



**STANDARDS OF COMPETENCE FOR CATEGORY "A"  
HYDROGRAPHIC SURVEYORS**

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S-5A and S-5B are available at <https://iho.int/en/standards-and-specifications>

**Pages 13 to 34 inclusive:**

**FOUNDATION SCIENCE SUBJECTS**

**F1: Earth Models**

**F1.1 Physical geodesy**

- F1.1a The gravity field of the Earth
- F1.1b Gravity observations and their reduction
- F1.1c Height systems and height determination
- F1.1d Geopotential and geoidal Modelling

**F1.2 Coordinate Systems**

- F1.2a Coordinate Systems for Positioning
- F1.2b Datum transformation techniques
- F1.2c Geodetic computations on the ellipsoid
- F1.2d Three-Dimensional Geodetic Modeling

**F1.3 Land surveying methods and techniques**

- F1.3a Trigonometric surveys
- F1.3b Existing survey control
- F1.3c Establishing survey control
- F1.3d Instrument tests
- F1.3e Historical surveys

**F1.4 Levelling**

- F1.4a Levelling instruments
- F1.4b Height reduction

**F1.5 Map Projections**

- F1.5a Map Projections

**F1.6 Trigonometry and least-squares**

- F1.6a Trigonometry
- F1.6b Theory of observations
- F1.6c Least squares

## **F2: Oceanography**

### **F2.1 Physical Oceanography and measurements**

- F2.1a Water masses and circulation
- F2.1b Physical properties of sea water
- F2.1c Oceanographic measurements
- F2.1d Waves

## **F3: Geology and geophysics**

### **F3.1 Geology**

- F3.1a Earth structure
- F3.1b Geomorphology
- F3.1c Substrates

### **F3.2 Geophysics**

- F3.2a Gravity fields and gravity surveys
- F3.2b Magnetic fields
- F3.2c Seismic surveys

## **HYDROGRAPHIC SCIENCE SUBJECTS**

### **H1: Positioning**

#### **H1.1 Vessel and sensor reference frames**

- H1.1a Common reference frames for sensors
- H1.1b Integration of reference frames

#### **H1.2 GNSS positioning**

- H1.2a GNSS Signals
- H1.2b GNSS observables
- H1.2c Relative and absolute techniques
- H1.2d Installation and operation
- H1.2e Quality control

#### **H1.3 Inertial navigation systems**

- H1.3a Accelerometers and gyroscopes, inclinometers, and compass
- H1.3b Strapdown inertial measurement units
- H1.3c Kalman filtering
- H1.3d Aided inertial navigation

#### **H1.4 Subsea positioning**

- H1.4a Acoustic positioning principles
- H1.4b Acoustic positioning systems
- H1.4c Acoustic positioning error analysis
- H1.4d Acoustic positioning applications

#### **H1.5 Line keeping**

- H1.5a Track guidance

### **H2: Underwater Sensors and Data Processing**

#### **H2.1 Underwater acoustics**

- H2.1a Transducers and generation of acoustic waves
- H2.1b Propagation of acoustic waves
- H2.1c Acoustic noise
- H2.1d Reflection, scattering and system performance
- H2.1e Refraction and ray-tracing

## **H2.2 Single beam systems**

- H2.2a Single beam echo sounders principles
- H2.2b Single beam returns interpretation
- H2.2c Single beam survey system
- H2.2d Processing of single beam data

## **H2.3 Sonar imagery systems**

- H2.3a Side-scan sonar systems
- H2.3b Synthetic Aperture Sonar

## **H2.4 Swath echo sounder systems**

- H2.4a Multi-beam echo sounders
- H2.4b Multi-beam system parameters
- H2.4c Multi-beam systems
- H2.4d Multi-beam data processing
- H2.4e Interferometric Sonar

## **H2.5 Backscatter**

- H2.5a Backscatter from side scan, interferometric swath sonars and multi-beam echo sounders

## **H3: LiDAR and Remote Sensing**

### **H3.1 LiDAR**

- H3.1a Airborne LiDAR systems
- H3.1b Airborne LiDAR data products
- H3.1c Terrestrial LiDAR

### **H3.2 Remote Sensing**

- H3.2a Remotely sensed bathymetry
- H3.2b Satellite altimetry
- H3.2c Optical methods of shoreline delineation

## **H4: Survey Operations and Applications**

### **H4.1 Hydrographic survey projects**

- H4.1a Hydrographic survey requirements
- H4.1b Hydrographic survey project management

### **H4.2 Hydrographic survey operations**

- H4.2a Survey planning
- H4.2b Single Beam operations
- H4.2c Multi-beam and Interferometric operations
- H4.2d Magnetic surveys
- H4.2e Airborne LiDAR surveys
- H4.2f Side scan sonar operations
- H4.2g Side-scan sonar data interpretation

### **H4.3 Seabed characterization**

- H4.3a Classification from acoustic data
- H4.3b Classification from optical data
- H4.3c Seabed sampling
- H4.3d Seabed characterization

## **H5: Water Levels and Flow**

### **H5.1 Principles of Water Levels**

- H5.1a Tide theory
- H5.1b Non-tidal water level variations

## **H5.2 Water level measurements**

- H5.2a Water level gauges
- H5.2b Tidal measurement
- H5.2c Uncertainty in water level

## **H5.3 Tide modelling**

- H5.3a Harmonic analysis
- H5.3b Ocean water level

## **H5.4 Ellipsoid separation models and vertical datums**

- H5.4a Separation models
- H5.4b Vertical Datums
- H5.4c Sounding reduction

## **H5.5 Currents**

- H5.5a Tidally induced currents
- H5.5b Current measurement, portrayal and surveys

## **H6: Hydrographic Data Acquisition and Processing**

### **H6.1 Real-time data acquisition and control**

- H6.1a Hydrographic Data acquisition
- H6.1b Real-time data monitoring
- E6.1c Survey data storage and transfer

### **H6.2 Bathymetric data filtering and estimation**

- H6.2a Filtering and estimation of single beam data
- H6.2b Filtering and estimation of multi-beam data
- H6.2c Spatial data quality control
- H6.2d Spatial data interpolation
- H6.2e Spatial data representation

## **H7: Management of Hydrographic Data**

### **H7.1 Data organization and presentation**

- H7.1a Databases
- H7.1b Marine GIS basics

### **H7.2 Marine data sources and dissemination**

- H7.2a MSDI
- H7.2b Open access marine data

### **H7.3 Spatial data integration and deliverables**

- H7.3a Spatial data integration
- H7.3b Spatial data visualisation
- H7.3c Deliverables

## **H8: Legal Aspects**

### **H8.1 Product liability**

- H8.1a Responsibilities of the hydrographic surveyor
- H8.1b Contracts

### **H8.2 Maritime zones**

- H8.2a Delimitations
- E8.2b Impact of surveys



**STANDARDS OF COMPETENCE FOR CATEGORY "B" HYDROGRAPHIC SURVEYORS**

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**Pages 12 to 24 inclusive:**

**ESSENTIAL SUBJECTS**

**E1: Underwater Acoustics**

**E1.1 Acoustic Theory**

- E1.1a Generation of acoustic waves
- E1.1b Propagation of acoustic waves
- E1.1c Reflection, scattering and system performance
- E1.1d Reception of acoustic waves

**E1.2 Single Beam Systems & Side Scan Sonar**

- E1.2a Single beam echo sounders
- E1.2b Single beam echo sounder data recording
- E1.2c Range uncertainty
- E1.2d Side scan sonar

**E1.3 Swath Systems**

- E1.3a Beam characteristics
- E1.3b Backscatter and water column returns
- E1.3c Bottom spatial coverage
- E1.3d Installation and configuration
- E1.3e Range and angle uncertainty
- E1.3f Operation

**E2: Remote Sensing**

**E2.1 LiDAR**

- E2.1a Airborne LiDAR systems
- E2.1b Airborne LiDAR data products
- E2.1c Terrestrial LiDAR

**E2.2 Remote Sensing**

- E2.2a Remotely sensed bathymetry
- E2.2b Shoreline delineation

### **E3: Water Levels and Flow**

#### **E3.1 Principles of Water Levels**

- E3.1a Tidal fundamentals
- E3.1b Tidal information
- E3.1c Non-tidal water level variations

#### **E3.2 Water Level Measurement**

- E3.2a Water level gauges
- E3.2b Tidal measurement
- E3.2c Water level datums
- E3.2d Uncertainty in water level

#### **E3.3 Water Level Reduction**

- E3.3a Water level reduction of soundings
- E3.3b Reduction of soundings using GNSS observations

#### **E3.4 Currents**

- E3.4a Tidal streams and currents
- E3.4b Current measurement and portrayal

### **E4: Positioning**

#### **E4.1 Geodesy**

- E4.1a Introduction to Geodesy
- E4.1b Coordinate systems, frames and datums
- E4.1c Geodetic transformations and associated computations
- E4.1d Ellipsoidal computations

#### **E4.2 Principles of Cartography**

- E4.2 Map projections

#### **E4.3 Positioning Measurements, Methods and Techniques**

- E4.3a Positioning fundamentals
- E4.3b Satellite positioning
- E4.3c Positioning systems
- E4.3d Historical surveys
- E4.3e Survey control

#### **E4.4 Vertical Positioning**

- E4.4a Height systems
- E4.4b Elevation measurements and computation

#### **E4.5 Acoustic Positioning**

- E4.5a Acoustic positioning concepts
- E4.5b Acoustic positioning systems

#### **E4.6 Inertial Navigation**

- E4.6a Inertial Measurement Units
- E4.6b Inertial Navigation Systems

#### **E4.7 Uncertainty in Positioning**

- E4.7 Sources of uncertainty

## **E5: Hydrographic Practice**

### **E5.1 Hydrographic Survey Projects**

- E5.1a Hydrographic survey purposes
- E5.1b Hydrographic survey execution requirements
- E5.1c Hydrographic survey project organization

### **E5.2 Hydrographic Survey Operations**

- E5.2a Operational survey data transfer
- E5.2b Survey systems
- E5.2c Calibration and corrections
- E5.2d Line planning
- E5.2e Line keeping
- E5.2f Survey operations
- E5.2 Quality control

### **E5.3 Hydrographic Survey Documentation**

- E5.3a Documentation

### **E5.4 Legal Aspects**

- E5.4a Liability of the hydrographic surveyor
- E5.4b Delimitations

## **E6: Hydrographic Data Management**

### **E6.1 Real-Time Data Acquisition and Control**

- E6.1a Hydrographic Data acquisition
- E6.1b Real-time data monitoring
- E6.1c Data transfer and storage

### **E6.2 Data Processing and Analysis**

- E6.2a Spatial data cleaning
- E6.2b Spatial data quality control
- E6.2c Spatial data representation

### **E6.3 Data Organization and Presentation**

- E6.3a Databases
- E6.3b Marine GIS basics
- E6.3c Visualization and presentation
- E6.3d Deliverables

## **E7: Environment**

### **E7.1 Oceanography**

- E7.1a Physical properties of sea water
- E7.1b Oceanographic measurements
- E7.1c Waves

### **E7.2 Marine Geology and Geophysics**

- E7.2a Seabed characteristics
- E7.2b Magnetic surveys
- E7.2c Seismic surveys

### **E7.3 Environmental impact**

- E7.3a Impact of surveys