

Ultrasonics – Hydrophones –
Part 2: Calibration for ultrasonic fields up to 40 MHz

CORRIGENDUM 1

Page 15

5 Overview of calibration procedures

5.1 Principles

On page 16, instead of:

NOTE 2 “Absolute” **hydrophone** calibration is understood here in the sense of “without reference to another **hydrophone**”. This is sometimes also referred to as “primary” or “substitution” procedure, which means a sensitivity comparison with a calibrated reference **hydrophone**. The reference **hydrophone** itself may have been calibrated in “absolute” terms or against another reference **hydrophone**, and so on. Obviously, there are two different, fundamental procedures: to perform an absolute **hydrophone** calibration and to compare the sensitivity of two **hydrophones**. Clauses 9, 10, 11, Annexes D, F and H deal with the former procedure. The latter procedure is dealt with in detail in Clause 12. It should be noted that a substitution calibration usually involves both steps and that the interested user should refer to both Clause 12 and other clauses dealing with absolute calibration (and that **uncertainties** from both fundamental steps contribute to the final calibration **uncertainty** in the case of a substitution calibration).

read:

NOTE 2 “Absolute” **hydrophone** calibration is understood here in the sense of “without reference to another **hydrophone**”. This is sometimes also referred to as “primary” calibration. On the other hand, **hydrophones** are often calibrated in practice following a “secondary” or “substitution” procedure, which means a sensitivity comparison with a calibrated reference **hydrophone**. The reference **hydrophone** itself may have been calibrated in “absolute” terms or against another reference **hydrophone**, and so on. Obviously, there are two different fundamental procedures: to perform an absolute **hydrophone** calibration and to compare the sensitivity of two **hydrophones**. Clauses 9, 10, 11, and Annexes D, F and H deal with the former procedure. The latter procedure is dealt with in detail in Clause 12. It should be noted that a substitution calibration usually involves both steps and that the interested user should refer to both Clause 12 and the other clauses dealing with absolute calibration (and that **uncertainties** from both fundamental steps contribute to the final calibration **uncertainty** in the case of a substitution calibration).

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6.3 Hydrophone size

In the second sentence, instead of:

“...the **effective radius of the hydrophone** shall be small compared with...”

read:

“the **effective radius of the hydrophone** shall be small compared with...”

10 Free field calibration by planar scanning

On page 26, for Equation (6), instead of:

$$P(l) = \iint \overline{l(x, y, l, t)} \cos \theta \, dy \, dz \quad (6)$$

read:

$$P(l) = \iint \overline{l(x, y, l, t)} \cos \theta \, dy \, dx \quad (6)$$

Annex D Absolute calibration of hydrophones using the planar scanning technique

D.2 Hydrophone scanning methodology

For Equation (D.2), instead of:

$$\iint \overline{[U_L(x, y, l, t)]^2} \, dy \, dx \approx \left(\frac{\pi}{N}\right) \sum_{i=1}^N \left\{ \sum_{r=R_{1i}}^{R_{2i}} [U_L(l, r)]^2 r \, \Delta r + [U_L(l, s)]^2 \left(\left(\frac{\Delta r}{2}\right) - s\right)^2 \right\} \quad (D.2)$$

read:

$$\iint \overline{[U_L(x, y, l, t)]^2} \, dy \, dx \approx \left(\frac{\pi}{N}\right) \sum_{i=1}^N \left\{ \sum_{r=R_{1i}}^{R_{2i}} [U_L(l, r)]^2 r \, \Delta r + [U_L(l, s)]^2 \left(\frac{\Delta r}{2} - s\right)^2 \right\} \quad (D.2)$$

D.3 Corrections and sources of measurement uncertainty

D.3.4 Directional response

In the last sentence of the first paragraph, instead of:

$$\theta_1 = \tan^{-1}[(x^2 + y^2)^{1/2}/l]$$

read:

$$\theta_1 = \arctan [(x^2 + y^2)^{1/2}/l]$$

D.3.6 Noise

In the first paragraph, fourth sentence, instead of :

“The rms noise level, $U_n(l, x, y)$...”

read:

“The rms noise level, $U_n(x, y, l)$...”

D.3.7 Non-linear propagation

For Equation (D.10), instead of:

$$R = l\lambda/\pi a_t^2 \quad (\text{D.10})$$

read:

$$R = l\lambda/\pi a_t^2 \quad (\text{D.10})$$

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D.4 Rationale behind the planar scanning technique for calibrating hydrophones

D.4.2 Relationship between hydrophone and transducer effective radii

For equation (D.14), instead of:

$$k a_h \sin(\theta) \leq \quad (\text{D.14})$$

read:

$$k a_h \sin(\theta) \leq 1 \quad (\text{D.14})$$

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Annex F The absolute calibration of hydrophones by optical interferometry up to 40 MHz

F.2.3.1.1 Measurement system

On page 50, for Equation (F.2), instead of:

$$\zeta = \frac{U_S \lambda_l}{2\pi T \hat{U}} \frac{V(f=0)}{V(f)} \quad (\text{F.2})$$

read:

$$\zeta = \frac{U_S \lambda_l}{2\pi T F \hat{U}} \frac{V(f=0)}{V(f)} \quad (\text{F.2})$$

and, directly following Equation (F.2), instead of:

λ_l is the optical wavelength (the wavelength of the light in vacuum;)

read:

λ_l is the optical wavelength (the wavelength of the light in vacuum;)

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F.2.3.2.4 Calibration corrections and sources of measurement uncertainty

Renumber subclause F.2.3.2.5 as F.2.3.2.4.1 and subclause F.2.3.2.6 as F.2.3.2.5.

Annex G Waveform concepts

G.4 Hydrophone position concepts

G.4.3 Far field hydrophone position with special reference to a long propagation path in order to achieve non-linear distortion (concept C)

On page 62, in the fourth sentence of the second paragraph, instead of:

“...50 % of the pressure amplitude at the source...”

read:

“...50 % of the pressure amplitude at the source...”

and instead of:

“...the harmonic number corresponding to the upper frequency band of the hydrophone...”

read:

“...the harmonic number corresponding to the upper frequency limit of the hydrophone...”

G.5 Special considerations for calibrations close to the face of a transducer

G.5.2 Influence of edge waves

In the first sentence of the note, on page 64, instead of:

“...the inequality as outlined in equation (G.6)...”

read:

“...the inequality as outlined in equation (G.5)...”

Annex H Time delay spectrometry – requirements and a brief review of the technique

H.3 Measurement procedure (sensitivity intercomparison)

Correct “b” to “b)” in the lettering of the second item.