

**IHO Colours & Symbols Maintenance Working Group (C&SMWG)
15th Meeting, BSH, Rostock, Germany, 2-4 May 2005**

The Next Edition of IHO S-57 (4.0)
Version 1.1, March 2005

Introduction

The International Hydrographic Organization (IHO) is an intergovernmental consultative and technical organization which was established in 1921 to support the safety of navigation and to contribute to the protection of the marine environment. IHO Special Publication 57 (IHO S-57) is the IHO Transfer Standard for Digital Hydrographic Data. It is the standard to be used for the exchange of digital hydrographic data between hydrographic offices (HOs), and for the distribution of hydrographic data to manufacturers, mariners and other data users (e.g. environmental management organizations). It was developed so that the transfer of all forms of hydrographic data would take place in a consistent and uniform manner. To date, S-57 3.0/3.1 has been used almost exclusively for encoding Electronic Navigational Charts (ENCs) required for ECDIS. However, S-57 is intended to support all types of hydrographic data. In order to do so, S-57 needs to be expanded in order to accommodate new requirements, customers, and technology.

Version 1.0 of this information paper was originally prepared in November 2004 by the TSMAD (Transfer Standard Maintenance and Applications Development) S-57 Edition 4 Sub-Working Group [a subsidiary group of the IHO CHRIS (Committee on Hydrographic Requirements for Information Systems)]. In December 2004, it was posted on the IHO Website (www.iho.shom.fr), and also forwarded to IHO Member States as IHO Circular Letter 83/2004 (7 Dec 04).

Background

S-57 was formally adopted as the official IHO hydrographic data transfer standard at the XIVth International Hydrographic Conference in May 1992. It includes:

- A general introduction with list of references and definitions
- A theoretical data model on which the standard is based
- The data structure or format that is used to implement the data model
- General rules for encoding data into the ISO 8211 encapsulation.

In addition to the main document, there are two appendices:

Appendix A is the Object Catalogue. It provides the official, IHO-approved data schema that can be used within an exchange set to describe real-world entities.

Appendix B contains the IHO-approved Product Specifications. These contain additional sets of rules for specific applications. Currently, the only product specification in S-57 is for an ENC.

S57 Edition 3.0 was released in November 1996. Edition 3.1 containing minor revisions/additional attribute values was issued in November 2000. There have been no changes made since that time. Currently, S-57 3.1 is “frozen”. It will remain valid – in perpetuity -- until no longer required. The present intention is to release Edition 4.0 in late 2006.

Current Limitations of S-57 Edition 3.1

S-57 Ed. 4.0 will not be an incremental revision of Edition 3.1. It will be a new standard that includes both additional content and a new data exchange format. Although S-57 Edition 3.1 has many good aspects, it does have certain limitations:

- It was primarily developed to meet the ENC requirement called for in an IMO-compliant ECDIS.
- It has an inflexible maintenance regime. Freezing standards for lengthy periods is counter-productive.
- As presently structured, it cannot support future requirements (e.g., gridded bathymetry).
- Embedding the data model within the encapsulation restricts the flexibility and capability of using a wider range of transfer mechanisms.
- It is regarded by some as a limited standard focused exclusively on the production and exchange of ENC data.

Goal/Objectives

The primary goal for the next edition of S-57 is to be able to support a greater variety of hydrographic-related digital data sources, products, and customers (see Figure 1).

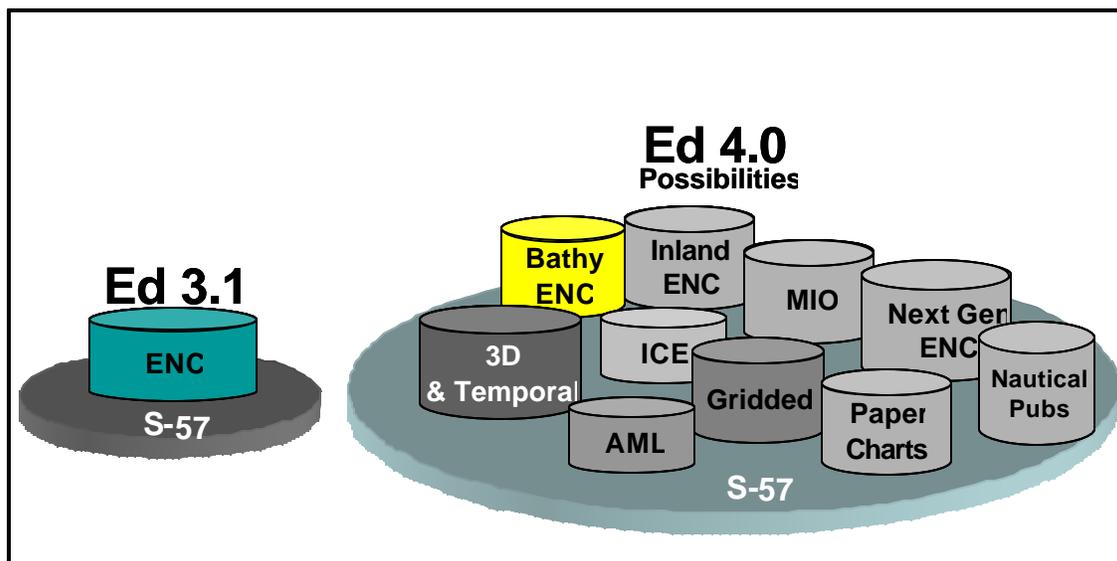


Figure 1 – S-57 Edition 4 will support a greater variety of data sources, products and services

This includes matrix and raster data, 3-D and time-varying data (x, y, z, and time), and new applications that go beyond the scope of traditional hydrography (e.g. high-density

bathymetry, seafloor classification, marine GIS). It will also enable the use of web-based services for data discovery, browsing, query, analysis, and transfer.

Other objectives include:

- Separate the content from the carrier. In this way, data can be manipulated and encoded without being permanently tied to a single exchange mechanism.
- Manageable flexibility that can accommodate change. Future product specifications will be based on a core data model that may be extended to meet the needs of different hydrographic information communities. This will allow the core standard to evolve (e.g., through extension) without the need for new versions of product specifications.
- An ISO-conforming registry on the IHO web site containing feature data dictionaries and product feature catalogues that are more flexible and capable of being expanded.
- Separate registers for other user communities. This includes new S-57 features/attributes and additional product specifications that may be created (e.g., Inland ENC Product Specification).

ISO Geospatial Standards

The International Standards Organization (ISO) is a non-governmental international standards organization comprising a worldwide federation of national standards bodies from over 130 countries. In response to a growing demand for geo-spatial information standards, ISO established Technical Committee 211 (ISO/TC211) in 1994. The aim of ISO/TC211 is to establish a structured set of standards for information concerning geographic objects or phenomena. IHO, together with many other geographic standards development organizations, is a Class A Liaison Organization to ISO/TC211. Currently, there are over 22 Class A members, including:

- Digital Geographic Information Working Group (DGIWG)
- Global Spatial Data Infrastructure (GSDI)
- Open Geospatial Consortium (OGC)
- United Nations Geographic Information Working Group (UNGIWG)

A more complete listing is contained in Appendix A.

ISO 19100 Standards

The standards developed by ISO/TC211 are contained in the ISO 19100 series of geographic standards. For all forms of geographic data, these standards specify the methods, tools, and services for:

- Data management (including definition and description)
- Acquiring, processing, analyzing, accessing, and presenting data
- Transferring data in digital electronic form between different users, systems and locations.

In the most general sense, they fall into one of the following categories:

Framework and Reference Model
Profiles and Functional Standards
Data Models and Operators

Data Administration
Geographic Information Services

Currently, there are over 40 standards in the ISO 19100 series. These include both formally adopted and draft International Standards for spatial and temporal schema, metadata, imagery and gridded data, profiles, portrayal, encoding, etc. A current listing of all ISO 19100 series standards is provided in Appendix B.

Alignment with ISO/TC211

Given the prominence of ISO standards and their worldwide recognition and use, it makes sense for IHO to follow the “ISO/TC211 way” of standards development for the next edition of S-57.

In 1999, ISO/TC211 invited the IHO and the NATO Digital Geographic Information Working Group (DGIWG) to enter into a cooperative agreement for future standards development. Rather than work at cross-purposes, it was considered prudent to harmonize the data content contained in IHO S57 (e.g., the Object Catalogue) with that of NATO DIGEST (e.g., DGIWG Feature Data Dictionary – formerly called FACC). Further, the intent was to develop hydrographic standards that were compatible with a broad range of other ISO Geospatial standards. This was agreed to by IHO at the 12th CHRIS meeting in October 2000. Currently members of both organizations attend each other’s meetings and have played important roles in the harmonization process.

New Framework

Alignment with the ISO 19100 series of geographic standards will require a new way of organizing and defining S-57 Edition 4. More specifically, it will require a new framework or structure, and a new (or revised) set of terms used to describe the components of S-57 Edition 4.0.

Registry and Registers

Perhaps the most significant aspect in terms of alignment with the ISO TC/211 standards is the employment of a “registry” containing one or more “registers” (see Figure 2).

A “registry” is the entire information system (or location) in which a collection of registers is located. In the case of the future S-57 Edition 4.0, IHO will host a registry that will provide a facility to store various registers of hydrographic-related information. This will include feature data dictionaries, metadata and code lists (e.g. sounding datums). There will be registers for Hydrographic Information, Dynamic Ice Coverage, Additional Military Layers (AMLs), and Inland ENCs. Other types of information that do not fit into these categories can be included in the Open ECDIS Forum (OEF) register. For each register there is an organization that will be responsible for its content and management.

A major benefit of the registry concept is its flexibility. Multiple versions of similar entries in a data dictionary can be maintained using unique identification and classification. For instance, an entry can be classified as being either:

- valid (latest version)

- superseded (previous version/s)
- retired (no longer recommended for use)
- not valid (proposed but not accepted, or no longer acceptable).

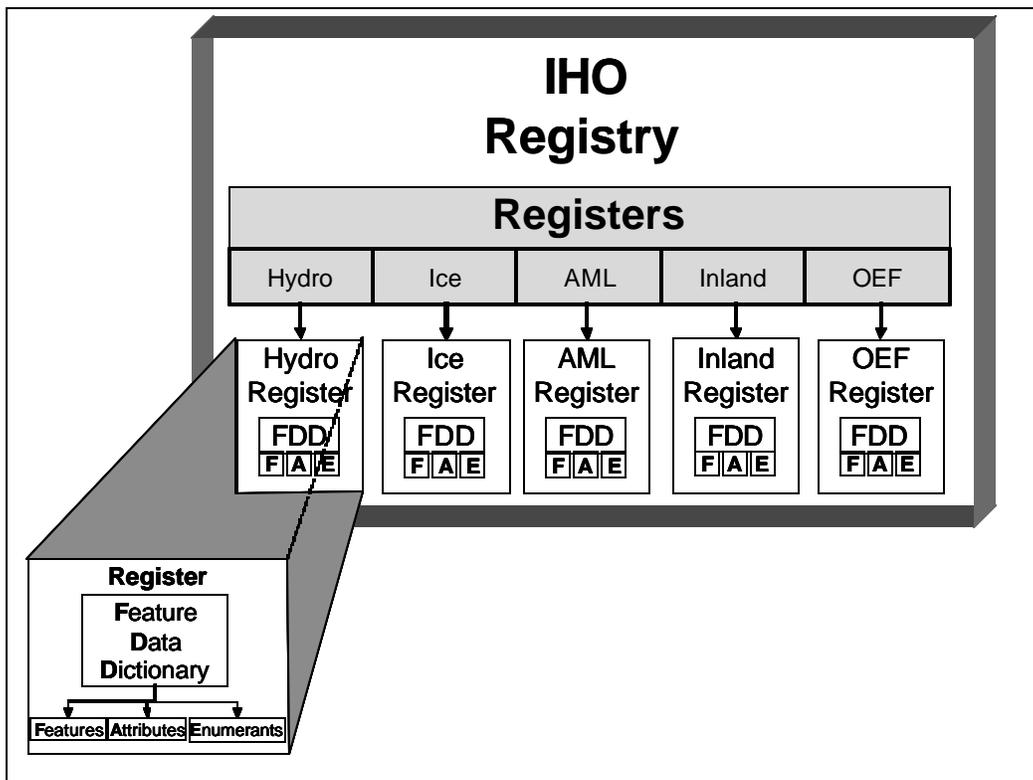


Figure 2

In this way product feature catalogues can reference an item that will remain valid even if a newer version is registered at a later date. In this way, if a new item is registered, a new version of a current product specification is not required. Not valid items will remain public in order to ensure that any future proposals for similar items have not been previously rejected. A prototype registry will be available for comment at the IHO website in December 2004. An operational registry is planned for 2005.

Application Schema Template

An application schema template (see Figure 3) specifies the rules for how:

- features, attributes and associations are used to specify a data model
- the various components are 'glued' together (i.e. a feature and its spatial component)
- to use registers as part of an overall registry

These rules can then be applied to develop a product specific application schema that in turn forms the basis of the product specification.

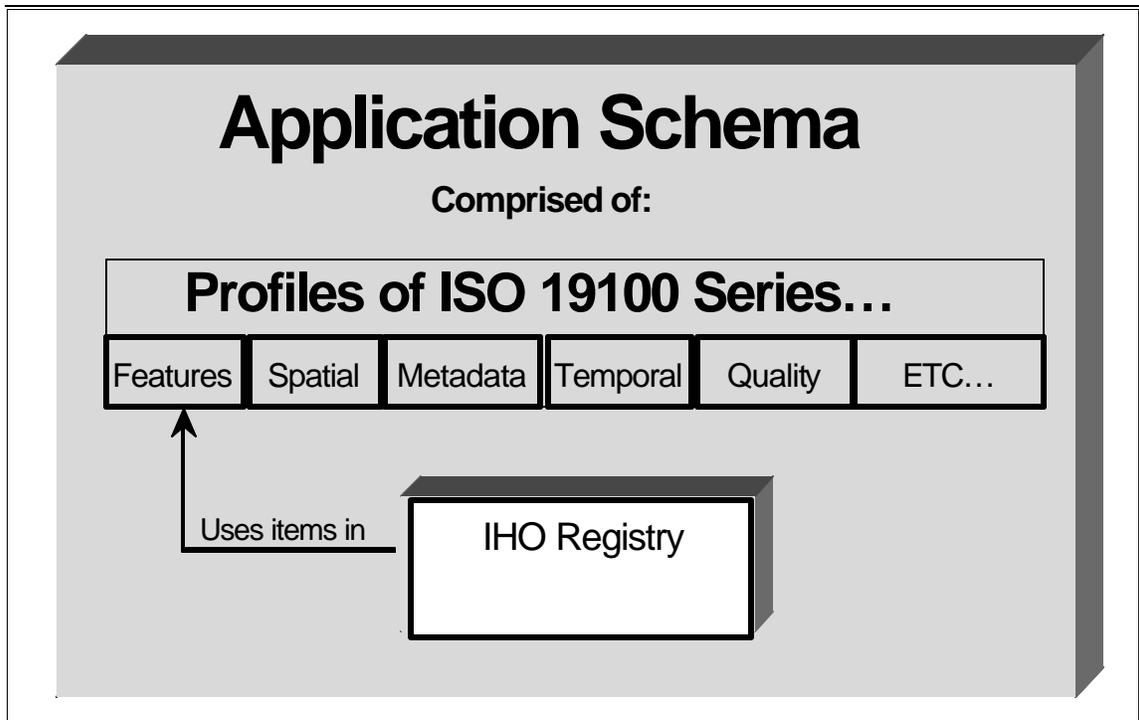


Figure 3

Individual product specifications consist of a feature catalogue, an application schema, an encoding (e.g., Geographic Markup Language – GML), etc. (see Figure 4).

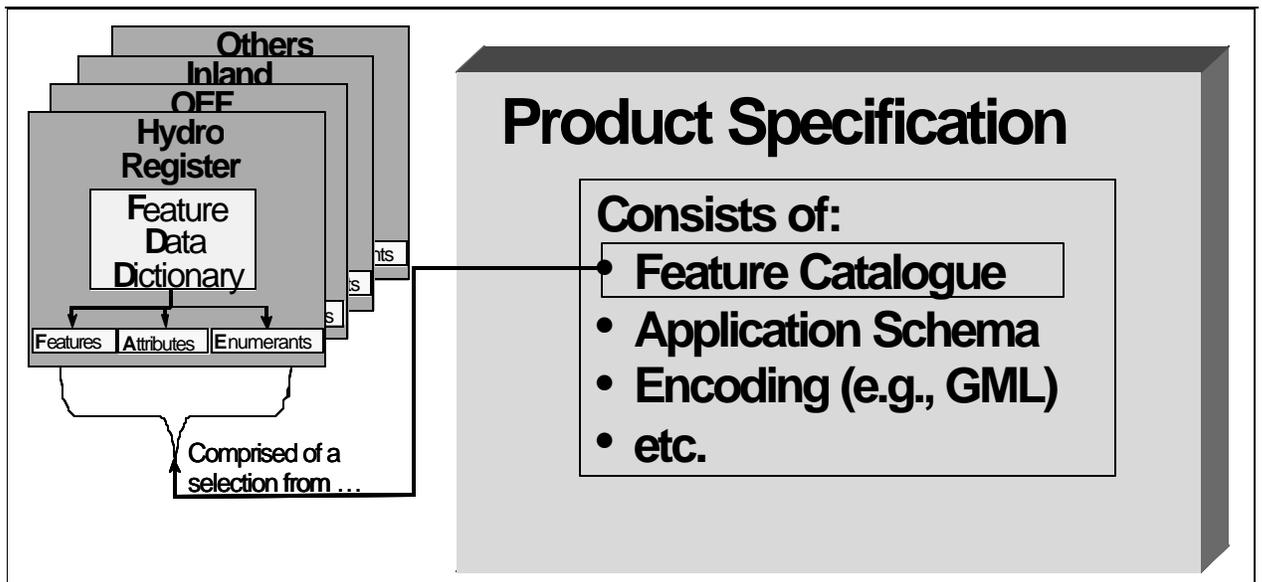


Figure 4

New Terminology (IHO S-57 → “ISO-ese”)

Some of the terms and definitions currently used in S-57 Ed. 3.1 will no longer be employed. They will be re-defined or will “evolve” into what some have described as a new language (i.e., “ISO-ese”). While this transition may be difficult at first, in the longer term it will be beneficial since IHO S-57 Edition 4.0 will be using the same language as ISO TC/211 series of standards.

Some examples of this change in terminology include:

<p><u>S-57 Ed. 3.1</u> [none] * object attribute attribute values object catalogue</p>	<p>→</p>	<p><u>ISO 19100 series</u> a <i>registry</i> for a standard contains a number of <i>registers</i> <i>feature</i> <i>feature attribute</i> <i>enumerants</i> a <i>feature data dictionary</i> contains features and attributes but without any mandatory relationship. Using this, a specific <i>feature catalogue</i> (mandating relationships between features and attributes) can be specified for a variety of requirements (e.g., a product specification).</p>
--	----------	---

* The closest thing to a registry/registers that we presently have is the Open ECDIS Forum (OEF). During the past four years, it has served as a useful mechanism/database for registering additional objects/attributes that were not contained in S-57 Edition 3.0/3.1.

In S-57 Ed. 4.0, a comprehensive translation will be included as an Appendix.

Benefits

There will be a number of benefits in adopting S-57 Edition 4.0:

- Using ISO-developed components and terminology will help ensure that S-57 and future extensions are in the mainstream of the geospatial information industry. This should also help to facilitate a greater use and lower cost implementation of S-57 for hydrographic and other types of geospatial applications (e.g., Marine GIS).
- Conformance with the ISO/TC211 standards will maximize the use of COTS (commercial-off-the-shelf) software applications and development.
- New components of S-57 will not be developed in isolation from the rest of the spatial information technology community.
- Any new requirements can be incorporated within the established framework of ISO/TC211 based standards.
- Rather than being regarded as simply a standard for hydrography, S-57 Edition 4.0 will be interoperable with other ISO/TC211 standards and profiles (e.g., NATO DIGEST).
- There are many national standards bodies that will take full advantage of S-57 being aligned with ISO/TC211 standards.
- More than just hydrographic offices and ECDIS equipment will be able to use S-57 hydrographic data.
- It will facilitate the ability of HOs to use other sources of geospatial data (e.g., combining topography and hydrography to create a coastal zone map).

Another improvement will be the way in which ENC data will be encapsulated. In simple terms, encapsulation means deciding what data structure is used for the exchange of ENC

data. The current edition of S-57 uses an ISO standard referred to as ISO/IEC 8211, “*Specification for a data descriptive file for information interchange.*” First published in 1985, ISO/IEC 8211 was developed when the state-of-the-art was the 3.5” floppy disk. ISO/IEC 8211 is no longer widely used, and it would not be possible to efficiently encapsulate some of the new data functionality using this outdated standard. The GIS industry has provided a standards- based format that should be a good replacement for 8211. The Geography Markup Language (GML) has been developed by the Open Geospatial Consortium. The current version is going through the process of becoming an ISO standard. Using GML as one method of encapsulating S-57 Edition 4.0 data fits in well with the overall strategy of using existing standards in order to facilitate acceptance.

S-57 Edition 3.1 → 4.0

Edition 3.1 will continue to be valid for many years to come – even after Edition 4.0 has been released. Since ECDIS equipment uses ENC data conforming to the ENC Product Specification contained in S-57 Edition 3.1, Hydrographic Offices will continue to produce Edition 3.1 ENC data in order to continue to improve world-wide ENC coverage. If or when a new ENC Product Specification is published based on S-57 Edition 4.0, it is reasonable that systems will eventually be upgraded to take advantage of the new functionality that an S57 e4.0 ENC may offer. It should be stressed, however, that **No decision has been made to supersede or replace the current S57e3.1 ENC Product Specification.**

Implications for ENC Product Specification

There are some deficiencies in the ENC Product Specification that have been identified since the release of S-57 Editions 3.0 and 3.1. Once the work on the main parts of the new Edition 4.0 standard has been completed, the new ENC Product Specification will address all of these accumulated corrections and additions. There are some other decisions to be made regarding the ENC Product Specification such as “backwards compatibility”. Although it sounds good, this term is somewhat misleading since any change made to the existing ENC Product Specification will result in an ENC that will not be completely compatible with an existing ECDIS. However, this can be overcome when ECDIS equipment is upgraded to be able to take advantage of new ENC data that has increased functionality. This should not be a surprise to anyone who has upgraded their office suite of computer software and sent files in a new word processing format to their colleagues who, using older software, reply ‘I can’t open the file that you sent me!’

Another issue to be decided is what new functionalities of Edition 4.0 should be included in any new ENC Product Specification. For new features and attributes, this could include archipelagic sea-lanes (ASL) and the Environmentally Sensitive Sea Areas (ESSA) that have recently been mandated by the IMO to be included on paper and electronic charts. Another capability could be the incorporation of gridded data. This would provide the capability for ENCs to show detailed bathymetric information and to create three-dimensional views of the detailed bathymetry. Finally, allowing for time-varying data to be part of a new ENC Product Specification will enable the incorporation of tide and current data, weather, oceanographic and dynamic ice coverage.

Summary

The primary goal for the next edition of S-57 (Edition 4) is to support a greater variety of hydrographic-related digital data sources, products, and customers. This includes matrix and raster data, 3D and time-varying data (x, y, z, and time), and new applications that go beyond the scope of traditional hydrography (e.g. high-density bathymetry, seafloor classification, marine GIS). It will also enable the use of web-based services for data discovery, browsing, query, analysis, and transfer. S-57 Edition 4.0 will not be an incremental revision of Edition 3.1. Edition 4 will be a new standard that includes both additional content and a new data exchange format.

Due to the world-wide prominence of ISO standards, IHO S-57 will conform to the “ISO way” of standards development. However, alignment with the ISO 19100 series of geographic standards will require a re-structuring of S-57 Edition 4. More specifically, this requires a new framework, and a new (or revised) set of terms used to describe the components of S-57 Edition 4.0.

The present intention is to release S57 Edition 4.0 as a hydrographic data transfer standard in late 2006. Edition 3.1 will continue to be valid for many years to come -- even after Edition 4.0 has been released. Since current ECDIS equipment uses ENC data conforming to the ENC Product Specification contained in S-57 Edition 3.1, Hydrographic Offices will continue to produce Edition 3.1 ENC data in order to continue to improve world-wide ENC coverage. No decision has been made to supersede or replace the current S57e3.1 ENC Product Specification.

Appendix A

Class A Liaison Organizations to ISO/TC211

Committee on Earth Observation Satellites/Working Group on Information Systems and Services
(CEOS/WGISS)
Digital Geographic Information Working Group (DGIWG)
European Commission Joint Research Centre (JRC)
European Petroleum Survey Group (EPSG)
Food and Agriculture Organization of the United Nations (FAO/UN)
Global Spatial Data Infrastructure (GSDI)
IEEE Geoscience and Remote Sensing Society
International Association of Geodesy (IAG)
International Cartographic Association (ICA)
International Civil Aviation Organization (ICAO)
International Federation of Surveyors (FIG)
International Hydrographic Organization (IHO)
International Society for Photogrammetry and Remote Sensing (ISPRS)
International Steering Committee for Global Mapping (ISCGM)
Open GIS Consortium, Incorporated (OGC)
Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP)
Permanent Committee on Spatial Data Infrastructure for Americas (PC IDEA)
Scientific Committee on Antarctic Research (SCAR)
UN ECE Statistical Division
United Nations Geographic Information Working Group (UNGIWG)
United Nations Group of Experts on Geographical Names (UNGEGN)
World Meteorological Organization (WMO)

Appendix B

ISO 19100 Series (Geographic Information) Standards

International Standards

ISO 19101:2002 Geographic information — Reference model
ISO 19105:2000 Geographic information — Conformance and testing
ISO 19107:2003 Geographic information — Spatial schema
ISO 19108:2002 Geographic information — Temporal schema
ISO 19111:2003 Geographic information — Spatial referencing by coordinates
ISO 19112:2003 Geographic information — Spatial referencing by geographic identifiers
ISO 19113:2002 Geographic information — Quality principles
ISO 19114:2003 Geographic information — Quality evaluation procedures
ISO 19115:2003 Geographic information — Metadata
ISO/TR 19120:2001 Geographic information — Functional standards
ISO/TR 19121:2000 Geographic information — Imagery and gridded data

Final Draft International Standards

ISO/FDIS 19115 Geographic information — Methodology for feature cataloguing

Draft International Standards

ISO/DIS 19104 Geographic information — Terminology
ISO/DIS 19106 Geographic information — Profiles
ISO/DIS 19109 Geographic information — Rules for application schema
ISO/DIS 19116 Geographic information — Positioning services
ISO/DIS 19117 Geographic information — Portrayal
ISO/DIS 19118 Geographic information — Encoding
ISO/DIS 19119 Geographic information — Services
ISO/DIS 19123 Geographic information — Schema for coverage geometry and functions
ISO/DIS 19125-1 Geographic information — Simple feature access — Part 1: Common architecture
ISO/DIS 19125-2 Geographic information — Simple feature access — Part 2: SQL option
ISO/DIS 19128 Geographic information — Web Map Server interface
ISO/DIS 19133 Geographic information — Location based services tracking and navigation