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

Eighth Meeting May 20, 2009
ASA Conference, Portland, OR
**MINUTES**
(Prepared by Michael Bahtiarian)

The purpose of this meeting was to solely review comments on the draft copy sent to the ASA S12 Committee on Noise. S12 approved the standard on May 12 with vote of 16 Yes, 0 No and 23 abstained. The Yes vote was subject to incorporation of 27 comments (see attached). The chair discussed a few of the S12 reviewer comments before this meeting. No S12 members attended the meeting.

Of the 27 comments, many are simple editorial and typo's. They are items 1, 2, 3, 4, 5, 7, 12, 13, 14, 15, 20, 23, 24, 25, 26, 27 on attached comment list. The chair has reviewed all comments and will correct mistakes as noted. These comments were not discussed during the meeting. Only substantive comments were discussed during the meeting as follows:

Comment 6: The term CPA should refer to the point or location and not the distance itself where the distance between the ship and hydrophone are nearest. So where ever the term CPA is used it would refer to the location and if the distance is required, the wording shall state "distance at CPA". Further, the distance at CPA will use the symbol, $d_{CPA}$. This term only appears in Equation (1) and Figures 1, 2 & 4.

Comments 10 & 11: Were from two different committee members concerning the definitions for data window length (3.8), end data location (3.10) and start data location (3.24). The start data location to be revised as given in comments 8 & 9 of the S-12 comment list. The definition for end data location and start data location to be simply location relative to acoustic center of the ship where data is ended, or started respectively. The aim is to remove circular definitions as pointed out in comment 11. Definition for Start Data Location (was 3.24 now 3.25 with revised numbering) was not changed, except to add acoustic center to location of the ship.

Comment 16/17: Comment concerns use of abbreviations instead of symbols, for example CPA, DWL, etc. The chair checked with S12 Chair (Murphy) and found that abbreviation use was consistent with other ASA/ANSI S12 standards. Further, none of the parameters have special symbols that could be used instead of the abbreviation. All equations and abbreviations will be left along. Chair will check that all terms are defined.

Comment 18: The addition of conversion factor for knots to meters per second of "(1852/3600)" does not add any better information unless a full explaination is provided. The chair did not feel it was necessary to provide footnote or a note on this section as it was already a note. No changes will be made.

Comment 19: Comment concerns redefining Dhorz as geometric average of the distance at CPA and distance at Start Data (see attached page for background). Thus Dhorz = sqrt ($CPA*D_{Start\ Data}$). From geometry, DHorz = CPA* 1.1547 which results in 0.6 dB higher value if you do not make separate measurement at $D_{Start\ Data}$. If you take into account Dvert the difference is between 0.59 for the shallow hydrophone to 0.32 dB for the deep hydrophone.

Chair is electing not to make such change due to fact that equations, figures, maybe figure numbers will have to change and difference is very small. Thus, the method that will be used may result in lower sound levels by no more than 0.6 dB or less.

Comment 21: The issue of what arithmetic average is used for Eqn (9) as opposed to using logarithmic average as used in Eqn (8) was brought up by one person on the S-12 committee (Bill Murphy of NIOSH & S-12 vice-chair). Members of the WG-47 working group have also supported the use of logarithmic averaging in Eqn 9 (Val Schmidt, John Diebold) and supported the use of arithmetic averaging (Duff Kirklewski and Dave Vendittis).

Before this WG meeting, Duff Kirklewski provided a good explanation in email dated 5/19/2009. I found his explanation of why the best prepared and will repeat the important portion below:

> *Averaging decibels with regard to power (mean square) [is] obviously wrong: the powers (mean squared) must be averaged and then converted back to dB - that is immutable and well understood. However, averaging decibels with regard to serial numbers of products or sample sets (which one could consider one direction of runs in our case) is not necessarily incorrect. The purpose is entirely different as the average of the mean square value itself is not the salient point of interest when dealing with a population of widgets where an average NUMBER for the population not mean pressure (in dB terms) is desired. This is a very subtle point. I hope I can try to explain it one more time.*
>
> *When geometric averaging is carried out, it has a physical representation: i.e. an average of powers at different locations. But in this case, it is a simple average of what should be exactly the SAME result or conditions and the same locations (in other words it is NOT representative of a spatial average). I don't think it is the same case as sited below, or at least with the information given. I would agree that it is not correct to arithmetically average decibel values 99% of the time. – DUFF KIRKLEWSKI.*

Given the intensity of the questions, I inquired two people while at the ASA Conference. One was Paul Schomer, PhD, PE and standards director. I explained the two situations, one case where we wanted spatial average and one where we had independent set of events which need compilation. His answer was it could be done either way. When pressed he favored arithmetic. I had follow-on discussion with Bill Murphy who agreed that arithmetic average was not necessarily wrong. He provided an email response on 05/20/2009 with following answer:

> *Fundamentally, those arguing for geometric averaging are correct. The fact remains that for numerous applications the arithmetic average is what is used. It is used in occupational noise estimates it is used in hearing assessment of impairment. Primarily it is used to make life easier, Since the final effort is to assign one number from multiple repeated measurements, the arithmetic average is what tends to be the preferred method.*
>
> *You could sidestep the problem by noting that if the dB range of measurements is more than 3 dB, then the geometric average must be used. I would ask a different question: What is the intent of reporting this number? If it is to report a maximum level of noise from a ship, then report the max. If it is to estimate the range, then report a range. If the intent is to report an average, which method yields the higher number? I think the arithmetic might be higher. The purpose of this would seem to be to know what is the noise signature of the ship. Whether the Navy intends to use it to say how loud a ship*

*is or whether NOAA is going to estimate the hazardous effects on marine mammals and wildlife, the Max noise level is the one which is of interest.*

*So, my recommendations are report the range and report the arithmetic average.*

His final recommendation is underlined above. His comments about use of the data and likely need of users to know range and/or maximum to used the data in a conservative manner is reasonable. Amy Scholik-Schlomer from NOAA Fisheries Service agreed during the WG meeting. For evaluations relating to protected species and underwater noise, maximum values would be most useful."

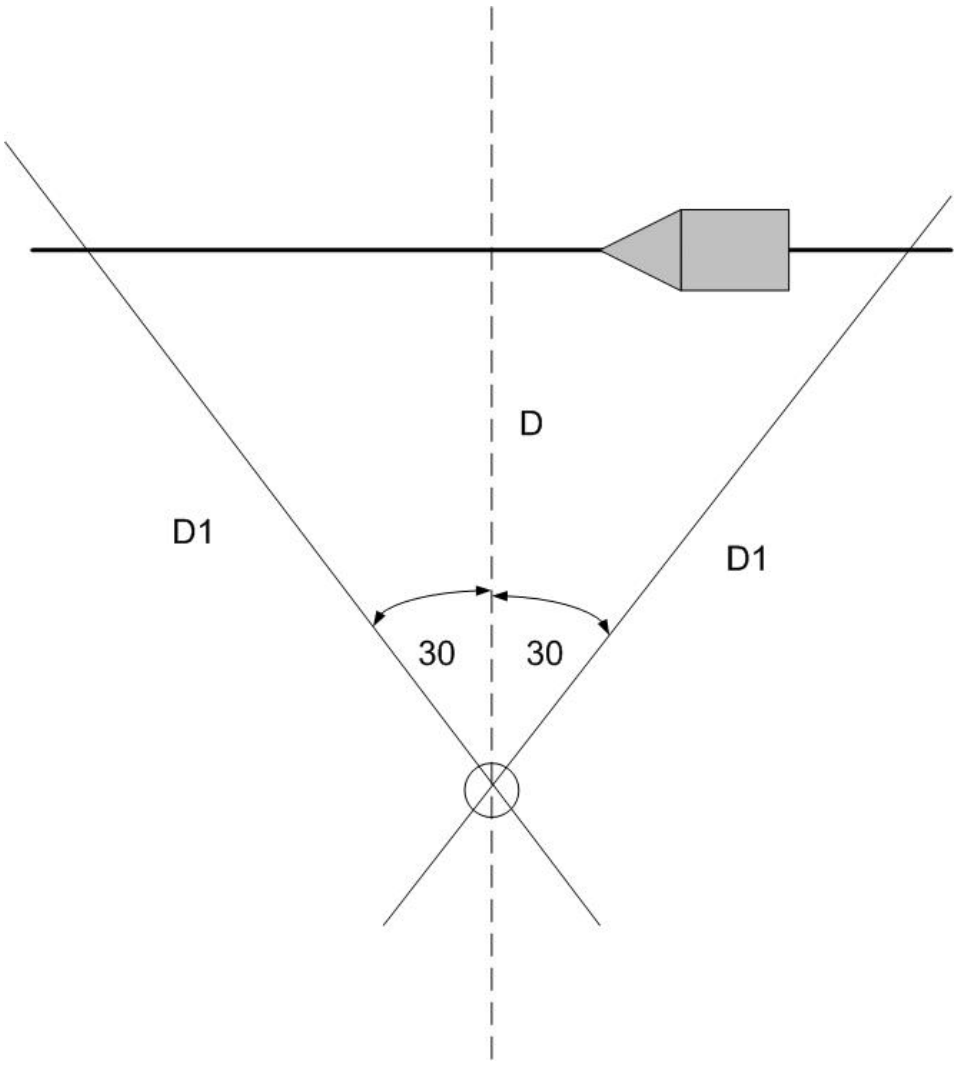
**After much discussion, the chair's decision is to keep the arithmetic average, but add requirement to report the maximum, minimum, range when requested by the specifier of the test. This will appear in section 8, Reporting.**

Comment 22: Will revise the sentence as follows: "The typical uncertainty specified for a naval acoustic range is about 1.5 to 2 dB."

**ATTENDEES**

Michael Bahtiarian (Chair), Noise Control Engineering, Inc.
Andrew Holden, DSTL (UK)
James Meyers, NUWC, Bremerton
Robert Drake, NUWC, Newport
Eric Kalapinski, TetraTech
Amy Scholik-Schomer, NOAA
Susan Blaeser, ASA Standards Manager

GEOMETRIC MEAN




D = CPA Distance which is used for current Grade B & C spreading losses, 20*log(D)

For Geometric Mean:

Dg = sqrt(D*D12) which would then be used in 20*log(D).

However from Geometry, for perfect conditions, D1 = D/cos(30°) = D/0.866 = 1.15 * D.

Thus, Dg with Geometric mean = sqrt (D*1.15*D) = sqrt($1.15*D^2$)= 1.07*D

Thus, for perfect world, Dg would be 15% larger resulting in 0.6 dB higher noise level.