INTERNATIONAL ELECTROTECHNICAL COMMISSION

1980–2020 THE FIRST FORTY YEARS

TECHNICAL COMMITTEE 80

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS

Foreword

The International Electrotechnical Commission (IEC) is the leading global organisation that prepares and publishes international standards for all electrical, electronic and related technologies. IEC's international standards facilitate world trade by removing technical barriers to trade, leading to new markets and economic growth whilst improving human health and safety and contributing to the protection of the environment. The IEC was founded in 1906 and now has members from 173 countries, covering 99% of the world's population and supports over 10,000 publications many of which are used as the basis for national standards.

IEC conducts its technical work through Technical Committees of which there are currently 179. Technical Committee 80 (TC80) was set up in 1980 for the specialised task of standards for navigation instruments and has developed in scope over the years to address standards for maritime navigation and radiocommunication. At the time of the IEC century in 2006 TC80 had completed 25 years of continuous effort to improve maritime standards. Today TC80 has completed 40 years.

Kim Fisher Secretary TC80 *December 2020*

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Abbreviations

AIS	Automatic Identification System
CCIR	International Radio Consultative Committee (now part of ITU-R)
CIRM	International Maritime Radio Committee
CISPR	International Special Committee on Radio Interference
ETSI	European Telecommunications Standard Institute
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICS	International Chamber of Shipping
IHO	International Hydrographic Organisation
IMO	International Maritime Organization (formerly IMCO Inter-Governmental Maritime Consultative Organization)
IMSO	International Mobile Satellite Organisation
ISO	International Standards Organization
ITU	International Telecommunication Union
LORAN	Long range navigation (a hyperbolic radio navigation system)
NMEA/IMEA	National/International Marine Electronics Association
SOLAS	International Convention for the Safety of Life at Sea
RTCM	Radio Technical Commission for Maritime Services

TC80 - THE FIRST FORTY YEARS

Introduction

Technical Committee 80 produces operational and performance requirements together with test methods for maritime navigation and radiocommunication equipment and systems. The Committee work programme is associated with that of the IMO by mirroring the performance standards adopted by IMO in its resolutions with associated relevant ITU recommendations and IHO standards. The scope does not however exclude items which are not mandatory through the IMO SOLAS Convention, being "to prepare standards for maritime navigation and radiocommunication equipment and systems, making use of electrotechnical, electronic, electroacoustic, electro-optical and data processing techniques for use on ships and where appropriate on shore".

TC80 currently supports 45 standards which have been developed over the past 40 years to support IMO resolutions and for non-SOLAS and shore applications.

The Committee objective is to publish standards which gain international acceptance, and thus provide international industry with a single equipment standard which has also been accepted by Administrations as suitable for type approval where this is required by the SOLAS Convention. This objective is achieved by ensuring that the Committee has representatives from industry, users, Governments and test certification bodies. There are currently 17 participating members in the Committee and liaisons with all the major international maritime organisations[1].

The Technical Committee is able, by being represented in both IMO and ITU and IHO, to influence the performance and technical content of the resolutions and recommendations. This is invaluable to manufacturing industry, in that the performance and technical standards represent the practical state of the current and emerging technology.

Origins

The origins of TC80 date from the 1970s when electromechanical instruments started to be replaced by electronic instruments. The Committee of Action (now the Standardization Management Board) at its meeting in Florence in 1978 set up a working group to propose a possible programme of work for the IEC on "advanced navigational instruments". The preferred approach was a "multi-modal" approach covering land, sea and air applications, and the concept envisaged for navigation included related aspects of radiocommunications. Experts from France, Germany, Japan and Norway formed the working group with contributions from CCIR, CIRM, IALA, IMCO, EUROCAE and ISO. At the meeting in Sydney in 1979 the working group presented its report. The working group had identified a need for standards for

[1] ***P members –*** 17 – Australia, Austria, Canada, China, Denmark, Finland, Germany, India, Japan, Korea Republic of, Netherlands, Norway, Russian Federation, Spain, Sweden, United Kingdom, United States of America. ***O members*** –18 – Belgium, Bulgaria, Croatia, Czech Republic, Egypt, France, Greece, Hungary, Iran, Ireland, Italy, New Zealand, Pakistan, Poland, Romania, Serbia, Turkey, Ukraine. ***Liaisons –*** IEC/TC 18, ISO/TC 8 A) CIRM, IALA, ICS, IHO, IMEA, IMO, ITU, RTCM

IMO

The International Maritime Organization, founded in 1948, is a specialised agency of the United Nations with headquarters in London and known until 1982 as the Inter-Governmental Maritime Consultative Organization (IMCO). It is a technical organisation of 174 member states which has drafted some 40 Conventions and 800 supporting Resolutions.

The International Convention for the Safety of Life at Sea (SOLAS) in fact predates IMO resulting from the Titanic accident in 1912. The first SOLAS in 1914 introduced the carriage of a radiotelegraphy installation on passenger ships, extended by the 1929 SOLAS to cargo ships over 1600 gross tonnage. The 1948 SOLAS added a requirement for smaller cargo ships over 500 gross tonnage to carry a radiotelephone installation, extended by the 1960 SOLAS to cargo ships over 300 gross tonnage. The 1974 SOLAS introduced the carriage of VHF radiotelephony on all ships. The 1974 SOLAS was drafted so that it could be amended to reflect changing requirements and the radio fit was subsequently developed into the Global Maritime Distress and Safety System (GMDSS) introduced in the 1988 amendments.

The carriage of navigation equipment was limited to a signalling lamp and a Radio Direction Finder, (introduced in the 1929 SOLAS for passenger ships and extended by the 1948 SOLAS to all ships over 1600 gross tonnage), until the 1974 SOLAS introduced a navigation fit of magnetic and gyro compasses, radar and echo sounder. This was gradually extended into the 2000 amendments of today's extensive fit.

Requirements for electrical installations were first introduced in the 1948 SOLAS for a main and emergency source of power for passenger ships which was extended to cargo ships in the 1960 SOLAS.

IEC TC18

Technical Committee 18 (Electrical installations of ships and of mobile and fixed offshore units) produces the 60092 series of standards for electrical installations on ships and the 61892 series for electrical installations on offshore units.

The Committee dates back to 1934. The first complete edition of Publication 92 "Recommendations for electrical installations on ships" which included a chapter on radio interference suppression was published in 1954. This chapter was developed in 1977 into Publication 533 on Electromagnetic compatibility of electrical and electronic installations on ships. In 1992 an official liaison was established with TC80 for electromagnetic compatibility (EMC) issues and in 1999 a second edition was published as 60533 and a third edition in 2015 which is cross referenced to the EMC section of 60945.

TC18 maintains a close liaison with IMO and achieved consultative status for IEC at the then IMCO in 1961.

instruments used on ships and possibly aircraft, had noted the complex inter relations between IMCO, the European Organisation for Civil Aviation Electronics (EUROCAE) and ISO and centres of expertise existing within IEC particularly in TC18 and CISPR. The Sydney meeting considered that there was an urgent need to begin work and the French national committee offered a Secretariat. There was a discussion on whether TC18 should take on the work but it was concluded that a new Technical Committee would make co-operation with other bodies easier and thus TC80 was born. The new Technical Committee held in first meeting in June 1980 in Stockholm under the title of "Advanced Electronic Navigational Instruments". The Secretary was Mr P L Duran from the French Electrotechnical Committee and Mr S R Parsons, the Technical Director of Kelvin Hughes (UK), was elected Chairman. There were delegates from China, France, Germany, Japan, Netherlands, Sweden, UK, USA and Yugoslavia with observers from TC18 and CIRM. The first meeting was spent discussing the way forward. It was noted that although there were no international aeronautical standards, the European and US bodies were in liaison and therefore that the contribution of the new Committee would be limited. Concerns were expressed about duplication of work for ships being carried out in IMCO but it was noted that IMCO did not have the resources to produce detailed technical standards and had previously indicated that they were unlikely to attain such resources. The result was that the meeting proposed a revised title of "Navigation Instruments" with a scope to prepare standards for navigational instruments making use of electrotechnical and electronic techniques on board ships and possibly in the field of land navigation. Instruments whose technology was primarily mechanical were excluded from the scope as ISO TC8 held the expertise and had a set up a new Sub-committee on Navigation.

Mr Stiven Parsons, the first Chairman

The early years

The second meeting was held in Copenhagen in October 1981 where it was decided that, as a first priority, TC80 should develop standards for which IMO had established mandatory carriage requirements. The 1974 edition of the SOLAS Convention had come into force in 1980 which had, for the first time, called up the carriage of some navigation instruments. Amendments had already been agreed to extend the requirements to the carriage of automatic radar plotting aids (ARPA) starting in 1984. The Italian delegate suggested the concept of setting up working groups for each instrument as it would then be easier to convene experts in the relevant field. Four working groups were consequently set up to support the new IMO requirements: WG1 – shipborne radars, WG2 – Automatic Radar Plotting Aids, WG3 – Devices to

CIRM

The Comite′ International Radio-Maritime or International Maritime Radio Committee has objectives to promote the application of electronic technology to the efficient conduct of shipping and the safety of life at sea, and to foster relations between all organisations concerned with electronic aids to marine navigation and marine radiocommunications.

CIRM was originally founded in Spain in 1928 by eight companies engaged in the application of radio to the maritime service. It was reconstituted in Belgium in 1947 and subsequently moved to London. It is now the principal international association for companies engaged in maritime electronics, with current membership of some 107 companies from 29 nations worldwide

The functions of CIRM include representing the interests of industry, enabling members to participate in the development of international regulations and standards affecting their products and services, and providing technical and industrial advice to the international regulatory organisations.

CIRM was accorded consultative status by IMCO in 1961. CIRM is also a Sector Member of the ITU, and is a Liaison Member both of the ISO and of the IEC.

CIRM provides the Secretary of TC80 under an agreement with the British Standards Institution.

ISO

The International Organization for Standardization was established in 1946 although its origins go back to 1926 and the International Federation of the National Standardizing Associations (ISA). ISA dealt predominately with mechanical engineering and Technical Committee 8 was responsible for shipbuilding.

Today TC8 deals with ships and marine technology and has 13 Sub-Committees of which SC1-Maritime safety, SC6-Navigation and ship operation and SC11-Intermodal and short sea shipping have liaisons with IEC TC80.

TC8 standards which compliment the work of IEC TC80, or have been produced jointly, include: ISO 25862 Magnetic compass, ISO 8468/14612 Ships' bridge layout, ISO 8728/16328 Gyro-compass, ISO 8729 Radar reflector, ISO 9875 Echo sounder, ISO 11674/16329 Heading controller, ISO 16273 Night vision, ISO 17884 Searchlight, ISO 14859 Sound reception systems, ISO 22554/5 Indicators, ISO 22090 Transmitting heading devices and ISO 19697 Electronic inclinometer.

measure speed and distance and WG4 – OMEGA[2]. The working group structure subsequently was adopted as the working method of the Committee.

The third meeting was held in June 1983 in London where the UK delegate Mr P. Griffiths proposed to distinguish IMO text from IEC text by italic typing. This was subsequently adopted as the format of the standards produced by the Committee. Throughout the studies which led to the setting up of TC80, three issues kept recurring as needing to be addressed, these being; the need for standard outlines and dimensions for equipment, the need for standard general requirements for equipment and the need for standard electrical interfaces to allow equipment to communicate with one another. The issue of standard outlines and dimensions has never been addressed by TC80 as the change to software-based processor-controlled equipment has largely taken away the need, the interest being now more in standardising information displays and menus. However, at the meeting, the issue of general requirements was addressed and WG5 was set up – Environmental conditions for navigational instruments aboard ship. WG5 subsequently developed the 60945 standard which was accepted by IMO and is now referenced in IMO performance standards.

The fourth meeting was held in October 1984 in Florence. The question of interfaces was addressed and there was uncertainty over whether each equipment standard should contain interface information or whether a separate interface standard was required. The final result was the setting up in 1986 of WG6 – Digital interfaces for navigational equipment within a ship. WG6 subsequently developed the 61162 series of interface standards which again were accepted by IMO and are also referenced in IMO performance standards. 61162 has enabled integrated navigation systems to become a reality long before the concept was formally considered.

The fifth meeting was held in June 1986 in Paris where Mr J L Thomson from IMO, who was present as an observer, suggested using "shall" in IEC text for "should" in IMO text. This again was subsequently adopted as the format of the standards produced by the Committee. At the meeting the French national committee reported that they were unable to continue the secretariat which would consequently become vacant from 1 October. No national committee was immediately able to take on the task, which resulted in no plans being made for a subsequent meeting.

The formative years

TC80 had by now clearly proved its worth with its approach of rigorously interpreting the IMO performance standards, providing technical detail and developing test methods. With yet further requirements being investigated by IMO there was interest in continuing the Committee work and a consortium of manufacturers, being members of CIRM based in London, approached the British Electrotechnical Committee with an offer of assisting with the Secretariat. This proved to be acceptable to all parties and the British Electrotechnical Committee took on the Secretariat and CIRM offered Peter Griffiths as the Secretary.

[2] A very low frequency hyperbolic navigation system. The system was shut down in 1997 being overtaken by satellite based navigation systems.

GENERAL REQUIREMENTS

In 1980, when TC80 was formed, there were 20 Classification Societies, together with the International Association of Classification Societies, numerous Statutory Authorities, regional standards bodies and IMCO - all with different ideas on what the general requirements should be for equipment to be used on ships.

WG5, when it was set up in 1983, was originally tasked with attempting to define standard environmental conditions for testing equipment. TC77 held responsibility for the classification of climatic conditions and published those for a ship environment as 721-3-6 in 1987. This however contained five variants and an early task was to select the most appropriate for electronic equipment. The type of salt to be used to represent a sea environment proved to be surprisingly contentious with strong ideas from the Chinese delegation.

It was however quickly realised that environmental issues interrelated with other general issues concerning the design of the equipment, its power supplies, electromagnetic compatibility (EMC) and safety, and the scope of the work was consequentially widened. In 1985 IMCO published resolution A.574(14) on general requirements for navigation equipment and the first edition of 945 (now 60945) was completed in 1988. Even then agreement could not be reached on EMC immunity parameters, and this section followed as an amendment in 1992.

In 1991 the IMO, when discussing the changes which would arise with the introduction of the GMDSS, noted that in future, radio equipment would be installed on the bridge alongside the navigation equipment instead of in a special radio room as hitherto. The IMO consequently withdrew Resolution A.574(14) (and a corresponding Resolution A.569(14) dealing with the general requirements of radio equipment) and replaced them with IMO Resolution A.694(17). A second edition of IEC 945 was prepared to reflect this change in 1994.

Having now attained consensus in IMO for the requirements for equipment used on the bridge of a ship, discussions were commenced with classification societies, TC18 (electrical equipment) and ISO to attempt to align all their general requirements. This resulted in a third edition of 945 in 1996 which was a complete revision which aligned the test methods wherever possible, and has since become the industry standard. This edition also introduced new requirements for software, reflecting the technological changes taking place in equipment design. The scope was extended to make the standard applicable additionally to other equipment installed on and around the bridge of a ship with regard to EMC.

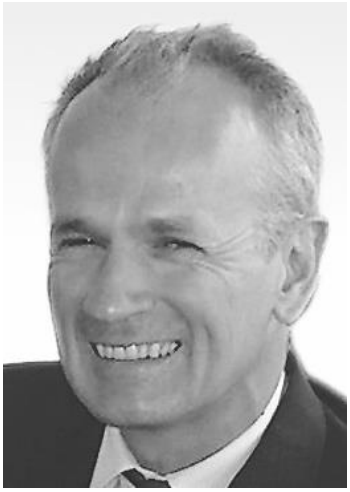
A fourth edition of 60945 was published in 2002 which extended the detail of operational tests, particularly for equipment which is operated through software menus, to reflect the importance given by IMO to aspects of the human element. The EMC tests were also extended to address the increasing problems being experienced by the use of ever more electronic equipment on a ship.

A meeting was held in London in May 1988 and a further meeting, coincident with the IEC General meeting, in Brighton (UK) in July 1989. Russia and ICS attended this meeting for the first time and a further working group WG7 – Electronic Chart and Information Systems (ECDIS) was set up to reflect work ongoing in IMO.

The next meeting was held in October 1991 in Berlin. IMO had made substantial changes to Chapter IV of the SOLAS Convention in 1988 by introducing a completely new radiocommunication system called the Global Maritime Distress and Safety System (GMDSS) which had a phased implementation for carriage starting in 1992. The new system replaced the use of the Morse SOS by ships with more automated systems using digital techniques and satellites. ETSI in Europe had been preparing GMDSS standards but there were no international standards and the meeting consequentially set up a new group WG8 – GMDSS. WG8 went on to produce the 61097 series of standards in 16 parts to specify the GMDSS equipment. WG8, incidentally, was also the first group to adopt the "new" technology of exchanging drafts of standards by diskette rather than paper.

WG4, dealing with radionavigation aids under French convenorship, was producing standards for LORAN and Chayka but the upcoming interest was in GPS-NAVSTAR. It was accepted that the development of technical standards for GPS would require US input. RTCM in particular were supporting IEC work so a new group was set up in association with RTCM, WG4A – Position Fixing Aids (Satellite).

It appeared that the standards to support the IMO navigation carriage requirements would be completed by 1993 (although subsequent events were to alter that assumption) and the topic of integration of instruments was discussed. The trend in integration was then towards "consoles" made up by integrating equipment to existing technical standards and to reflect this development a further group was set up, WG9 – Integrated Bridge Systems for ships.



Charles Jacquemart, TC80 Technical Officer from 1991 to 2011

The meeting was attended for the first time by Charles Jacquemart from IEC central office who was to remain the Technical Officer responsible for TC80 for the next 20 years. He gave a presentation on new aspects of the IEC Directives which were designed to lead to a radical shortening of the lead time in the development of standards. All significant technical problems would henceforth need to be resolved at the Committee Draft stage as they would not be admissible at the Draft Standard stage. It was intended that this would reduce the development cycle for new standards to about 4 years, and in fact the average development time for a standard then reduced to about 38 months.

At the meeting Stiven Parsons announced his intention to retire as Chairman having steered the Committee through its 11 formative years. His replacement was agreed to be Dr Andy Norris the then Technical Director of Kelvin Hughes, thus maintaining

INTERFACES

Interest in standard interfaces to enable navigation equipment to communicate with one another developed in the 1970s. There were at the time 26 interfaces in use for auto-pilots and CIRM developed a recommended standard output for gyrocompasses. With the increasing availability of LORAN receivers for small craft which did not carry gyrocompasses, the National Marine Electronics Association (NMEA) in the USA produced in 1980 a standard to allow LORANs to communicate with auto-pilots. NMEA had been founded in 1957 by a group of electronics dealers to strengthen relationships with electronics manufacturers, and the new standard was known as 0180. Revisions in 1982 and 1983 became the 0182 and 0183 standards. CCIR published Report 1043 on Characteristics of a data exchange system for use with maritime navigation and radiocommunication equipment (Q/55/8) based on NMEA 0183 in 1985.

IMO became interested in standard interfaces during the development of the GMDSS. In 1981 at COM 23 INMARSAT suggested a standardised data interface for use between navigational and communication equipment on the bridge for providing current positioning information to relevant equipment used in the FGMDSS (the "F" stood for "future"). A joint working group was set up with the NAV sub-committee and the essentials of a data interface identified, particularly that RS422 was superior to RS232 as the transmission standard for the physical requirements of marine installations. IMO however decided in 1984 not to continue to define the technical characteristics for data interfaces, but to restrict its work to the content and format of distress messages and it invited other organisations to continue the work.

The interface issue was then in danger of polarising into two areas of exchange of navigational information and exchange of radiocommunication information. WG6 took the CCIR/NMEA 0183 format and drafted the necessary sentences dealing with communications equipment; these were included in the first standard 1162-1, (later 61162-1), which was published in 1995. The critical area of checksum was included as mandatory for those sentences required by IMO specified equipment but for other equipment this was optional. Additional status and mode information was added to the sentences following the accident to the "Royal Majesty" which grounded in June 1995 when 17 miles off course due to misinterpretation of position data. TC80 was formally invited to attend the enquiry of the National Transportation Safety Board in the USA. 61162-1 was updated to edition 2 in the year 2000, with close alignment to the NMEA document, v 2.30 (March 1998) and has since been updated as new requirements arise.

Data rate was improved in 61162-2, issued in 1998, increasing the baud rate from 4800 to 38400 bits/sec. The equivalent NMEA 0183 HS was issued in 1999.

WG6 subsequently developed a higher speed standard 61162-3 which adopted the NMEA 2000 using the ISO CAN bus, and a 61162-4 series for a network based approach. Neither standard however was widely adopted. 61162-3 proved to be too late as the amount of information that was becoming needed for the bridge equipment exchange already exceeded its capabilities, and the network approach of 61162-4 was a too specialised design to be economically developed.

Consequentially in 2008 consideration was given to a light-weight Ethernet approach which would adopt standard Ethernet components as far as possible. This led to 61162-450 for Ethernet interconnection in 2011, with a second edition in 2018. With increasing awareness of cybersecurity, a companion standard for safety and security of networks 61162-460 was developed in 2015 leading to a second edition in 2018.

the Kelvin Hughes connection. Kelvin Hughes originated from the companies of Henry Hughes & Sons who made chronometers and sextants from the 1750s and William Thomson & James White who made marine instruments from the 1850s. William Thomson (1824-1907) is also known as Lord Kelvin, who is now best remembered for his work on thermodynamics and in particular the concept of absolute zero, the temperature at which all molecular motion ceases. However, amongst his many achievements, he was a notable electrical engineer and was the first president of IEC when IEC was founded in 1906.

It was decided to hold meetings henceforth on a bi-annual basis and the next meeting was held in September 1993 in Milan. By this time the Committee included 18 Participating Members, 15 Observer Members and 9 Liaison members. After 13 years it was also clear that the Committee's contribution was related exclusively to maritime matters, and the Committee title was changed to the current "Maritime navigation and radiocommunication equipment and systems".

The Chapter V years

In 1993 the IMO Sub-Committee on the Safety of Navigation commenced work on a complete revision of Chapter V (Safety of Navigation) of the SOLAS Convention which resulted in requirements for navigation equipment to improved specifications, a more functional approach to safe ship operation, and some completely new navigation equipment. The revision ultimately resulted in some 30 new and revised performance standards and a consequent very heavy workload for TC80. In particular, the revision led to improved receivers for a Global Navigation Satellite System, improved Radars with plotting facilities, improved Echo Sounders and improved Speed and Distance Measuring Equipment. The new equipment included a Transmitting Heading Device for ships too small to require a gyro-compass, Automatic Identification Systems and Voyage Data Recorders. TC80 took a proactive approach and assisted IMO in developing the performance standards whilst developing the technical standards in parallel to ensure that published standards would be available when new carriage requirements came into effect. ISO TC8 prepared the new standards for the Echo Sounder and the Transmitting Heading Device, as these replaced traditional mechanical instruments.

TC80 met in November 1995 in Kista (Stockholm) where with changes in information technology, Word for Windows was used for the first time instead of Wordperfect with DOS. It was realised that integration of navigation information could be taken further than the integrated bridge approach adopted in Berlin four years previously and a new group WG10 was set up for Integrated Navigation Systems. Their task proved in fact to be very difficult and it was to be 10 years before 61924 was completed.

Means of identifying ships so as to take away the anonymity of the radar blip was discussed. Proposals for secondary radar systems had given way to proposals for systems using the VHF radio together with electronic position fixing systems and IALA had developed a system suitable for shore surveillance which was in use in the USA following the Exxon Valdez[3] accident. With increasing IMO interest, a new

[3] A major oil spill in 1989 in Prince William Sound Alaska resulting from the grounding of the tanker.

Andrew Norris

Andy Norris was born in the UK in 1948. He qualified in electronics and attained a PhD for work on microwave antennas. After variously working for Plessey Radar and the Standard Telecommunications Research Laboratory he joined Kelvin Hughes as Technical Director in 1990. He then was the founding Managing Director of ChartCo Ltd, a joint venture company with Fugro NV until becoming an international consultant in maritime electronics in 2003. He has authored a number of books and has been a regular contributor to Digital Ship.

He became the Chair of TC80 in August 1991 serving for 24 years until August 2015. As Chair he provided invaluable insight to the running of TC80 with his wealth of knowledge in navigation and the shipping industry.

He is a past president of CIRM and has held leading roles in the Royal Institute of Navigation and the Nautical Institute. He is Honorary Professor of Navigation at Nottingham University and now represents the International Association of Institutes of Navigation (IAIN) in IMO Committees.

Peter Griffiths

Peter Griffiths was born in the UK in 1927. He qualified in maths and physics and joined the UK Royal Naval Scientific Service where he was concerned with the development of naval radar and radio systems which included postings to the USA to assist in the Apollo programme. When the 1974 SOLAS was introduced, there was a new obligation on Governments to type approve navigational equipment and Peter was asked to set up a test facility for the UK at Fraser Range near Southampton. In this role he gained detailed knowledge of SOLAS equipment and their standards. On his retirement in 1986 he took on the role of TC80 Secretary as its second Secretary, a post he held for the next 11 years.

After his second “retirement” he took on a role of assisting the radar manufacturers with negotiations in the ITU concerning radio spectrum issues in which he was an acknowledged expert. He made a great contribution to this work and in fact continued into his 90th year.

A man who simply had a lot of class, died in 2019 aged 92.

working group was set up as WG8A to develop this new topic of Automatic Identification Systems (AIS).

The next meeting took place in November 1997 in Brussels. WG1 reported proposals to revise 60936 (radar) into four parts for the different types of radar under consideration at IMO and 60872 (ARPA) into three parts for different types of plotting under consideration. WG4A reported on revising 61108 into four standards for GPS, GLONASS and with their various combinations and differential corrections. A new group WG11 had been set up for Voyage Data Recorders to support IMO work which had had substantial input from the aircraft industry who already had 25 years experience in both operating and specifying similar equipment.

TC80 then met in October 1999 in Southampton (UK). Canada and Finland joined as new Participating members. WG1 reported that the testing of radar spurious emissions to ITU Radio Regulations had been included in the IEC standards for first time and that further ITU requirements were expected due to increased pressures for the use of the radio spectrum. WG2A was consequentially set up to consider a standard for small boat radars, which were not subject to IMO requirements but were subject to the ITU requirements. WG6 reported that, with further developments in information technologies they were working by e-mail and had set up a FTP server. WG8 reported that the conversion to the GMDSS by merchant ships had been completed in February 1999 but interest was being shown in encouraging non-SOLAS craft to use the GMDSS, which resulted in a new group WG12 being set up to consider standards for a small craft VHF. WG8A reported that a standard for AIS using Digital Selective Calling had been completed as 61993-1 but IMO were now considering other time division access systems for AIS, and developing a universal AIS. A further new group WG1A was set up to produce a standard for track controllers to support IMO work.

At the meeting Peter Griffiths announced his resignation from the post of Secretary which he had held for 11 years. The new Secretary was to be Michael Rambaut who had recently joined CIRM as its Deputy Secretary-General.

The year 2001 marked the anniversary of Marconi's first transatlantic radio signal from Poldu in Cornwall (UK) to Signal Hill in St John's Newfoundland. The Canadian authorities had arranged a celebration with a Conference in September and invited TC80 to St John's for its meeting. Unfortunately the timing turned out to be a couple of weeks after the 9/11 outrages in New York and many delegates were unable to travel to attend the meeting, which resulted in Peter Griffiths standing in for the Chairman. The meeting was however able to report that the standards required to support the introduction of the new Chapter V of SOLAS in July 2002 had been completed: 60872-1 to -3 (Plotting), 60936-1 to –3 (Radar), 61023 (SDME), 61108-1 (GPS) and 61108-2 (GLONASS), 61174 (ECDIS), 61209 (IBS), 61993-2 (UAIS), 61996 (VDR) and 62065 (Track Control).

IMO had recently invited IEC to look into issues of harmonising displays on the bridge and a new group WG13 was set up for this which was to lead to the standard 62288. The scope of AIS work was extended to study AIS for non-SOLAS craft. A difficulty with the AIS standard was that it employed Self organized time division multiple access (SOTDMA) which was subject to a Swedish patent and it was thought

IEC TC80
WG 13
11-13 Dec 2001


Kim Fisher


Joe Ryan


Lee Alexander


Mathias Jonas


Matthias Westphal


Andrey Vorobiev


Rob Andrews


Adil Abbas


Junji Takita


Brian Ring


Roy Lee


Takamasa Yauchi


Benny Pettersson


Hans Ramsvik


Dan Mades


Ron Grady


Dave Hannah


Chris Meade


Simon Cooke


Hannu Peiponen


Alain Deverre

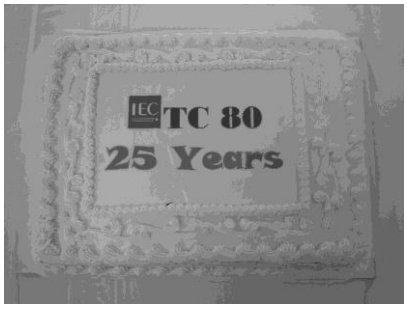

Dave Blevins

that this could make AIS equipment too expensive for small craft use. WG8A subsequently designed a new access system called Carrier sense time division multiple access (CSTDMA) which was to form the basis of a non-SOLAS craft standard, 62287-1 (AIS B CS).

The next meeting was held back in Southampton (UK) in October 2003. As a result of 9/11, the IMO in 2002 had introduced changes to the SOLAS Convention and introduced a security code. One outcome of this was that the implementation timescale for the fitting of AIS equipment to ships had been greatly shortened and this was leading to an urgent requirement to define standards for the display of AIS information on the radar. WG1 were working with IMO to develop a new radar standard which was to have, additionally, increased performance and permit, in some circumstances, the use of non-pulsed radars. The security application of AIS was perceived to be shore surveillance and a new working group WG14 was set up, in association with IALA, to prepare standards for shore based AIS installations. A further new sub group WG7A was set up to prepare a standard for Electronic Chart Systems, (which do not necessarily meet all the IMO ECDIS requirements), in liaison with RTCM. WG8 reported work to revise the NAVTEX standard resulting from a new NAVTEX performance standard published by IMO which no longer required the equipment to be fitted with a printer.

The quarter century

The 25th year meeting was held at the RTCM Headquarters in Arlington (USA) in October 2005 and the quarter century was suitably celebrated with a birthday cake, kindly donated by RTCM, cut by the Chairman. Michael Rambaut resigned as Secretary, having been promoted to Secretary-General of CIRM, and Kim Fisher took over as Secretary. WG14 reported on progress on standards 62320-1 for an AIS Base Station and 62320-2 for AIS AtoN. Future work for further developments in satellite navigation was identified particularly regarding progress in Europe with the Galileo system and also further work for AIS for non-SOLAS craft. This was to lead to 62287-2 (AIS B SO) employing the same self-organizing technology used by the SOLAS ships as the patents gradually expired.



The next meeting was held in Oslo (Norway) in May 2007, this being rather earlier in the year than normal in order to avoid clashing with the 2007 ITU World Radiocommunications Conference. Austrian and Korean delegates attended for the first time and Chinese delegates for the first time since the 1991 Berlin meeting. As a result of a decision of a Standardization Management Board meeting in January 2006, there was a new requirement for each Technical Committee to produce its own standard practice document describing the IEC procedures to be used and to be called Committee Good Working Practice. Another change was that working groups were to be disbanded when they had completed their projects and now only one of the original working groups, WG6 for digital interfaces, still exists. Three late running projects were reported where the drafts prepared for revisions in 2006 had been rejected by the national committees, 61993-2 (AIS), 61097-2 (DSC) and 62238 (VHF radio Class D). The convenors promised new drafts by the end of 2007. In the event

The original Working Groups and Convenors of TC80

WG1	Radar *(Italy) A Robotti, (UK) R Lee, (UK) D Hannah*
WG1A	Track control (*Germany) B Berking*
WG2	Automatic Radar Plotting Aid (ARPA) *(UK) P Griffiths, (UK) S Matthews, (UK) G Woodcock*
WG2A	Navigation equipment for small craft (Radar) *(UK) B Ring*
WG3	Devices to measure speed and distance (SDME) *(US) Ch Donoho, (US) Bowers*
WG4	Terrestrial radionavigation systems *(France) General L Ribadeau-Dumas, (France) L Laborde*
WG4A	Global navigation satellite systems (GNSS) *(UK) M Fox, (UK) R Lee, (US) G Schlechte*
WG5	General Requirements *(UK) P Griffiths, (UK) S Matthews, (UK) G Woodcock, (UK) L Moore, (UK) K Fisher*
WG6	Digital interfaces *(UK) C Wake-Walker, (UK) M Fox, (Sweden) S Steier*
WG7	Electronic chart and information system (ECDIS) *(Sweden) B Aardh, (Sweden) B Carlgren, (US) D Mades*
WG7A	Electronic Chart System (ECS) *(US) J Ryan*
WG8	Global maritime distress and safety system (GMDSS) *(Belgium) A Godts, (UK) M Rambaut*
WG8A	Automatic shipborne identification system (AIS) *(UK) K Fisher, (UK) R Lee, (UK) A Abbas, (USA) M Browning*
WG9	Integrated Bridge Systems (IBS) *(Germany) J Froese, (Germany) J Clauss, (Germany) A Salfner*
WG10	Integrated Navigation System (INS) (*Italy) A Gambardella, (UK) R Lee, (Germany) H Wentzell*
WG10A	Integrated Navigation System (Modular INS) (*Germany) V Koehler, (Finland) H Peiponen*
WG11	Voyage Data Recorder (VDR) *(UK) C Winkley, (Germany) H Wentzell*
WG12	Communications equipment for small craft *(UK) K Fisher*
WG13	Display of navigational related information *(US) J Ryan*
WG14	Non-shipborne Automatic Identification System *(Canada) J Carson-Jackson, (USA) M Browning*

this proved to be somewhat optimistic. The revised AIS standard was finally published in 2012, the DSC in 2018 and the VHF radio revision is still not completed.

The next meeting was held in London in September 2009. Australia and Pakistan had joined the committee as P members. A further new requirement from the Standardization Management Board was for each committee to produce a Strategic Business Plan. It was reported that the new standard, 62288, for the presentation of navigational information on shipborne navigational displays had been completed. This had been a major task of harmonising the display requirements of all the bridge equipment commenced by WG13 in 2001. Interim work had been presented to IMO who had adopted it as resolution MSC.191(79) in December 2004. The new standard now was an overarching document potentially affecting all other TC80 standards which would then need revising, and a revision had in fact been made of 61174 (ECDIS). A new radar standard 62388 had been completed which incorporated the new IMO requirements developed from 2003 and completely replaced the earlier 60936 (Radar) series and 60872 (Plotting) series. New work had started for Integrated Navigation Systems in a new working group WG10A as IMO had developed new performance standards for a modular structure. This was to result in 61924-2 which replaced the standard 61924 started in Kista in 1995. IALA had ceased to lead the work of WG14 set up in 2003 and as a result the AIS groups, WG8A (Shipborne) and WG14 (Non-shipborne) were disbanded. A new combined group, WG15, was set up initially under the convenorship of Håkan Lindley of Sweden and then Stefan Bober of Germany.

The next meeting was held in Melbourne (Australia) in October 2011 by invitation of the Australian national committee who were hosting the 2011 IEC General Meeting. Mr Jacquemart reported on the new communication platform for Technical Committees called Collaboration Tools which had replaced the FTP site. The United States had requested a review of the committee structure and working methods and had proposed setting up a Chairman's Advisory Group. They had experienced difficulties with the AIS standard 61993-2 which needed technical changes due to a problem which had occurred in US waters which could not be accommodated at FDIS stage. The US NMEA had proposed taking on sole responsibility for the interface sentences in 61162-1 with IEC referring to NMEA. This had been circulated to the national committees who could not support the proposal. There was considerable discussion which finally concluded that no fundamental change to TC80 was needed. Cooperation between NMEA and IEC could be investigated with a view to making it more efficient and WG6 was tasked with developing procedures for further comment.

New faces

The next meeting was held in San Diego (USA) in September 2013. Christophe Boyer had taken over, after a brief spell with David Hanlon, as Technical Officer. The Chinese delegation were unfortunately unable to attend due to visa difficulties. IEC had introduced a new proforma for minutes and actions sheets. This removed the difficulties which had been experienced of agreeing verbatim minutes but at the expense of leaving less records for future generations to interpret events. It was reported that a new edition of 62388 Radar had been published incorporating new ITU requirements for unwanted emissions and interference from emissions in adjacent

Michael Rambaut

Michael Rambaut was born in the UK in 1948 into an engineering family. Having an interest in amateur radio he joined the Ferranti Company as a student apprentice and worked on semiconductor applications. He then joined the International Marine Radio Company where he stayed for 20 years becoming Technical Director and working on HF radio receivers, high power transmitters, VHF radiotelephones and the first Inmarsat terminal.
In 1998 when the successors of IMRC ceased trading, he joined CIRM becoming its Secretary-General from 2004 to 2013.

He was active in maritime radio standards and chaired many working groups producing standards for ETSI and IEC. He was Secretary of TC80 from 1999 to 2005 taking over from Peter Griffiths.

On retirement from CIRM he took on consultancy roles and maintained his interest in classic boats and classic cars.

Kim Fisher

Kim Fisher was born in the UK in 1945. Qualifying in electrical engineering he worked for Plessey Telecommunications and other engineering companies and also in various Government Departments in the UK dealing with telecommunication and transport matters.

Radio Regulatory work in the 1980s introduced him to maritime communications and the GMDSS. He then spent 12 years from 1992 to 2005 as Head of Navigation and Communication for the UK Maritime and Coastguard Agency. His responsibilities included the provision of maritime safety information, meteorology, civil hydrography, equipment standards and approval, radio spectrum policy, merchant shipping legislation and coastal protection. He became closely involved with the committees of the IMO and ITU and chaired a number of their working groups.

He also became involved with the IEC, attending TC80 plenary meetings since 1993 and acting as convenor of TC80 working groups from the 1990s. On retirement in 2005 he took on the role of Secretary of TC80, taking over from Michael Rambaut.

frequency bands. Peter Griffiths, the past Secretary had largely been instrumental in this work. The Republic of Korea reported on new work for network security management which was to become 61162-460, and also proposed new work for the use of S-100[4] databases which was to become the 63173 series of standards. The meeting included several goodbyes. Stefan Steier stood down as convenor of WG6. He had been convenor for 10 years and Hannu Peiponen offered to take over as convenor. Michael Rambaut, also past secretary, reported that this would be his last meeting representing CIRM as he was retiring. The Chairman Andy Norris reported that this would be his last meeting as chair as he would have to stand down in August 2015 due to new IEC procedures which would limit the tenure of a chair to a maximum of 9 years. Andy had served for a staggering 24 years. The meeting was followed by a workshop on Software Quality Assurance and Type Approval.

Christophe Boyer, TC80 Technical Officer from 2012 to 2020

The next meeting was held in Busan (Republic of Korea) in October 2015. Hannu Peiponen of Finland had been elected as the new chair. A new form was available for the Strategic Business Plan which was much simplified over that introduced in 2009. WG6 had developed procedures, as requested in 2011, for the next edition of 61162-1 to be a top level document which would refer for the definition of the sentences to NMEA 0183. This had been circulated to the national committees who had expressed some support, but the majority favoured retaining the current system. It was not clear that the proposed new system would in practice lead to any simplification. It could instead result in the need to refer to multiple standards and legal, copyright and financial consequences were foreseen if the final authority for publishing a standard rested in a national rather than an international standards body. The conclusion therefore was for the next edition of 61162-1 to continue to include the sentence definitions. It was suggested that NMEA might consider itself referencing the IEC documents.

A new edition of 62320-1 for the AIS Base station had been published and a revision of 62320-2 for the AIS Aids to Navigation (AtoN) was underway. These included different control sentences from those in the original editions. These sentences had not been included in 61162-1 because they were specific to shore networks while 61162-1, reflecting the title of WG6, defined digital interfaces for navigational equipment within a ship. An objection had been received from NMEA that the conclusions on the future of 61162-1 should not apply to any other standard. As a consequence, the meeting agreed that the next revisions of the AIS Base Station and AIS AtoN standards would reference a dated version of NMEA 0183 for content not available in IEC.

[4] A Universal Hydrographic Data Model developed by IHO and adopted by IMO for use in a Common Maritime Data Structure for application to information exchange between shore and ship in a programme called e-navigation.

Hannu Peiponen

Hannu Peiponen was born in Finland in 1960. Qualifying in electrical engineering he specialised in coastal surveillance radar before joining Furuno Finland working in research and development where he has become Technical Director.

He became involved in committees in IHO, CIRM, IALA and IMO and joined WG7 of TC80 to produce the first ECDIS standard, 61174, in 2001. He subsequently acted as convenor of the maintenance team (MT7) which revised the ECDIS standard and as convenor of MT5 which revised the standard (62288) for Presentation of information on displays, both for the 2nd edition and 3rd edition. He acted as convenor of WG10A which produced the standard 61924-2 for Integrated Navigation Systems and took over as convenor of WG6 in 2013.

He started attending TC80 plenary meetings in 2009 and took on the role of Chair of TC80 in 2015 on the retirement of Andy Norris. He maintains a very active involvement in TC80 continuing as Convenor of WG6 and maintenance teams as needed.

Current Working Groups and Convenors

WG 6 Digital interfaces
(Finland) H Peiponen
WG 15 Automatic identification system (AIS)
(Germany) S Bober
WG 16 Bridge alert management (BAM)
(UK) A Moosa, (Netherlands) S Kransse
WG 17 Common Maritime Data Structure (CMDS)
(Rep Korea) K Lee

MT 1 Revision of IEC 62388 Radar
(USA) D Blevins
MT 5 Revision of IEC 62288 Presentation
(Finland) H Peiponen
MT 6 Revision of IEC 61996 series VDR
(UK) S Austin
MT 7 Revision of IEC 61174 ECDIS
(Finland) H Peiponen
MT14 Revision of IEC 62065 Track control
(Norway) O Gundersrud
MT 19 Revision of IEC 61097 series GMDSS
(UK) K Fisher

Progress on Bridge alert management (BAM) was discussed. This work had been started to implement IMO requirements that had been developed to rationalise the excessive number of alarms occurring on ship's bridges. The work was thought to be an extension of the work completed on integrated navigation systems in 61924-2 but was proving much more complex. It was considered that a further two years would be required and, as there was likely to be follow on work, a new working group, WG16, was set up initially under the convenorship of Ahmed Moosa (UK) and then Steven Kransse (Netherlands). This led to the 62923 series of standards which became overarching documents potentially affecting all other standards which would then need revising,

The delegate from Korea reported on activities on the use of the IHO S-100 database. A new working group was proposed for interoperability with shore-based system interfaces which would support the IMO e-navigation strategy. This resulted in the setting up of WG17 for Common Maritime Data Structure (CMDS) with Dr Kwangil Lee (Korea) as convenor and led to the 63171 series of standards.

The next meeting was held by invitation of the chairman in Espoo (Helsinki) in August 2017. WG6 had prepared a new work proposal for a standard to provide protection against cyber incidents. Increasing awareness of the need to protect shipborne systems from cyber issues was reported. The IMO had published Guidelines on maritime cyber risk management and the shipping industry had published Guidelines on cybersecurity onboard ships. TC80 had previously published 61162-460 on safety and security for Ethernet interconnections and PAS 63062 on Removable external data source (REDS) for application to individual equipment. The new standard was proposed to build on PAS 63062 by identifying further protection measures which could be applied to the shipborne equipment. There was debate on whether WG6 was the best working group for this subject or whether there was a need for a new working group which concluded with the work remaining with WG6.

The delegation of the Republic of Korea made a presentation proposing a new interface standard in IEC to enable IPV6 for Ethernet based on the IMEA OneNet standard. There was considerable debate on this and whilst it was appreciated that this was forward looking there could be problems in migrating from existing systems on ships. The meeting did not think that there was clear justification to introduce an option for a further Ethernet standard at this time and decided to keep the issue under review.

It was reported that a new standard 62940 for an Integrated Communication System had been published, work had started for a new standard 61097-16 for Ship Earth Stations and a new work item had been circulated for a new standard 61108-5 for a BeiDou satellite navigation system (BDS) receiver.

The next meeting was held in Shanghai (China) in October 2019 by invitation of the Chinese national committee who were hosting the IEC General meeting. The standard 61097-16 for the Ship Earth Station had been published and the standard 61108-5 for BDS was approaching completion. The new standard 63154 for protection against cyber incidents was progressing well and expected to be published in 2021. WG17 reported that the S-100 standard 63173-1 on route exchange was proving more complex than anticipated, and a companion standard 63173-2 had been commenced

on secure transfer of information. The 2009 standard 62288 on presentation of navigational information was under review as IMO had expanded its requirements with a requirement for simpler modes of operation which they called S-mode. Work had started on a revision of 61097-2 for EPIRBs due to new IMO requirements resulting from Cospas-Sarsat introducing a new second generation satellite system. Consideration was given to revising the ECDIS standard 61174. IHO was developing a new standard for charts based on S-100 called S-101 and there was a perceived future need for ECDIS to handle these.

And so to 40 years

The first meeting of TC80 had been held in June 1980 so the 40th anniversary was to occur in June 2020. It had not been planned to hold a TC80 meeting in 2020 but CIRM were meeting for their annual conference at about that time which could have given an opportunity for a celebration.

However, we were not aware when we met in China that the world was about to change due to a Coronavirus pandemic to be called COVID-19. There was a meeting in London in January of WG17 but that proved to be the last face-to-face meeting we would have for a considerable time.

Work carried on by means of on-line meetings using Zoom and we gradually learnt to use that. Christophe Boyer moved on to be Tools and Procedures Group Manager in the Technical Department in Geneva in March and was replaced by Marianna Kramarikova as Technical Officer.

Marianna Kramarikova, TC80 Technical Officer from 2020

Work is being successfully completed using on-line meetings and the TC80 programme is being achieved. The next meeting planned for 2021 will need to be a further virtual on-line meeting. One day hopefully we will all be able to meet up again.

So 40 years have gone by.

The above only describes the highlights of the work and achievements. Considerably more has been done by teams quietly revising standards and generating new ones thanks to the efforts of individuals who have not been mentioned here. All thanks to them, and in fact to everyone for all the efforts they have put in over the years.

And, as there does not appear to be any reduction in the adoption of maritime developments, TC80 is likely to be around for a while longer yet.

Current Publications issued by TC 80 with the reference to the IMO performance standards where applicable

NUMBER	IMO Resolution	TITLE
IEC 60945 Ed. 4.0 + Corr.1	*A.694(17)*	General requirements
IEC 61023 Ed. 3.0	*MSC.96(72)*	Marine speed and distance measuring equipment (SDME)
IEC 61097-1 Ed. 2.0	*A.802(19) amended by MSC.247(83)*	GMDSS - Part 1: Radar transponder - Marine search and rescue (SART)
IEC 61097-2 Ed. 3.0	*A.810(19) amended by MSC.56(66) and MSC.120(74)*	GMDSS - Part 2: COSPAS-SARSAT EPIRB
IEC 61097-3 Ed. 2.0	*A.803(19) A.804(19), A.806(19) amended by MSC.68(68)*	GMDSS - Part 3: Digital selective calling (DSC) equipment
IEC 61097-4 Ed. 3.2 + Am 1 + Am 2	*A.807(19) amended MSC.68(68) Annex 4, MSC.263(84), MSC.306(87), MSC.431(98)*	GMDSS - Part 4: INMARSAT C ship earth station and EGC
IEC 61097-6 Ed. 2.2 + Am 1 + Am 2	*MSC.148(77) MSC.430(98)*	GMDSS - Part 6: NAVTEX
IEC 61097-7 Ed. 1.1 +Am 1	*A.803(19) amended MSC.68(68) Annex 1*	GMDSS - Part 7: VHF radiotelephone transmitter and receiver
IEC 61097-8 Ed. 1.0	*A.803(19) A.804(19), A.806(19)*	GMDSS - Part 8: Watchkeeping receivers for DSC
IEC 61097-9 Ed. 1.0	*A.806(19) amended MSC.68(68) Annex 3*	GMDSS - Part 9: Transmitters and receivers for use in the MF and HF bands
IEC 61097-12 Ed. 1.1 + Amd 1	*A.809(19)*	GMDSS - Part 12: Survival craft portable two-way VHF radiotelephone apparatus
IEC 61097-13 Ed 1.0	*MSC.130(75)*	GMDSS - Part 13: Inmarsat F77 Ship Earth Station
IEC 61097-14 Ed 1.0	*MSC.246(83)*	GMDSS - Part 14: AIS search and rescue transmitter (AIS-SART)
IEC 61097-15 Ed 1.0	*MSC.130(75)*	GMDSS – Part 15: Inmarsat FB500 Ship Earth Station
IEC 61097-16 Ed. 1.0	*MSC.434(98)*	GMDSS – Part 16:Ship Earth Station
IEC 61108-1 Ed. 2.0	*MSC.112(73)*	GNSS - Part 1: Global positioning system (GPS) - Receiver equipment
IEC 61108-2 Ed. 1.0	*MSC.113(73)*	GNSS - Part 2: Global navigation satellite system (GLONASS) – Receiver equipment
IEC 61108-3 Ed. 1.0	*MSC.233(82)*	GNSS – Part 3: Galileo receiver equipment
IEC 61108-4 Ed. 1.0	*MSC.114(73)*	GNSS - Part 4: Differential GPS / Differential GLONASS
IEC 61108-5 Ed. 1.0	*MSC.379(93)*	GNSS – Part 5: BeiDou (BDS) - receiver equipment

NUMBER	IMO Resolution	TITLE
IEC 61162-1 Ed.5.0		Digital interfaces – Part 1: Single talker and multiple listeners
IEC 61162-2 Ed.1.0		Digital interfaces – Part 2: Single talker and multiple listeners, high speed
IEC 61162-3 Ed.1.2 + Am 1 + Am 2		Digital interfaces – Part 3: Serial data instrument network
IEC 61162-450 Ed. 2.0		Digital interfaces - Part 450: Ethernet interconnection
IEC 61162-460 Ed.2.1 + Am 1		Digital interfaces – Part 460: Ethernet safety and security
IEC 61174 Ed. 4.0	*MSC.232(82)*	Electronic chart display and information system (ECDIS)
IEC 61924-2 Ed. 1.0 + Corr.1	*MSC.252(88)*	Integrated navigation systems (INS)
IEC 61993-2 Ed. 3.0	*MSC.74(69) Annex 3*	AIS Part 2: Class A Universal Automatic Identification System
IEC 61996-1 Ed. 2.0 + Corr. 1	*MSC.333(90)*	Shipborne voyage data recorder (VDR)
IEC 61996-2 Ed. 2.0	*MSC.163(78) amended by MSC.214(81)*	Simplified shipborne voyage data recorder (S-VDR)
IEC 62065 Ed. 2.0	*MSC.74(69) Annex 2*	Track control
IEC 62238 Ed. 1.0		VHF radiotelephone with class "D" Digital Selective Calling (DSC)
IEC 62287-1 Ed. 3.0		AIS Class B equipment for non-SOLAS craft (CSTDMA)
IEC 62287-2 Ed. 2.0		AIS Class B equipment for non-SOLAS craft (SOTDMA)
IEC 62288 Ed. 2.0	*MSC.191(79)*	Presentation of navigation-related information on shipborne navigational displays
IEC 62320-1 Ed. 2.0		Automatic identification systems – Part 1: AIS Base Stations
IEC 62320-2 Ed. 2.0		Automatic identification systems – Part 2: AIS AtoN Stations
IEC 62320-3 Ed. 1.0		Automatic identification systems – Part 3: AIS Repeater Stations
IEC 62388 Ed. 2.0 + Corr.1	*MSC.192(79)*	Shipborne radar
IEC 62616 Ed. 1.0 + Corr.1	*MSC.128(75)*	Bridge navigational watch alarm system (BNWAS)
IEC 62729 Ed. 1.0	*MSC.263(84) SOLAS V/19-1*	Long range identification and tracking (LRIT)
IEC 62923-1/2 Ed. 1.0	*MSC.302(87)*	Bridge Alert Management
IEC 62940 Ed. 1.0		Integrated communication system (ICS)
IEC PAS 63062		Removable external data source (REDS)
IEC 63135 Ed.1.0		Automatic Identification System - SAR airborne