Academic Requirements for Surveyors Working in the Offshore Survey Sector

International Marine Contractors Association

www.imca-int.com

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The International Marine Contractors Association (IMCA) is the international trade association representing offshore, marine and underwater engineering companies.

IMCA promotes improvements in quality, health, safety, environmental and technical standards through the publication of information notes, codes of practice and by other appropriate means.

Members are self-regulating through the adoption of IMCA guidelines as appropriate. They commit to act as responsible members by following relevant guidelines and being willing to be audited against compliance with them by their clients.

There are two core activities that relate to all members:
- Safety, Environment & Legislation
- Training, Certification & Personnel Competence

The Association is organised through four distinct divisions, each covering a specific area of members' interests: Diving, Marine, Offshore Survey, Remote Systems & ROV.

There are also four regional sections which facilitate work on issues affecting members in their local geographic area – Americas Deepwater, Asia-Pacific, Europe & Africa and Middle East & India.

IMCA S 005 Rev. 1

This guidance note was prepared for IMCA, by its Offshore Survey Division Management Committee, whose members are drawn from the principal offshore survey contractors.

This document supersedes IMCA S 005 dated June 2002, which is now withdrawn.

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1 Introduction

Over recent years it has become increasingly noticeable that graduates from survey courses who are recruited into the offshore survey sector are not equipped with the expected level of knowledge upon completing their course and that knowledge between courses can vary considerably.

This has resulted in IMCA member offshore survey companies having to provide a further level of training to ensure that staff surveyors have these basic skills. This is on top of already comprehensive training programmes that aim to give graduates knowledge in company organisation and operations, safety and survival training and in-depth knowledge and operation of a wide range of technical software and survey hardware.

To assist both these IMCA member companies and the colleges and universities from which they recruit, this document has been developed to provide guidelines for the areas in which IMCA would expect an offshore or hydrographic surveyor to have knowledge upon completion of an appropriate course in offshore or hydrographic surveying.

Although largely aimed at ensuring the students are equipped with the necessary theoretical knowledge, it is expected that much of the theory has been backed up with practical sessions, either classroom- or field-based, and that the student has had the opportunity to put many of the principles into practice. IMCA recognises that access to specialised knowledge and equipment can be difficult for some colleges and universities and would be willing to assist in supporting courses by facilitating the provision of such, where possible.

It is hoped that this document will assist colleges and universities in focusing on 'customer requirements' when revising existing courses and developing new courses.

2 Expectations from Offshore Survey Contractors

Surveyors to be employed in the offshore sector study a wide variety of courses, some with a hydrographic theme, although others may study subjects with a greater emphasis on land survey techniques. Each type of survey course will bring relevant benefits to the industry. It is expected that any survey course will impress on its students the importance of online quality control and the importance of ongoing checks and re-computations throughout the course of any survey.

Students would be expected to have a good understanding of the following:

2.1 Health, Safety and Environment

Students should have familiarised themselves with:

- offshore survival training;
- permit to work systems;
- risk assessment;
- personal protective equipment;
- the International Convention for the Prevention of Pollution From Ships (MARPOL).

2.2 Geodesy

Students are expected to have a good understanding of geodesy and map co-ordinate systems and other matters related to position on the earth's surface.

Specific areas include:

- co-ordinate systems;
- map projections;
- spheroids;
- horizontal datums;
- vertical datums (land and marine).

2.3 Hydrography

Students are expected to have a good understanding of hydrographic surveys.

Specific areas include:

- Bathymetry data acquisition, processing and presentation (single beam and multi-beam echo sounders), digital terrain models (DTMs) and target resolution;
- water column parameters and their effects on echo sounding;
- tidal data and cycles;
- impact of timing errors and sensor offsets on data accuracy (particularly multi-beam echo-sounders);
- calibrations (inc multi-beam echo-sounders and motion sensors);
- accuracy of final products (cumulative effect of errors);
- tidal reduction;
- tidal prediction, tidal roses;
- tidal streams;
- co-tidal information and application (source and derivation);
- accuracy of bathymetric systems;
- bathymetric error budgets and appreciation of different survey categories within IHO SP44 4th Edition and IMCA S 003 Rev. 1 – *Guidelines for the use of multibeam echosounders for offshore surveys*.

2.4 Oceanography

Students are expected to have a good understanding of basic oceanography and marine environments.

Specific areas include:

- tidal streams and currents;
- water column parameters;
- sea water properties;
- turbidity;
- deep water measurements;
- underwater acoustic positioning, thermoclines and their effects on bathymetric measurements;
- general observations.

2.5 Geology and Geophysics

Students are expected to have a basic understanding of geology and how seabed and sub-seabed features are interpreted from geophysical systems:

- single and multibeam echo sounder interpretation;
- side scan sonar and sub bottom profiler interpretation;
- digital sonar processing and seabed imagery;
- magnetometers and interpretation of results;
- geotechnical sampling/soil testing techniques and interpretation of results.

2.6 Mathematics

Students are expected to have a good understanding of the basic mathematical concepts used in surveying and be able to use them.

Specific areas include:

- basic geometry and algebra;
- plane and spherical trigonometry;
- basic calculus;
- co-ordinate systems;
- statistics and statistical analysis;
- theory of errors and error budgets;
- theory of precision and accuracy;
- data distribution plots/curves.

2.7 Survey Computations

Students are expected to have a good understanding of basic and intermediate survey computations

Specific areas include:

- use of chart dividers and scale rulers;
- calculation of nautical miles from latitude and longitude;
- land survey computations (resection, triangulation, trilateration, joints, polar);
- spherical trigonometry;
- co-ordinate transformations (geographical, projection, cartesian);
- computation of sail lines (Great Circle and Rhumb);
- computations on the grid (arc to chord, convergence, scale factor etc.);
- statistical analysis (least squares, matrices, variance etc.).

2.8 Surface Positioning Systems

Students are expected to have a good understanding of surface positioning systems and how they are used in modern marine survey. Particular attention should be paid to satellite positioning systems

Specific areas include:

- signal transmission;
- geodetic considerations;
- radio positioning systems theory;
- satellite positioning systems theory;
- global positioning systems;
- differential GPS;
- motion sensors including GPS based motion sensors;
- the theory of gyro compasses and their calibration;
- effect of latitude on heading sensors (true and magnetic north);
- effect of offsets and vessel pitch/roll in surface positioning;
- real-time kinematic (RTK) GPS;
- accuracy expectations for and practical considerations in using surface positioning systems.

2.9 Acoustics

Students are expected to have a good understanding of acoustics and how they are used in modern marine survey.

Specific areas include:

- sound propagation in water;
- sonar theory;
- sound velocity determination, ultra-short baseline (USBL) and long baseline (LBL), vehicle tracking;
- acoustic positioning techniques including calibration, USBL and LBL, vehicle tracking;
- single and multibeam echo sounder operation;
- side scan sonar and sub bottom profiler, pipe/cable trackers;
- 'CHIRP' technology and applications;
- digital sonar processing techniques and seabed imagery;
- importance of relative and absolute accuracy in subsea work.

2.10 Marine Survey Industry

Students are expected to have a good understanding of the offshore and marine survey industry and the role of the surveyor within it. Students should have a theoretical knowledge of the range of survey activities undertaken and the basic equipment necessary for undertaking these activities.

Specific areas include:

- oil and gas industry;
- telecommunications industry;
- nautical/navigational charting;
- marine survey and exploration;
- seismic industry and techniques;
- offshore vessel types;
- remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs);
- dredgers and rock dumpers;

- ability to read and use a nautical chart;
- coastal zone management;
- offshore renewable energy industry (wind, waves, currents);
- organisations for further professional development – IMCA, Hydrographic Society, RICS, ICES.

2.11 Land and Engineering Survey

Students are expected to have a good understanding of land and engineering survey techniques.

Specific areas include:

- basic land survey techniques (e.g. traversing, levelling, detail survey);
- basic engineering survey techniques (e.g. setting out, dimensional control);
- computations associated with these techniques;
- equipment requirements for these techniques, including checks and calibration;
- azimuth determination;
- astronomical observations e.g. sun observation to complete a gyro calibration;
- use of total station, tripods and other survey hardware.

2.12 Data Management and Presentation

Students are expected to have a good understanding of methods used to manage and present the results of field survey operations and be able to use to a practical level a number of these

Specific areas include:

- computer-aided design (CAD) packages;
- geographic information system (GIS) packages;
- cartography;
- use of digital simulations and animation;
- remote sensing (Lidar);
- terrain recognition.

2.13 Databases

Students are expected to have a good understanding of database technology and how it relates to survey data.

Specific areas include:

- database models;
- database management systems (relational, object-oriented);
- database applications;
- structured query language (SQL).

2.14 IT Skills

Students are expected to have a good practical ability to use modern computers (hardware and software).

Specific areas include:

- basic knowledge and ability to operate computer hardware (e.g. PCs, printers);
- operating systems;
- good keyboard skills;

- word processing, spreadsheets and presentations;
- ability to work with and manipulate large data sets;
- networks;
- data and file storage and retrieval – RAID, NAS drives etc.

2.15 Technical Report Writing

Specific knowledge areas include:

- report planning;
- understanding/defining the purpose of a report;
- presentation skills – spreadsheets, graphs etc.;
- integration and cross-referencing with other deliverables – charts, database, recordings, images etc.;
- summary, conclusions and recommendations;
- quality control;
- ability to write technical appraisals;
- ability to create compliance matrices.

2.16 Project Management

It is beneficial for students to have a basic understanding of project management and project teams, team dynamics, understanding stakeholder relationships, risk analysis and an understanding of the safety responsibilities that apply to the individual employee and the working environment.

Specific areas include:

- project planning;
- requirements and specifications;
- equipment;
- personnel – disciplines, numbers;
- vessels;
- timing and scheduling of survey activities;
- deliverables;
- contractual awareness (liquidated and consequential damages, insurance and liability).