

References (database v5.0, 21.08.2025)

References for the acoustic properties listed in our material properties database. Values for tissues of which the properties are not available in the literature are substituted with values from other tissues. In these cases, the tissue used for the value is listed instead of a reference. The rationale for each individual substitution is provided in the Rationale for Tissue Substitutions.

Tissue	Tissue Speed of Sound	Non-Linearity Parameter B/A	Attenuation Constant
Adrenal Gland	arb.	Not in Database	Thyroid Gland
Air	Kyriakou, 2015	Not in Database	Kyriakou, 2015
Bile	arb.	Duck, 1990	Duck, 1990
Blood	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990 Kyriakou, 2015	Collins et al., 1998 Duck, 1990 Kyriakou, 2015	Duck, 1990
Blood Plasma	Duck, 1990	Duck, 1990	Not in Database
Blood Serum	arb.	Not in Database	Not in Database
Blood Vessel Wall	Duck, 1990	Not in Database	Duck, 1990
Bone	Bone (Cortical)	Not in Database	Bone Cortical
Bone (Cancellous)	Duck, 1990 Hosokawa and Otani, 1995 Kyriakou, 2015 van den Bergh et al., 1999	Not in Database	El-Brawany et al., 2009
Bone (Cortical)	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990 Hosokawa and Otani, 1995 Kyriakou, 2015 Shelke et al., 2012	Not in Database	Goss et al., 1980 Hosokawa and Otani, 1995

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Bone Marrow (Red)	Hosokawa and Otani, 1995	Not in Database	Hosokawa and Otani, 1995
Bone Marrow (Yellow)	El-Sariti et al., 2006	Not in Database	Fat
Brain	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990 Kyriakou, 2015	Collins et al., 1998 Duck, 1990 Kyriakou, 2015	Collins et al., 1998 Duck, 1990
Brain (Grey Matter)	arb.	Not in Database	N/A
Brain (White Matter)	Duck, 1990	Not in Database	Duck, 1990
Breast Fat	Fat	Fat	Fat
Breast Gland	Chivers and Parry, 1978 Collins et al., 1998 Goss et al., 1978 Kyriakou, 2015	Kyriakou, 2015	Collins et al., 1998
Bronchi	Blood Vessel Wall	Not in Database	Blood Vessel Wall
Bronchi lumen	Air	Not in Database	Air
Cartilage	Nitta et al., 2013 Töyräs et al., 2002	Not in Database	Duck, 1990
Cerebellum	Duck, 1990	Brain	Goss et al., 1978
Cerebrospinal Fluid	Duck, 1990	Not in Database	Goss et al., 1978
Cervix	Duck, 1990	Not in Database	Uterus
Commissura Anterior	Brain (White Matter)	Not in Database	Brain (White Matter)
Commissura Posterior	Brain (White Matter)	Not in Database	Brain (White Matter)
Connective Tissue	Chivers and Parry, 1978	Not in Database	Tendon/Ligament
Diaphragm	Muscle	Muscle	Muscle
Ductus Deferens	Blood Vessel Wall	Not in Database	Blood Vessel Wall
Dura	arb.	Not in Database	Goss et al., 1978
Epididymis	Testis	Not in Database	Testis
Esophagus	arb.	Not in Database	Large Intestine
Esophagus Lumen	Air	Not in Database	Air
Extracellular Fluids	Duck, 1990	Not in Database	Cerebrospinal Fluid
Eye (Aqueous Humor)	Goss et al., 1978	Not in Database	Cerebrospinal Fluid

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Eye (Choroid)	De Korte et al., 1994	Blood	Blood
Eye (Ciliary Body)	Ye et al., 1995	Muscle	Muscle
Eye (Cornea)	Chivers and Parry, 1978 De Korte et al., 1994 Ye et al., 1995	Not in Database	Ye et al., 1995
Eye (Iris)	Ye et al., 1995	Muscle	Muscle
Eye (Lens)	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990 Goss et al., 1978 Kyriakou, 2015	Not in Database	Goss et al., 1978
Eye (Retina)	De Korte et al., 1994	Not in Database	Brain (Grey Matter)
Eye (Sclera)	Chivers and Parry, 1978 Duck, 1990 Ye et al., 1995	Not in Database	Ye et al., 1995
Eye (Vitreous Humor)	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990 Goss et al., 1978 Kyriakou, 2015	Not in Database	Kyriakou, 2015
Eye Lens (Cortex)	Eye (Lens)	Not in Database	Eye Lens
Eye Lens (Nucleus)	Eye (Lens)	Not in Database	Eye Lens
Fat	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990 Kyriakou, 2015	Collins et al., 1998 Duck, 1990 Kyriakou, 2015 Sehgal et al., 1984	Duck, 1990
Fat (Average Infiltrated)	Fat	Fat	Fat
Fat (Not Infiltrated)	Fat	Fat	Fat
Gallbladder	Duck, 1990	Duck, 1990	Yongchen et al., 1986
Glandula Vesiculosa	Prostate	Not in Database	Prostate
Heart Lumen	Blood	Blood	Blood

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Heart Muscle	Chivers and Parry, 1978 Duck, 1990 Kyriakou, 2015	Collins et al., 1998 Duck, 1990 Kyriakou, 2015	Duck, 1990 Goss et al., 1980
Hippocampus	arb.	Not in Database	Brain (Grey Matter)
Hypophysis	arb.	Not in Database	Thyroid Gland
Hypothalamus	arb.	Not in Database	Brain (Grey Matter)
Intervertebral Disc	Cartilage	Not in Database	Cartilage
Kidney	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990	Duck, 1990 Collins et al., 1998 Zhang and Gong, 1998	Goss et al., 1980
Kidney (Cortex)	Kyriakou, 2015 Duck, 1990	Kidney	Kyriakou, 2015
Kidney (Medulla)	Duck, 1990	Kidney	Kidney
Large Intestine	arb.	Not in Database	Goss et al., 1978
Large Intestine Lumen	Muscle and Water	Muscle and Water	Muscle and Water
Larynx	Cartilage	Not in Database	Cartilage
Liver	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990 Goss et al., 1980 Kyriakou, 2015	Bjorno et al., 1986 Collins et al., 1998 Duck, 1990 Kyriakou, 2015 Sehgal et al., 1984 Zhang and Gong, 1998	Collins et al., 1998 Duck, 1990
Lung	Lung (Inflated)	Not in Database	Lung (Inflated)
Lung (Deflated)	arb.	Not in Database	Goss et al., 1978
Lung (Inflated)	Duck, 1990	Not in Database	Dunn, 1986 Goss et al., 1978
Lymph	arb.	Not in Database	Not in Database
Lymphnode	Hildebrandt et al., 1990	Duck, 1990	Hildebrandt et al., 1990
Mandible	Bone (Cortical)	Not in Database	Bone (Cortical)

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Medulla Oblongata	Brain	Brain	Goss et al., 1978
Meniscus	Cartilage	Not in Database	Cartilage
Midbrain	Brain	Brain	Brain
Mucous Membrane	Assentoft et al., 2000 Jorgensen et al., 2001 Saijto et al., 1990	Muscle	Muscle
Muscle	Chivers and Parry, 1978 Collins et al., 1998 Duck, 1990 El-Brawny et al., 2009 Kyriakou, 2015	Bjorno et al., 1986 Collins et al., 1998 Duck, 1990 Kyriakou, 2015	Collins et al., 1998 Duck, 1990 El-Brawny et al., 2009
Nerve	Duck, 1990	Not in Database	Goss et al., 1978
Ovary	Testis	Not in Database	Siddiqi et al., 1990
Pancreas	Duck, 1990	Not in Database	Duck, 1990
Patella	Bone (Cortical)	Not in Database	Bone (Cortical)
Penis	Blood Vessel Wall	Not in Database	Blood Vessel Wall
Pharynx	Air	Not in Database	Air
Pineal Body	arb.	Not in Database	Thyroid Gland
Placenta	arb.	Not in Database	Caloone et al., 2015
Pons	Brain	Brain	Brain
Prostate	Parker et al., 1995 Verma et al., 2005	Not in Database	Parker et al., 1995
Salivary Gland	Prostate	Not in Database	Prostate
SAT (Subcutaneous Fat)	Duck, 1990 Kyriakou, 2015	Not in Database	Kyriakou, 2015
Skin	Collins et al., 1998 Duck, 1990 Kyriakou, 2015	Not in Database	Duck, 1990
Skull	Connor et al., 2002	Not in Database	Bone (Cortical)

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Small Intestine	arb.	Not in Database	Large Intestine
Small Intestine Lumen	Muscle and Water	Muscle and Water	Muscle and Water
Spinal Cord	Duck, 1990	Not in Database	Goss et al., 1978
Spleen	Chivers and Parry, 1978 Duck, 1990 Goss et al., 1980 Kyriakou, 2015	Collins et al., 1998 Duck, 1990 Kyriakou, 2015 Zhang and Gong, 1998	Duck, 1990
Stomach	arb.	Not in Database	Large Intestine
Stomach Lumen	Muscle and Water	Muscle and Water	Muscle and Water
Tendon\Ligament	Kyriakou, 2015 Duck, 1990	Not in Database	Goss et al., 1980
Testis	Duck, 1990	Not in Database	Duck, 1990 Goss et al., 1978
Thalamus	arb.	Not in Database	Brain (Grey Matter)
Thymus	Lymphnode and Fat	Lymphnode and Fat	Lymphnode and Fat
Thyroid Gland	arb.	Not in Database	Fuji et al., 2003 Zenteno et al., 2013
Tongue	Muscle	Muscle	Goss et al., 1978
Tooth	Dentin & Enamel	Not in Database	Tooth (Enamel) & Tooth (Dentin)
Tooth (Dentine)	Duck, 1990 Harput et al., 2009 Kyriakou, 2015 Shelke et al., 2012	Not in Database	Duck, 1990
Tooth (Enamel)	Duck, 1990 Harput et al., 2009 Kyriakou, 2015 Shelke et al., 2012	Not in Database	Duck, 1990
Trachea	Cartilage	Not in Database	Cartilage
Trachea Lumen	Air	Not in Database	Air
Ureter\Urethra	Blood Vessel Wall	Not in Database	Blood Vessel Wall

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Urine	Verma et al., 2005 Yongchen et al., 1986	Duck, 1990	Verma et al., 2005
Urinary Bladder Wall	arb.	Not in Database	Large Intestine
Uterus	Kyriakou, 2015	Not in Database	Duck, 1990 Goss et al., 1980
Vagina	arb.	Not in Database	Large Intestine
Vertebrae	Bone (Cortical)	Not in Database	Bone (Cortical)
Water	Kyriakou, 2015	Kyriakou, 2015	Kyriakou, 2015

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