of thicknesses. The set of values is represented as an S-57 List (or repeating) attribute.

Corresponds to "S_o, S_a, S_b, S_c, S_d" in International System of Sea Ice Symbols. Corresponds to "SO, SA, SB, SC, SD" in SIGRID-3

Stage of Development is reported in order from the thickest to the thinnest. The following categories are defined:

Deleted: Partial concentration

S_o – Stage of Development of ice thicker than S_a but having a concentration of less than 1/10.
S_a - Thickest/oldest; Stage of Development of ice concentration C_a.
S_b - Second thickest/oldest; Stage of Development of ice concentration C_b.
S_c - Third thickest/oldest; Stage of Development of ice concentration C_c.
S_d – Stage of Development of any other remaining class.

Missing values are represented by the absence of any value of the attribute that in ISO 8211 encoding of S57 would be adjacent commas.

Change from Version 4.0: Numeric code added
Code 70 added
References added
Remarks amended

Deleted: "Brash" is not supported. Amendements to SIGRID-3 Code Proposal 2007-4 will be tabled at an upcoming ETSI meting in Geneva. If this is accepted, recommend reviewing the above codes to ensure full alignment.¶
.

Ice Attribute:	**Floe Sizes**

Acronym: **ICEFLZ**

Code: 30304

Attribute Type: List

Expected Input:

ID	Meaning
01	Pancake Ice (30 cm to 3m across)
02	Shuga/Small Ice Cake; Brash Ice (<2m across)
03	Ice Cake (<20m across)
04	Small Floe (20 to <100m across)
05	Medium Floe (100 to 500m)
06	Big Floe (500 to <2000m across)
07	Vast Floe (2000 to10000m across)
08	Giant Floe (>10000m across)
09	Fast Ice
10	Growlers, Floebergs or Floebits
11	Icebergs
99	Undetermined/Unknown

Definition: Floe Sizes describe the predominate forms of ice floe sizes (F_a, F_b and F_c) corresponding to the ice Stages of Development S_a, S_b and S_c respectively.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States." Ice in ECDIS Workshop," June 3,4, 2000, St. John's, Canada.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

"SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004

Remarks: The "Floe Sizes" Attribute indicates the floe size corresponding to the respective stage identified in the Stages of Development Attribute and reported as a single enumerated value or as a set of values represented as an S-57 List (or repeating) attribute.

Corresponds to "F_a, F_b, F_c" in International System of Sea Ice Symbols.
Corresponds to "FA, FB, FC" in SIGRID-3

Deleted: Optionally, predominant (Fp) and secondary (Fs) floe size can be reported independently from Sa, Sb, and Sc.¶

Deleted: New – expected input values based upon "SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004, Code Table 4.3.¶
¶

Missing values are represented by the absence of any value of the attribute that in ISO 8211 encoding of S57 would be adjacent commas.

Change from Version 4.0: Numeric code added
Optional use of F_p and F_s removed
References added
Remarks amended

Deleted: The optional use predominant (Fp) and secondary (Fs) floe size, independent from Sa, Sb, and Sc, creates coding and interpretation confusion for the user. In this context, it is recommended to review and possibly update the definitions for “Form of Ice” presently contained in: “WMO International System of Sea Ice Symbols”, Suppl. No. 4, 1970¶
¶
The codes above are not fully in alignment with JCOMM SIGRID-3 codes. In order to achieve full alignment, it is recommended to to update the JCOMM SIGRID-3 Code Table 4.3 as follows:¶
¶
<#>in order to avoid a “00” code value, change the code of “Pancake ice” to “01”, and sequence up all the codes by 1 numeral, numeral, up to and including “Icebergs”¶
<#>In order to remove ambiguities in range values, add “<” and “>” symbols as appropriate to conform to the definitions above.¶
¶

Ice Attribute:	**Melt Stage**

Acronym: **ICEMLT**

Attribute Type: Enumerated

Code: 30305

Expected Input:

ID	Meaning
01	Few Puddles
02	Many Puddles
03	Flooded Ice
04	Few Thaw Holes
05	Many Thaw Holes
06	Dried Ice
07	Rotten Ice
08	Few Frozen Puddles
09	All Puddles Frozen
10	No Melt
99	Undetermined/Unknown

Definitions: The Stage of Melt describes the stages of the melting ice.

Puddle:	An accumulation of water on ice, mainly due to the melting of snow, but in some more advanced stages also the melting of ice.
Thaw Hole:	Vertical holes formed in ice when surface puddles melt through to the underlying water.
Dried Ice:	Ice-surface from which water has disappeared after the formation of cracks and thaw holes. During the process of drying the surface whitens.
Rotten Ice:	Ice which has become honey-combed and is in an advanced state of disintegration.
Flooded Ice:	Ice which has been flooded and is heavily loaded by water or water and wet snow.
Frozen Puddle:	A puddle which has frozen over.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

"SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New – expected input values based upon "SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004 code table 4.11.¶
¶
The codes above are not fully in alignment with JCOMM SIGRID-3 codes. In order to achieve full alignment, it is recommended to to update the JCOMM SIGRID-3 codes, Table 4.11 as follows:¶
¶
in order to avoid a "00" code value, change the code of "ice free" to "01".¶
An additional code for code "02": "many puddles" should be added.¶

Ice Attribute:	**Concentration of Strips and Patches**

Acronym: **ICESPC**

Attribute Type: Enumerated

Code: 30306

Expected Input:

ID	Meaning
11	Strips and Patches (concentrations 1/10)
12	Strips and Patches (concentrations 2/10)
13	Strips and Patches (concentrations 3/10)
14	Strips and Patches (concentrations 4/10)
15	Strips and Patches (concentrations 5/10)
16	Strips and Patches (concentrations 6/10)
17	Strips and Patches (concentrations 7/10)
18	Strips and Patches (concentrations 8/10)
19	Strips and Patches (concentrations 9/10)
20	Strips and Patches (concentrations 10/10)
99	Undetermined/Unknown

Definition: A strip is a long narrow area of floating ice, about 1 kilometre or less in width, usually composed of small fragments detached from the main mass of ice, and run together under the influence of wind, swell or current. If the area of ice becomes more rounded in shape, it is referred to as a patch. ICESPC indicates the concentration in tenths within the area of Strips and Patches.

References: "SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks: The concentration of Strips and Patches are provided exclusive of Floe Size values. When a Strips and Patches value is supplied, Floe Size values are null.

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New – expected input values based upon "SIGRID-3: A Vector Archive Format for Sea Ice Charts", JCOMM Technical Report No. 23, 2004, Code Table 4.3.¶
¶

Deleted: At present, neither the above code set nor the JCOMM SIGRID-3 Code Table 4.3 supports the Canadian use of "9+". Recommended to add code "91" to SIGRID-3 Code Table 4.3. The form would be "Strips and Patches". The Size/Concentration would be "9+/10".¶
¶

Ice Attribute:	**Number of Icebergs in Area**

Acronym: **ICEBNM**

Attribute Type: Integer

Code: 30307

Expected Input: The number of icebergs in an area expressed by a density measurement on the basis of a grid.

Definitions: ICEBNM indicates the number of Icebergs within a specified area.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"Canadian Ice Service MANICE", 9th edition, June, 2005.

Remarks: The area is defined by the dimensions of one degree latitude by one degree longitude and the attribute will be limited to 80 degrees North or South due to distortion at the poles.

Although measurements are not taken, areas that contain icebergs also usually contain bergy bits, and growlers.

Change from Version 4.0: Numeric code added

Ice Attribute:	**Level Ice**

Acronym: **ICELVL**

Code: 30308

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	Level (undeformed)
02	Deformed
99	Undetermined/Unknown

Definition: ICELVL is an indication as to whether or not the ice has been affected by deformation

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks: Use of this Attribute is a regional practice in the Baltic Sea.

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New - the use of t

Deleted: for use

Deleted: , and is supported by WMO Symbology

Ice Attribute:	**Compacting Strength**

Acronym: **ICECST**

Attribute Type: Enumerated

Code: 30309

Expected Input:

ID	Meaning
01	Slight Compacting
02	Considerable Compacting
03	Strong Compacting
99	Undetermined/Unknown

Definition: ICECST is an indication of strength of the compacting of the ice.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New – supported by WMO Symbology¶

Ice Attribute:	**Ice Fracture Type**

Acronym: **ICEFTY**

Attribute Type: Enumerated

Code: 30310

Expected Input:

ID	Meaning
01	Crack (0 to 1m wide)
02	Very Small Fracture (>1m to 50m wide)
03	Small Fracture (>50m to 200m wide)
04	Medium Fracture (>200m to 500m wide)
05	Large Fracture (>500m wide)

Definition: ICEFTY indicates the type of fracture, based upon width.

References: ”WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: Type of Fracture is based upon width.

Ice Attribute:	**Ice Lead Status**

Acronym: **ICELST**

Code: 30311

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	Open Lead
02	Frozen Lead
99	Undetermined/Unknown

Definition: The Ice Lead Status indicates the surface nature of the lead.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended

Ice Attribute:	**Frequency of Leads or Fractures**

Acronym: **ICELFQ**

Code: 30312

Attribute Type: Integer

Expected Input: The number of leads or fractures per nautical mile

Definition: ICERFQ indicates the frequency of leads or fractures in number per nautical mile.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New - Added to support possible possible new Lead/Fracture map products.

Ice Attribute:	**Orientation of Leads or Fractures**

Acronym: **ICELOR**

Code: 30313

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	No Leads or Fractures
02	NE
03	E
04	SE
05	S
06	SW
07	W
08	NW
09	N
10	Variable
99	Undetermined/Unknown

Definition: ICELOR indicates the predominant orientation of leads and fractures.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New - Added to support possible possible new Lead/Fracture map products.

Ice Attribute:	**Ice Lead or Fracture Width**

Acronym: **ICELWD**

Code: 30314

Attribute Type: Floating

Expected Input: Numeric value of the width expressed in metres

Definition: ICELWD indicates the width of a lead or fracture in metres.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New – supported by WMO Symbology.

Ice Attribute:	**Ice Location Information**

Acronym: **ICELOC**

Code: 30315

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	Specific Location
02	Presence In Area

Definitions: ICELOC indicates whether the break is at a specific location, or whether there is a presence in the area.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New – supported by WMO Symbology.

Ice Attribute:	**Iceberg Size**

Acronym: **ICEBSZ**

Code: 30316

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	Growler (<1m asl)
02	Bergy Bit (1-<5m asl; 5-<15m length)
03	Small Iceberg (5-15m asl; 15-60m length)
04	Medium Iceberg (16-45m asl; 61-120m length)
05	Large Iceberg (46-75m asl; 121-200m length)
06	Very Large Iceberg (>75m asl; >200m length)
07	Ice Island Fragment
08	Ice Island (in the Northern Hemisphere) or Very Large Tabular Berg (in the Southern Ocean)
09	Radar Target
99	Undetermined/Unknown

Definitions: The "Iceberg Size" categorizes the size of an iceberg.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: Expected inputs based upon Iceberg Coding Tables 4.2 from "MANICE – Manual of Standards Procedures for Observing and Reporting Ice Conditions", 8th Edition, 1984, Canadian Ice Service (CIS), Ottawa, Canada. At present, there are are minor discrepancies between the International Ice Patrol (IIP) and the CIS published height and length definitions for several iceberg categories. This is presently being addressed by the two organizations, and any subsequent changes to the CIS definitions should be reflected in the ICEBSZ code table.¶
¶
Presently, this attribute does not adequately support very large tabular Antarctic icebergs. Any future changes to WMO symbology and/or code tables in this regard should be reflected in subsequent changes to to this ice attribute in order to ensure compatibility.

Ice Attribute:	**Ice Drift Direction**

Acronym: **ICEDDR**

Attribute Type: Enumerated

Code: 30317

Expected Input:

ID	Meaning
01	No Ice Motion
02	Ice Drift to NE
03	Ice Drift to E
04	Ice Drift to SE
05	Ice Drift to S
06	Ice Drift to SW
07	Ice Drift to W
08	Ice Drift to NW
09	Ice Drift to N
10	Variable
99	Undetermined/Unknown

Definition: ICEDDR indicates the direction in which an ice mass is drifting.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New - minor change to name and Acronym to make attribute more generic.

Ice Attribute:	**Ice Drift Speed**

Acronym: **ICEDSP**

Attribute Type: Floating

Code: 30318

Expected Input: A numeric value of the speed of an ice mass expressed in knots.

Definitions: ICEDSP describes the speed in knots at which an ice mass is traveling.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
Units of speed added to definition
References amended
Remarks amended

Deleted: New - minor change to name/Acronym to make attribute more generic.¶
¶
Note: Speed is determined in knots.

Ice Attribute:	**Ice Average Thickness**

Acronym: **ICETCK**

Attribute Type: Floating

Code: 30319

Expected Input: A numeric value indicating the average thickness of the ice in centimeters.

Definitions: Ice Average Thickness defines the average thickness of the ice.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks: The accuracy of this Attribute value is approximately 10% (i.e. within 5 cm for the first 30 cm of thickness and within 10 cm for measurements up to 1.5 m).

Deleted: Revised – minor change to name name and definition based upon WMO Symbology.¶
¶

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Ice Attribute:	**Maximum Ice Thickness**

Acronym: **ICEMAX**

Code: 30320

Attribute Type: Floating

Expected Input: A numeric value indicating the maximum thickness of the ice in centimeters.

Definition: ICEMAX specifies the maximum thickness of the ice.

References: “Ice in ECDIS Workshop,” June 3-4, 2000, St. John’s, Canada

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks: The accuracy of this Attribute value is approximately 10% (i.e. within 5 cm for the first 30 cm of thickness and within 10 cm for measurements up to 1.5 m).

Change from Version 4.0: Numeric code added
References amended

Ice Attribute:	**Minimum Ice Thickness**

Acronym: **ICEMIN**

Code: 30321

Attribute Type: Floating

Expected Input: A numeric value indicating the minimum thickness of the ice in centimeters.

Definition: ICEMIN specifies the minimum thickness of the ice.

References: “Ice in ECDIS Workshop,” June 3,4, 2000, St. John’s, Canada

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks: The accuracy of this Attribute value is approximately 10% (i.e. within 5 cm for the first 30 cm of thickness and within 10 cm for measurements up to 1.5 m).

Change from Version 4.0: Numeric code added
References amended

Ice Attribute:	**Ice Thickness Type**

Acronym: **ICETTY**

Code: 30322

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	Measured
02	Estimated
99	Undetermined/Unknown

Definition: ICETTY indicated whether the thickness of the ice was measured or estimated.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New – supported by WMO Symbology.

Ice Attribute:	**Snow Depth**

Acronym: **ICESCT**

Code: 30323

Attribute Type: Floating

Expected Input: A numeric value indicating the depth of the snow cover in centimeters.

Definitions: ICESCT specifies the depth of snow cover on the ice.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks: A range of values can be used if the Snow Cover varies, or the precise value is uncertain.

Deleted: Revised – minor change in name name based upon WMO Symbology.¶
¶

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Ice Attribute:	**Snow Cover Concentration**

Acronym: **ICESCN**

Code: 30324

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	1/10
02	2/10
03	3/10
04	4/10
05	5/10
06	6/10
07	7/10
08	8/10
09	9/10
10	10/10
11	<1/10
12	No Snow Cover
99	Undetermined/Unknown

Definitions: ICESCN indicates the concentration (aerial coverage) of snow in tenths.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New – supported by WMO Symbology.

Ice Attribute:	**Direction of Sastrugi**

Acronym: **ICEDOS**

Code: 30325

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	No Sastrugi
02	NE
03	E
04	SE
05	S
06	SW
07	W
08	NW
09	N
10	Variable
99	Undetermined/Unknown

Definitions: ICEDOS indicates the bearing of a sastrugi.

Sastrugi: Sharp, irregular ridges formed on a snow surface by wind erosion and deposition. On mobile floating ice the ridges are parallel to the direction of the wind at the time they were formed.

References: “Ice in ECDIS Workshop,” June 3-4, 2000, St. John’s, Canada

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended

Ice Attribute:	**Ice Ridge Concentration**

Acronym: **ICERCN**

Code: 30326

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	1/10
02	2/10
03	3/10
04	4/10
05	5/10
06	6/10
07	7/10
08	8/10
09	9/10
10	10/10
11	<1/10
12	No Ridging
99	Undetermined/Unknown

Definitions: ICERCN describes the concentration of ice ridges in an ice area.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended

Ice Attribute:	**Ice Ridge Classification**

Acronym: **ICERDV**

Code: 30327

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	New Ridge
02	Weathered Ridge
03	Very Weathered Ridge
04	Aged Ridge
05	Consolidated Ridge
99	Undetermined/Unknown

Definitions: ICERDV describes the predominant type of ice ridge(s) present.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: Revised – minor name change based upon WMO Symbology.

Ice Attribute:	**Ice Ridge Mean Height**

Acronym: **ICERMH**

Code: 30328

Attribute Type: Floating

Expected Input: A numeric value indicating the mean height of the ridge(s).

Definitions: ICERMH indicates the mean height of ice ridge(s) in decimetres.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

"WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
Units of measure added to definition
References amended
Remarks amended

Deleted: Revised – minor name and definition change based upon WMO Symbology.¶
¶
The standard unit for Ice Ridge Mean Height is decimeters.

Ice Attribute:	**Ice Ridge Frequency**

Acronym: **ICERFQ**

Code: 30329

Attribute Type: Integer

Expected Input: The number of ice ridges per nautical mile

Definitions: ICERFQ indicates the frequency of ice ridges in number per nautical mile

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: Attribute originally suggested for for Ridge Frequency by Germany, June, 2000.

Ice Attribute:	**Ice Ridge Maximum Height**

Acronym: **ICERXH**

Code: 30330

Attribute Type: Floating

Expected Input: A numeric value indicating the maximum height of the ice ridge(s).

Definitions: ICERMT indicates the maximum height of ice ridge(s) in decimetres.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
Units of measure added to definition
References amended
Remarks amended

Deleted: New – supported by WMO Symbology.¶
¶
The standard unit for Ice Ridge Maximum Height is decimeters.

Ice Attribute:	**Ice Keel Concentration**

Acronym: **ICEKCN**

Code: 30331

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	1/10
02	2/10
03	3/10
04	4/10
05	5/10
06	6/10
07	7/10
08	8/10
09	9/10
10	10/10
11	<1/10
12	No Keels
99	Undetermined/Unknown

Definitions: ICEKCN describes the concentration of ice keels beneath an ice area.

References: ”WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols”, WMO Publication No. 259, Suppl. No. 5, 1989.

Remarks:

Change from Version 4.0: Numeric code added
References added
Remarks amended

Deleted: New - Attribute is a copied equivalent to that used for ice ridge concentration, and supported by “WMO Sea-Ice Nomenclature”, Suppl. No. 5, 1989. 1989.

Ice Attribute:	**Ice Keel Frequency**

Acronym: **ICEKFQ**

Code: 30332

Attribute Type: Integer

Expected Input: The number of ice keels per nautical mile

Definitions: ICERFQ indicates the frequency of ice keels in number per nautical mile

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References added
Remarks amended

Deleted: New - Attribute is a copied equivalent to that used for ice ridge frequency, and supported by "WMO Sea-Ice Ice Nomenclature", Suppl. No. 5, 1989.

Ice Attribute:	**Ice Keel Mean Depth**

Acronym: **ICEKMD**

Code: 30333

Attribute Type: Floating

Expected Input: A numeric value indicating the mean depth of the ice keels.

Definitions: ICERMT indicates the mean depth of ice keels in decimetres.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
Units of measure added to definition
References added
Remarks amended

Deleted: New - Attribute is a copied equivalent to that used for ice ridge mean height, and supported by "WMO Sea-Ice Nomenclature", Suppl. No. 5, 1989.¶

Deleted: The standard unit for Ice Keel Mean Depth is decimeters.¶

Ice Attribute:	**Ice Keel Maximum Depth**

Acronym: **ICEKXD**

Code: 30334

Attribute Type: Floating

Expected Input: A numeric value indicating the maximum depth of the ice keels.

Definitions: ICERMT indicates the maximum depth of ice keels in decimetres.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
Units of measure added to definition
References added
Remarks amended

Deleted: New - Attribute is a copied equivalent to that used for ice ridge maximum height, and supported by "WMO Sea-Ice Nomenclature", Suppl. No. 5, 1989.¶ 1989.¶
¶
The standard unit for Ice Ridge Maximum Height is decimeters. ¶

Ice Attribute:	**Ice Rafting Concentration**

Acronym: **ICEFCN**

Code: 30335

Attribute Type: Enumerated

Expected Input:

ID	Meaning
01	1/10
02	2/10
03	3/10
04	4/10
05	5/10
06	6/10
07	7/10
08	8/10
09	9/10
10	10/10
11	<1/10
12	No Rafting
99	Undetermined/Unknown

Definitions: ICEFCN describes the concentration of ice rafting in an ice area.

References: "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

Remarks:

Change from Version 4.0: Numeric code added
References amended
Remarks amended

Deleted: New – supported by WMO Symbology.

Ice Attribute:	**Brash Ice**

Acronym:	**ICEBRS**
Code:	30336
Attribute Type:	List
Expected Input:	List of 4 IDs from below representing, in order from first to last, the concentrations of Very Thick Brash, Thick Brash, Medium Brash and Thin Brash Ice.

ID	Meaning
01	0/10 ice
02	< 1/10 ice
10	1/10 ice
12	1/10 to 2/10 ice
13	1/10 to 3/10 ice
20	2/10 ice
23	2/10 to 3/10 ice
24	2/10 to 4/10 ice
30	3/10 ice
34	3/10 to 4/10 ice
35	3/10 to 5/10 ice
40	4/10 ice
45	4/10 to 5/10 ice
46	4/10 to 6/10 ice
50	5/10 ice
56	5/10 to 6/10 ice
57	5/10 to 7/10 ice
60	6/10 ice
67	6/10 to 7/10 ice
68	6/10 to 8/10 ice
70	7/10 ice
78	7/10 to 8/10 ice
79	7/10 to 9/10 ice
80	8/10 ice
81	8/10 to 10/10 ice
89	8/10 to 9/10 ice
90	9/10 ice
91	9/10 to 10/10 or 9+/10 ice
92	10/10 ice
99	Undetermined/Unknown

Definition: ICEBRS specifies the concentrations of very thick brash (“AV”), thick brash (“AK”), medium brash (“AM”) and thin brash ice (“AT”).

Very Thick Brash Ice	>4 m
Thick Brash Ice	>2 - 4 m
Medium Brash Ice	1 – 2 m
Thin Brash Ice	<1 m

Example: ICEBRS: [30, 20, 50, 01]
represents 3/10 of Very Thick Brash, 2/10 of Thick Brash, 4/10 of Medium Brash and no Thin Brash in an area.

References: "Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States.

“SIGRID-3: A Vector Archive Format for Sea Ice Charts”, JCOMM Technical Report No. 23, 2004

“Proposed Changes to Harmonize the WMO Sea Ice Nomenclature and Symbology, the SIGRID-3 Coding Standard and the ENC Ice Objects Catalogue”; JCOMM Expert Team on Sea Ice Meeting IV, Document 2.6.1; March 2010.

Remarks: Ice Attribute ICEBRS is only used when Code 70 is reported in Ice Attribute ICESOD or ICELSO

Change from Version 4.0: This is a new attribute.

5. REFERENCES

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2. Report: “Workshop on the Use of ECDIS in Ice Navigation,” May 1996, Hamburg, Germany.
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5. “MANICE – Manual of Standards Procedures for Observing and Reporting Ice Conditions”, 8th Edition, 1984, Canadian Ice Centre, Ottawa, Canada.
6. “IHO Transfer Standard for Digital Hydrographic Data”, Special Publication No. 57, International Hydrographic Organization, Monaco, Edition 3.1 – November 2000.
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Appendix A

Attribute Types

For more detailed information see S57 IHO Transfer Standard for Hydrographic Data, Appendix A, Chapter 2,– Introduction: Section 2.1, International Hydrographic Organization, Monaco, 18 November 1996.

Each Attribute is assigned to one of six types:

1. Enumerated (‘E’): The expected input is a number selected from a list of pre-defined attribute values. Exactly one value must be chosen.
2. List (‘L’): The expected input is a number selected from a list of pre-defined attribute values. Where more than one value is used they must normally be separated but in special cases slashes (‘/’) may be used.
3. Floating (‘F’): The expected input is a floating-point numeric value with defined range, resolution, units, and format.
4. Integer (‘I’): The expected input is an integer numeric value with defined range, units, and format.
5. Coded string (‘A’): The expected input is a string of ASCII characters in a predefined format. (refer to S57 Appendix A, Annex A).
6. Free Text (‘S’): The expected input is a free-format alphanumeric string. It may be a file name that points to a text or graphic file.

Depending on the attribute type, the expected input is defined in the following ways:

For ‘E’ and “L’ type attributes a list of ID-numbers with associated, defined meanings is given.
For ‘A’, ‘F’, ‘I’ and ‘S’ type attributes the expected input is indicated in accordance with the type (see above).
In certain circumstances, it may be necessary to indicate to the recipient of a data set that the value of a certain attribute for an instance of an object class is not included. A zero length attribute value sub-field encodes this fact.

Appendix B

List of Non-ice S57 Attributes Referred to by Ice Objects

For more detailed information see S57 IHO Transfer Standard for Hydrographic Data, Appendix A, Chapter 2,– Attributes: Section 2.2, International Hydrographic Organization, Monaco, 18 November 1996.

Attribute Set A:

1. NOBJNM: The individual name of an object in the national language
2. OBJNAM: The individual name of an object in English

Attribute Set B:

3. INFORM: Information – Textual information about an object
4. NINFORM: Information – Textual information about an object in the national language
5. SCAMIN: Scale Minimum - The minimum scale at which the object may be used; e.g. for ECDIS presentation.
6. SCAMAX: Scale Maximum - The Maximum scale at which the object may be used; e.g. for ECDIS presentation.
7. TXTDSC: Textual Description - A string encoding the file name of an external text file that contains the text in English.
8. NTXTDS: Textual Description - A string encoding the file name of an external text file that contains the text in the national language.
9. PICREP: Pictorial Representation - A string encoding the file name of an external graphic file (pixel or vector).

Attribute Set C:

10. RECDAT: Recording Date - The date when the object was captured, edited or deleted.
11. RECIND: Recording Indication – The procedure used for the encoding and entering of data.
12. SORDAT: Source Date – The production data of the source, i.e. the date of measurement.
13. SORIND: Source Indication – Information about the source of the object.