

ASA S12 Committee on Noise
Working Group (WG) 47 – Underwater Noise Measurement of Ships

Kick-Off Meeting March 27, 2007, 1 pm
Mantech, Inc. Washington DC 20003

MEETING MINUTES

REVISION 1

Prepared by Michael Bahtiarian

These minutes were prepared by the Committee Chair (Michael Bahtiarian) with an audio tape of the meeting and limited written notes. To be fair to all committee members, no specific individuals (other than the Chair), have been identified in the minutes because of the Chair's unfamiliarity with all the participants voices.

The kick-off meeting of Working Group 47 was held at date, time and location noted above. The agenda for the meeting is on the last page of these notes. There were nineteen attendees at the meeting and two NSWC-CD (Navy) members telecon'ed from Bremerton, Washington. The attendee list is on second to last page of these notes.

Mr. Bahtiarian started the meeting with introduction on reasons for the meeting. His main reason was to address need for underwater noise measurements for new quiet research vessels, as his firm has been involved with NOAA-FRV's and University of Delaware's, R/V SHARP.

Mr. Bahtiarian reminded all that the sponsor was the Acoustical Society of America (ASA) and their interest is not to create a duplicate of any military standard. Mr. Perini suggested that the group know what the military standards are, or at least what the parameters are that go in the grade matrix (see discussion below).

There was some discussion about the classified nature of this topic and the group was polled as to how many had security clearances (such as to then allow discussion of classified material). More than half of the members have clearances; however, Mr. Bahtiarian (who is un-cleared) reminded all that this was commercial application and that the committee has Navy representatives that can insure Navy interests are addressed without disclosing any classified information. For example, the Navy reps can tell the committee what is minimum requirements (i.e. resolution, frequency response, etc) that would meet their needs without disclosing what requirements are currently used by the Navy. All/most agreed this would be sufficient for everyone's interests.

Discussion continued on the modification and revision of the Mission Statement. First comments were on item (5) concerning limitations of the measurement sites. After discussion it was decided to remove item (5). Second comment was on item (4) using COTS technology. Item (4) was not to mean that all hardware needed to be supplied by one vendor or that the measurement needs to be accomplished with one dedicated system. It was suggested that the words "be achievable with" be added after, "All grades".

A question was asked whether the Mission Statement and Grade Matrix should address cost and that cost can be a measure of accuracy. It was suggested that item (1), "cost" be added.

ASA S12 Committee on Noise
Working Group (WG) 47 – Underwater Noise Measurement of Ships

However, after further discussion it was agreed that the standard could not address cost directly in writing, but the Chair notes a major reason for the committee is to provide cost vs. complexity trade-offs.

Another question was whether this document would be a standard for a measurement system or measurement device. It was agreed this is a test methodology and parametric requirements, but not a full system hardware description. There was a good discussion of the various elements of such a system and that a “good” measurement involved appropriate use of many hardware elements (transducers, signal processing, range detection) and also appropriate process requirements (allowable sea state, allowable signal-to-noise ratio, etc).

The issues brought up were of accuracy & precision was mentioned. Is accuracy the system “error” or the deviation from true SPL at 1 meter? Matrix table assumed beam aspect. Is that what we want? Must also assume far field noise measurement. Do you account for Lloyd-Mirror?

Can this be an International Standard? The chair mentioned two other standards on underwater noise, ICES and NATO STANAG. Both were provided to all committee members, but neither provides good reference to start this standard from. ASA communicates with ISO on international standards. Committee has two international members (Canada & UK). Question was asked if ANY other international standards exist. One member was sure there was such an international standard. Chair asked all members to check with their sources. Chair stated that ISO does not have such standard.

However, Chair stated that this standard will be American National Standard promulgated through ANSI (American National Standards Institute). However, the WG47 work product may be distributed internationally when a late draft is ready. Note that ICES CRR 209 is not a standard, it is a report. Chair asked NOAA rep Amy Scholik to check for any international standards through their connections and international organizations similar to NOAA. Chair will bring up at Salt Lake City meeting and continue to seek out for similar standards.

A question was brought up about what the standard will be specifically be for. This will not be a specification for a “device”. It is a measurement standard for systems and methodologies, but not specific single instrument.

Relative to item (3) units, in the Mission statement, question was asked about the type of time processing, rms, peak, SEL? Comment about rms not appropriate for underwater noise from air guns. The group agreed. Measurements concerned with this statement are steady state. This may be too detailed discussion at this point. We need to focus on global things that allow any two measurements (different locations, different organizations) to be comparable. Also, there was a question about comparison between Grades. Some were happy to be able to compare Grade A measurement with Grade C measurement (they have worked with less). This does not necessarily need to be the case as standard is developed.

There was a comment about the inclusion of submerge vessels. One participant said. “do we want that 800 lbs gorilla” or something like that. This standard can certainly be used for

ASA S12 Committee on Noise
Working Group (WG) 47 – Underwater Noise Measurement of Ships

submerged vessels. This would probably NOT be nuclear subs, but could still be submerged ROV's, AUV's, etc. However, if included the standard would need to include methods capable of tracking underwater vessels, which may be easier for surface vessels. It was suggested to exclude submerged vessels and such capability could be added in the future. The Chair strongly agreed with exclusion of subsurface vessels. The mission statement also excludes aircraft. No one disagreed.

Item 6 from the Mission Statement was discussed regarding exclusion of the underwater noise limits due to their political sensitivity and also the make-up of the WG47 committee may not be the right group that can set such limits anyway. Only comment was that you need a good measurement standard to be able to compare to any limit.

Item 7 exclusions were added to keep the WG focused. Passive Acoustic Monitoring was added (as exclusion) to be clear with another ASA Workgroup working on such topic. The method addressed by WG47 would not be appropriate for long term underwater monitoring.

A question came up about the development of a list of reasons to use the standard. The Chair thought such a list would be very long. Others stated why it is used (i.e. applicability) and that this will be process standard, telling "how to", but not "why". You would not make such measurements unless you had specific reason (i.e. problem, contractual requirements, etc.). A section should state which grades to use for specific applications. Chair thought such information would/could go into informative annex or appendix.

Chair stated he would modify the Mission Statement based on specific and general comments (spirit of discussion) and send back a revised draft for all to comment and approve.

The remainder of the meeting was spent discussing the grades matrix. First comment was whether this is a source level measurement? The Chair believed he intended to be source level measurement (i.e. SPL at some distance, usually 1 meter). Question came up whether this should be 1 meter or 1 yard. The Navy uses 1 yard. However, all ASA standards use the metric system, so unit should be 1 meter. The group agreed main units would be SPL at 1 meter, measured in far-field and corrected to 1 meter. These two items should be put at the top of the Grades Matrix.

It was noted that the correction will be biggest unknown (or error). Chair agreed that far-field correction is big & complex technical issue and discussion should be tabled until one of the next meetings. Everyone agreed to start with the easier items on the grades matrix.

Distance ranging method may not need to be specifically mentioned and would be tied to distance ranging accuracy. Question came up about sound velocity profiles needed. This might be listed as an auxiliary measurement.

Far field rule of thumb was suggested earlier as $1\frac{1}{2}$ times the ship length, but the actual rule of thumb is $1\frac{1}{2}$ times the distance between the noise sources (call this the "Acoustic Length"). Chair stated that this is nominally $\frac{1}{2}$ of the ship length times $1\frac{1}{2}$ factor which gives a far-field

ASA S12 Committee on Noise
Working Group (WG) 47 – Underwater Noise Measurement of Ships

distance of $\frac{3}{4}$ of the ship length. Would it not be easier to just use one ship length? Another participant said $1\frac{1}{2}$ times the ship length would certainly be safe rule of thumb with margin.

Other errors associated with reflections off the bottom and the water surface were discussed. Each can be factored out. Bottom reflection errors can be factored out by requiring certain water depth. Water surface reflection can be factored out by using bottom mounted hydrophones and running the ship directly over the top (keel aspect). However, both requirements make measurement harder and thus more costly. There was long discussion about pro's and con's of beam and bottom measurements. Bottom reflections are also function of bottom surface conditions (i.e. how reflective the bottom is.).

It was finally realized that all the factors can be directly & indirectly tied to each other. For example, water depth affects bottom reflection, but also affects distance traveled to measurement site and thus cost. It was suggested that the main drivers for each grade should be determined. For example, Grade C is probably driven by cost of the test which would be directly related to water depth (i.e. deeper water can mean traveling farther distance large support vessels, burn more fuel, etc.).

Later in discussion it was stated that driving factor for Grade C is water depth. Minimum water depth should be 100 meters. Could use bottom mounted hydrophone. Bandwidth was also addressed. For Grade C low frequency range was given at 100 Hz to limit sea state affects. High frequency limit was 10 kHz which was driven by data acquisition instruments. High frequency limit for Grade C was between 10-20 kHz.

Grade A frequency response should be 10 to 50,000 Hz to match ICES noise requirement. Question from chair was should fisheries (i.e. NOAA) work be considered as applicable to Grade A or Grade B measurements. The chair originally thought ICES/fisheries would want to be part of Grade B. Navy takes measurements to 100,000 Hz. Also, the Navy does not just have one standard. For the Navy the most precision is used for "engineering runs", and less precision is used for "in-service runs". Chair believes Grade A is for Navy use and that Grade B was for fisheries work.

As for frequency analysis format, it was originally planned that Grade A would be done using narrowband, Grade B would be done using $\frac{1}{3}$ octave band and Grade C would be just overall value. One member commented that the data acquisition systems actually provide narrowband capability as part of standard package and to get $\frac{1}{3}$ octave band you have to get more add-on software. So, to have $\frac{1}{3}$ octave band for lower Grade, means buying more software. However, $\frac{1}{3}$ octave band allows cross-over to airborne noise easier and it also minimizes the data set. One-third octave band does give nice cross-section between narrowband discretetes and broadband signature. This allows for good (enough) comparison of data.

The chair thought it was agreed that Grades A & B would both 10 to 50,000 Hz frequency response and both would require narrowband and $\frac{1}{3}$ octave band processing. However after further discussion, the group agreed that Grade A would be 50,000 Hz (or what is needed to get to 50,000 Hz $\frac{1}{3}$ octave band). Grade B was believed should have high frequency limit of 20 to 25 kHz. The resolution of 1 Hz is more than adequate for Grade A approach and will satisfy

ASA S12 Committee on Noise
Working Group (WG) 47 – Underwater Noise Measurement of Ships

Navy users. Frequency response for Grade B can be driven by what instruments can do, and there was discussion about what that is. Hardware instruments have 800 to 1600 lines, software instrument have much more 10,000's. A comment was made that it should not be driven by what instruments can do, but by what user needs. It was stated that 1 Hz resolution would give you everything you would need. However, this makes Grade A & Grade B very close on frequency/bandwidth issues. It was stated that accuracy and repeatability would be different.

Measurement distance was previously discussed. It should be 1 to 1½ ship lengths. The Chair questioned should this be acoustic length. One member stated that the 1½ rule of thumb was from some time ago and he thought it should be revisited, calculated including bottom and surface interference. Bob Myers offered to prepare or forward spreadsheet computing bottom and surface (Lloyd-Mirror) interferences. These would drive minimum ranging distances. Maximum distance is driven by signal-to-noise for most parts. One suggestion was for beam aspect to be 1½ to 3 times ship length and bow aspect to be 3-7 times ship length. Some questions came up as to what these lengths should be. One person thought they would be Closest Point of Approach (CPA) lengths. Navy has guidelines for the ranging geometry which are all 40 years old ($\pm 15^\circ$ about CPA point). More discussion is needed.

Values for accuracy and repeatability were discussed. The original Grades Matrix had $\pm X$ for Grade A accuracy and repeatability, $\pm Y$ for Grade B and $\pm Z$ for Grade C. Chair thought accuracy and repeatability would be same number. However, there was strong disagreement. Repeatability is based on the precision of ranging system and accuracy is based on sound measurement system (hydrophones & calibration, etc.). It was agreed that the repeatability would be better than accuracy. For Navy range repeatability was less than 1 dB.

In general it was felt that multiple runs also helps improve accuracy. This applies to improving ship measurement vs. a fixed calibrated sound source. This brought up comment about the need for a definitions section.

For Grade A accuracy should be $\pm 1\frac{1}{2}$ dB, repeatability should be $\pm \frac{1}{2}$ dB. However, a committee member mentioned you will need certain time-bandwidth product to get these results. Another member questioned will background correction be factored in.

Grade B accuracy should be ± 2 dB, repeatability should be ± 2 dB. Grade C accuracy/repeatability should be $\pm 3-5$ dB. Again, above values for accuracy & repeatability are what committee thinks is reasonable. A member stated that the final values will need to be backed up with some analysis and support. However, it was stated by an appropriate committee member, that these values are consistent with what Navy can achieve.

The meeting closed as the Chair promised to publish the minutes of the meeting and also announced the next meeting in Salt Lake City on June 6th

ASA S12 Committee on Noise
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MEETING ATTENDEES

WG Member	Name	Company	Email
X	Michael Bahtiarian	Noise Control Engineering	mikeb@noise-control.com
X	James Roche	NSWC –CD	james.g.roche@navy.mil
X	Matt Hawkins	Univ. of Delaware	Hawkins@udel.edu
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	Andrew D. Perini Jr.*	MSEC	andy.perini@mantech
	Scott Sternfeld	NSWC CD	scott.sternfeld@navy.mil
	Blair Kipple**	NSWC-CD	
	Robert Green**	NSWC-CD	

* Acting host for this meeting

** Via Telecon

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Mantech, Inc. Room 730,
1100 New Jersey Ave SE,
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(Across from Washington Navy Yard)

AGENDA

1. INTRODUCTION

Committee members to discuss their need/interest in the standards committee and define what topics/parameters they want it to address.

2. BACKGROUND

Chair to provide relevant background information as to the forming of the committee and accreditation on behalf the sponsor of this effort, Acoustical Society of America.

3. MISSION STATEMENT

Committee to review mission statement (provided as separate PDF) and the committee to vote/agree on final wording.

4. DISCUSSION OF MEASUREMENT GRADES

Committee to review and discuss the idea of using grades (of measurement accuracy/precision) into the standard. Chair will provide a grade matrix to be reviewed and discussed. Also decide which grades to work on first.

5. OTHER STANDARDS

Discussion of other relevant unclassified/commercial standards for measurement of ship noise. Two documents were already sent as background information; one from NATO and one from ICES (International Council for Exploration of the Seas).

6. NEXT STEPS/SCHEDULE

What work needs to be done, who can do and what is first set of milestones. The next meeting to be held at the ASA Conference in Salt Lake City in June 6, 2007.

OTHER EVENTS/NEXT MEETING:

- NOAA Symposium on Vessel Quieting: May 1-2, DC Area, (M. Bahtiarian to speak about WG47 committee).
- WG47 Committee Meeting: Wednesday June 6, 2007, 5:30-7pm, Suite 326 Salt Lake City Hilton, during part of Spring Acoustical Society of America (ASA) Meeting.