

## **IQOE - INVENTORY OF EXISTING STANDARDS FOR OBSERVATIONS OF SOUND IN THE OCEAN**

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date: 6 April 2018

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The overview below presents international and national standards relevant for observations of sound in the ocean from the following organizations:

ISO: International Organization for Standardization, Geneva, Switzerland

IEC: International Electrotechnical Commission, Geneva, Switzerland

IEEE: Institute of Electrical and Electronics Engineers, Piscataway, New Jersey, USA

ANSI: American National Standards Institute, Washington DC, USA

DIN: Deutsches Institut für Normung, Berlin, Germany

ISO explains the relevance of international standardization at its web page 'Using and referencing ISO and IEC standards to support public policy', see <https://www.iso.org/sites/policy/index.html>.

In the overview below, the standards are grouped according to themes (*italic* headers).

### ***Standards on quantities and units***

ISO 80000-1:2009 Quantities and Units – Part 1: General.

ISO 80000-2:2009 Quantities and Units – Part 2: Mathematical signs and symbols to be used in the natural sciences and technology.

ISO 80000-3:2006 Quantities and Units – Part 3: Space and Time.

IEEE Standard 260.1:2004 IEEE Standard Letter Symbols for Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units)

IEEE Standard 260.4:1996 American National Standard Letter Symbols and Abbreviations for Quantities Used in Acoustics

### ***Acoustic terminology standards***

ANSI S1.1-2013, American National Standard: Acoustical terminology (Standards Secretariat, Acoustical Society of America, New York, USA).

ANSI S3.20-2015, American National Standard: Bioacoustical terminology (Standards Secretariat, Acoustical Society of America, New York, USA).

ISO 80000-8:2007 Quantities and Units – Part 8: Acoustics.

IEC 80000-13:2008 Quantities and Units – Part 13: Information science and technology, International Electrotechnical Commission.

ISO 18405:2017. Underwater acoustics — Terminology. International Organization for Standardization, Geneva, Switzerland, 2017.

IEC 60050-801-32:1994. International Electrotechnical Vocabulary- Chapter 801: Acoustics and electroacoustics, Section 32 - Underwater acoustics. International Electrotechnical Commission, Geneva, Switzerland, 1994.

DIN 1320:1997-06 *Akustik – Begriffe* (Acoustics - terminology), Deutsches Institut für Normung (DIN), Berlin, Germany, December 2009.

DIN 13320 *Akustik – Spektren und Übertragungskurven – Begriffe, Darstellung*, Deutsches Institut für Normung (DIN), Berlin, Germany, June 1979.

### ***Standards for reference quantities and filters***

ISO 266:1997, Acoustics – Preferred frequencies (International Organization for Standardization, Geneva, Switzerland)

ISO 1683:2015, Acoustics – Preferred reference values for acoustical and vibratory levels (International Organization for Standardization, Geneva, Switzerland)

IEC 61260-1:2014, Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications (International Electrotechnical Commission, Geneva, Switzerland)

ANSI/ASA S1.11 PART 1 2014 Edition, July 2, 2014. American National Standard Electroacoustics – Octave-band and Fractional-octave-band Filters – Part 1: Specifications (a nationally adopted international standard). Note: identical to IEC 61260-1:2014.

ANSI S1.6-2016, American National Standard: Preferred frequencies and filter band center frequencies for acoustical measurements (Standards Secretariat, Acoustical Society of America, New York, USA).

ANSI S1.8-2016, American National Standard: Reference values for levels used in acoustics and vibrations (Standards Secretariat, Acoustical Society of America, New York, USA).

### ***Calibration standards***

IEC 60500:2017. Underwater acoustics – Hydrophones – Properties of hydrophones in the frequency range 1 Hz to 500 kHz. International Electrotechnical Commission, Geneva, Switzerland, 2017.

IEC 60565:2006 Underwater acoustics – Hydrophones – Calibration in the frequency range 0.01 Hz to 1 MHz; Now under revision into two parts: part 1 (Free-field calibration) and part 2 (Low frequency pressure calibration).

ANSI S1.20-2012, American National Standard: Procedures for calibration of underwater electroacoustic transducers (Standards Secretariat, Acoustical Society of America, New York, USA).

### **Under development within ISO T43 SC3:**

ISO 20073: 201X. Standard-target method of calibrating active sonars for backscattering measurement. International Organization for Standardization, Geneva, Switzerland, 201X.

### ***Measurement standards (underwater acoustics)***

ISO 17208-1: 2016. Underwater acoustics — Quantities and procedures for description and measurement of underwater sound from ships; Part 1: Requirements for precision measurements in deep water used for comparison purposes. International Organization for Standardization, Geneva, Switzerland, 2016.

ISO 18406: 2017. Underwater acoustics — Measurement of radiated underwater sound from percussive pile driving. International Organization for Standardization, Geneva, Switzerland, 2017.

ISO 20233-1:2018. Ships and marine technology — Model test method for propeller cavitation noise evaluation in ship design; Part 1: Source level estimation. International Organization for Standardization, Geneva, Switzerland, 2017.

#### Under development within ISO T43 SC3:

ISO 17208-2: 201X. Underwater acoustics — Underwater acoustics — Quantities and procedures for description and measurement of underwater noise from ships — Part 2: Determination of source levels from deep water measurements. International Organization for Standardization, Geneva, Switzerland, 201X.

ISO 17208-3: 201X. Underwater acoustics — Underwater acoustics — Quantities and procedures for description and measurement of underwater noise from ships — Part 3: Determination of source levels from shallow water measurements. International Organization for Standardization, Geneva, Switzerland, 201X.

### ***Measurement standards (airborne environmental sound)***

ISO 1996-1:2016, Acoustics -- Description, measurement and assessment of environmental noise -- Part 1: Basic quantities and assessment procedures

ISO 1996-2:2007, Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of environmental noise levels

ISO 13474: 2009. Acoustics — Framework for calculating a distribution of sound exposure levels for impulsive sound events for the purposes of environmental noise assessment.

ISO 12913-1: 2014. Acoustics -- Soundscape -- Part 1: Definition and conceptual framework.

ANSI/ASA S12.100, 2014 Edition, December 5, 2014 American National Standard. Methods to define and measure the residual sound in protected natural and quiet residential areas. (Standards Secretariat, Acoustical Society of America, New York, USA).

ANSI/ASA S12.18 1994 Edition, May 12, 1994 American National Standard. Procedures for Outdoor Measurement of Sound Pressure Level (Standards Secretariat, Acoustical Society of America, New York, USA).

ANSI/ASA S12.9 PART 1 2013 Edition, February 27, 2013 American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound – Part 1: Basic Quantities and Definitions (Standards Secretariat, Acoustical Society of America, New York, USA).

ANSI/ASA S12.9 PART 2 1992 Edition, August 13, 1992 American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound Part 2: Measurement of Long-Term, Wide-Area Sound (Standards Secretariat, Acoustical Society of America, New York, USA).

ANSI/ASA S12.9 PART 3 2013 Edition, January 15, 2013 American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound – Part 3: Short-term Measurements with an Observer Present (Standards Secretariat, Acoustical Society of America, New York, USA).

### ***Underwater acoustic project standards or guidelines and other publications***

In addition to the above overview, the following project reports are relevant for observations of sound in the ocean:

#### **EU (task group noise):**

Dekeling, R.P.A., Tasker, M.L., Van der Graaf, A.J., Ainslie, M.A., Andersson, M.H., André, M., Borsani, J.F., Brensing, K., Castellote, M., Cronin, D., Dalen, J., Folegot, T., Leaper, R., Pajala, J., Redman, P., Robinson, S.P., Sigray, P., Sutton, G., Thomsen, F., Werner, S., Wittekind, D., Young, J.V., Monitoring Guidance for Underwater Noise in European Seas, Part II: Monitoring Guidance Specifications, JRC Scientific and Policy Report EUR 26555 EN, Publications Office of the European Union, Luxembourg, 2014, doi: 10.2788/27158. Available from <https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/monitoring-guidance-underwater-noise-european-seas-part-ii-monitoring-guidance>.

**BIAS project**, standards available from <https://biasproject.wordpress.com/downloads/deliverables/>

Verfuß, U.K., Andersson, M., Folegot, T., Laanearu, J., Matuschek, R., Pajala, J., Sigray, P., Tegowski, J., Tougaard, J. BIAS Standards for noise measurements. Background information, Guidelines and Quality Assurance. 2014.

Betke K., Folegot T., Matuschek R., Pajala J., Persson L., Tegowski J., Tougaard, J., Wahlberg M. (2015). BIAS Standards for Signal Processing. Aims, Processes and Recommendations. Amended version. 2015. Editors: Verfuß U.K., Sigray P.

BIAS Data-sharing platform and data storage of acoustic data.

Folegot T., Clorennec D., Chavanne R., R. Gallou (2016). Mapping of ambient noise for BIAS. Quiet-Oceans technical report QO.20130203.01.RAP.001.01B, Brest, France, December 2016

**ADEON project**, standards available from <https://adeon.unh.edu/standards>

Ainslie, M. A., de Jong, C. A. F., Martin, B., Miksis-Olds, J. L., Warren, J. D., Heaney, K. D. (2017). Project Dictionary (Terminology Standard). DRAFT. Technical report by TNO for ADEON Prime Contract No. M16PC00003.

Ainslie, M.A., Miksis-Olds, J.L., Martin, B., Heaney, K., de Jong, C.A.F., von Benda-Beckman, A.M., and Lyons, A.P. 2017. ADEON Soundscape and Modeling Metadata Standard. Version 2.0 DRAFT. Technical report by TNO for ADEON.

Heaney K., Martin B, Miksis-Olds, J., Ainslie, M., Moore, T., and Warren, J. 2017. ADEON Data Processing Specification., Version 2.0 DRAFT. Technical report by OASIS for ADEON.

Warren J., et al. 2017. DRAFT ADEON Calibration and Deployment Good Practice Guide Version 2, 2017

Martin B., C.A. Hillis, J. Miksis-Olds, M. Ainslie, and J. Warren. 2017. ADEON Hardware Specification. Document 01412, Version 1.1 DRAFT. Technical report by JASCO Applied Sciences for ADEON.

### **E&P Sound and Marine Life Joint Industry Programme**

The following standards developed for the IOGP E&P Sound and Marine Life Joint Industry Programme will be available soon:

Standard Procedures for Underwater Noise Measurements for Activities Related to Offshore Oil and Gas Exploration and Production. Phase I: Processing and Reporting Procedures’:

- Task 1: Terminology
- Task 2: Processing
- Task 3: Reporting

### **OTHER:**

IWC 2014. Joint workshop report: Predicting sound fields—global soundscape modelling to inform management of cetaceans and anthropogenic noise 15-16 April 2014, Leiden, Netherlands. International Whaling Commission (2014). Available from [http://scor-int.org/IQOE/Leiden\\_Report.pdf](http://scor-int.org/IQOE/Leiden_Report.pdf).

Robinson, S. P., Lepper, P. A. and Hazelwood, R. A. (2014). Good practice guide for underwater noise measurement. National Measurement Office, Marine Scotland, The Crown Estate, NPL guide No. 133, ISSN: 1368-6550. Available from <http://www.npl.co.uk/upload/pdf/gpg133-underwater-noise-measurement.pdf>.

U.S. Integrated Ocean Observing System (IOOS®) (2017) Manual for Real-Time Quality Control of Passive Acoustics Data - A Guide to Quality Control and Quality Assurance for Passive Acoustics Observations. Available from <https://ioos.noaa.gov/project/qartod/>