

**References (database v4.2, 04.06.2024)**

**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	<a href="#">Kyriakou, 2015</a>	Not in Database	<a href="#">Kyriakou, 2015</a>
Bile	arb.	<a href="#">Duck, 1990</a>	<a href="#">Duck, 1990</a>
Blood	<a href="#">Chivers and Parry, 1978</a> <a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Duck, 1990</a>
Blood Plasma	<a href="#">Duck, 1990</a>	<a href="#">Duck, 1990</a>	Not in Database
Blood Serum	arb.	Not in Database	Not in Database
Blood Vessel Wall	<a href="#">Duck, 1990</a>	Not in Database	<a href="#">Duck, 1990</a>
Bone	Bone (Cortical)	Not in Database	Bone Cortical
Bone (Cancellous)	<a href="#">Duck, 1990</a> <a href="#">Hosokawa and Otani, 1995</a> <a href="#">Kyriakou, 2015</a> <a href="#">van den Bergh et al., 1999</a>	Not in Database	<a href="#">El-Brawany et al., 2009</a>
Bone (Cortical)	<a href="#">Chivers and Parry, 1978</a> <a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Hosokawa and Otani, 1995</a> <a href="#">Kyriakou, 2015</a> <a href="#">Shelke et al., 2012</a>	Not in Database	<a href="#">Goss et al., 1980</a> <a href="#">Hosokawa and Otani, 1995</a>

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Bone Marrow (Red)	<a href="#">Hosokawa and Otani, 1995</a>	Not in Database	<a href="#">Hosokawa and Otani, 1995</a>
Bone Marrow (Yellow)	<a href="#">El-Sariti et al., 2006</a>	Not in Database	Fat
Brain	<a href="#">Chivers and Parry, 1978</a> <a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a>
Brain (Grey Matter)	arb.	Not in Database	N/A
Brain (White Matter)	<a href="#">Duck, 1990</a>	Not in Database	<a href="#">Duck, 1990</a>
Breast Fat	Fat	Fat	Fat
Breast Gland	<a href="#">Chivers and Parry, 1978</a> <a href="#">Collins et al., 1998</a> <a href="#">Goss et al., 1978</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Kyriakou, 2015</a>	<a href="#">Collins et al., 1998</a>
Bronchi	Blood Vessel Wall	Not in Database	Blood Vessel Wall
Bronchi lumen	Air	Not in Database	Air
Cartilage	<a href="#">Nitta et al., 2013</a> <a href="#">Töyräs et al., 2002</a>	Not in Database	<a href="#">Duck, 1990</a>
Cerebellum	<a href="#">Duck, 1990</a>	Brain	<a href="#">Goss et al., 1978</a>
Cerebrospinal Fluid	<a href="#">Duck, 1990</a>	Not in Database	<a href="#">Goss et al., 1978</a>
Cervix	<a href="#">Duck, 1990</a>	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	<a href="#">Chivers and Parry, 1978</a>	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	<a href="#">Goss et al., 1978</a>
Epididymis	Testis	Not in Database	Testis
Esophagus	arb.	Not in Database	Large Intestine
Esophagus Lumen	Air	Not in Database	Air
Extracellular Fluids	<a href="#">Duck, 1990</a>	Not in Database	Cerebrospinal Fluid
Eye (Aqueous Humor)	<a href="#">Goss et al., 1978</a>	Not in Database	Cerebrospinal Fluid

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

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Tissue	Tissue Speed of Sound	Non-Linearity Parameter B/A	Attenuation Constant
Heart Muscle	<a href="#">Chivers and Parry, 1978</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Duck, 1990</a> <a href="#">Goss et al., 1980</a>
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	<a href="#">Chivers and Parry, 1978</a> <a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a>	<a href="#">Duck, 1990</a> <a href="#">Collins et al., 1998</a> <a href="#">Zhang and Gong, 1998</a>	<a href="#">Goss et al., 1980</a>
Kidney (Cortex)	<a href="#">Kyriakou, 2015</a> <a href="#">Duck, 1990</a>	Kidney	<a href="#">Kyriakou, 2015</a>
Kidney (Medulla)	<a href="#">Duck, 1990</a>	Kidney	Kidney
Large Intestine	arb.	Not in Database	<a href="#">Goss et al., 1978</a>
Large Intestine Lumen	Muscle and Water	Muscle and Water	Muscle and Water
Larynx	Cartilage	Not in Database	Cartilage
Liver	<a href="#">Chivers and Parry, 1978</a> <a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Goss et al., 1980</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Bjorno et al., 1986</a> <a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a> <a href="#">Sehgal et al., 1984</a> <a href="#">Zhang and Gong, 1998</a>	<a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a>
Lung	Lung (Inflated)	Not in Database	Lung (Inflated)
Lung (Deflated)	arb.	Not in Database	<a href="#">Goss et al., 1978</a>
Lung (Inflated)	<a href="#">Duck, 1990</a>	Not in Database	<a href="#">Dunn, 1986</a> <a href="#">Goss et al., 1978</a>
Lymph	arb.	Not in Database	Not in Database
Lymphnode	<a href="#">Hildebrandt et al., 1990</a>	<a href="#">Duck, 1990</a>	<a href="#">Hildebrandt et al., 1990</a>
Mandible	Bone (Cortical)	Not in Database	Bone (Cortical)

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Medulla Oblongata	Brain	Brain	<a href="#">Goss et al., 1978</a>
Meniscus	Cartilage	Not in Database	Cartilage
Midbrain	Brain	Brain	Brain
Mucous Membrane	<a href="#">Assentoft et al., 2000</a> <a href="#">Jorgensen et al., 2001</a> <a href="#">Saijto et al., 1990</a>	Muscle	Muscle
Muscle	<a href="#">Chivers and Parry, 1978</a> <a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">El-Brawny et al., 2009</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Bjorno et al., 1986</a> <a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">El-Brawny et al., 2009</a>
Nerve	<a href="#">Duck, 1990</a>	Not in Database	<a href="#">Goss et al., 1978</a>
Ovary	Testis	Not in Database	<a href="#">Siddiqi et al., 1990</a>
Pancreas	<a href="#">Duck, 1990</a>	Not in Database	<a href="#">Duck, 1990</a>
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	<a href="#">Caloone et al., 2015</a>
Pons	Brain	Brain	Brain
Prostate	<a href="#">Parker et al., 1995</a> <a href="#">Verma et al., 2005</a>	Not in Database	<a href="#">Parker et al., 1995</a>
Salivary Gland	Prostate	Not in Database	Prostate
SAT (Subcutaneous Fat)	<a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	Not in Database	<a href="#">Kyriakou, 2015</a>
Skin	<a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a>	Not in Database	<a href="#">Duck, 1990</a>
Skull	<a href="#">Connor et al., 2002</a>	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	<a href="#">Duck, 1990</a>	Not in Database	<a href="#">Goss et al., 1978</a>
Spleen	<a href="#">Chivers and Parry, 1978</a> <a href="#">Duck, 1990</a> <a href="#">Goss et al., 1980</a> <a href="#">Kyriakou, 2015</a>	<a href="#">Collins et al., 1998</a> <a href="#">Duck, 1990</a> <a href="#">Kyriakou, 2015</a> <a href="#">Zhang and Gong, 1998</a>	<a href="#">Duck, 1990</a>
Stomach	arb.	Not in Database	Large Intestine
Stomach Lumen	Muscle and Water	Muscle and Water	Muscle and Water
Tendon\Ligament	<a href="#">Kyriakou, 2015</a> <a href="#">Duck, 1990</a>	Not in Database	<a href="#">Goss et al., 1980</a>
Testis	<a href="#">Duck, 1990</a>	Not in Database	<a href="#">Duck, 1990</a> <a href="#">Goss et al., 1978</a>
Thalamus	arb.	Not in Database	Brain (Grey Matter)
Thymus	Lymphnode and Fat	Lymphnode and Fat	Lymphnode and Fat
Thyroid Gland	arb.	Not in Database	<a href="#">Fuji et al., 2003</a> <a href="#">Zenteno et al., 2013</a>
Tongue	Muscle	Muscle	<a href="#">Goss et al., 1978</a>
Tooth	Dentin & Enamel	Not in Database	Tooth (Enamel) & Tooth (Dentin)
Tooth (Dentine)	<a href="#">Duck, 1990</a> <a href="#">Harput et al., 2009</a> <a href="#">Kyriakou, 2015</a> <a href="#">Shelke et al., 2012</a>	Not in Database	<a href="#">Duck, 1990</a>
Tooth (Enamel)	<a href="#">Duck, 1990</a> <a href="#">Harput et al., 2009</a> <a href="#">Kyriakou, 2015</a> <a href="#">Shelke et al., 2012</a>	Not in Database	<a href="#">Duck, 1990</a>
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	<a href="#">Verma et al., 2005</a> <a href="#">Yongchen et al., 1986</a>	<a href="#">Duck, 1990</a>	<a href="#">Verma et al., 2005</a>
Urinary Bladder Wall	arb.	Not in Database	Large Intestine
Uterus	<a href="#">Kyriakou, 2015</a>	Not in Database	<a href="#">Duck, 1990</a> <a href="#">Goss et al., 1980</a>
Vagina	arb.	Not in Database	Large Intestine
Vertebrae	Bone (Cortical)	Not in Database	Bone (Cortical)
Water	<a href="#">Kyriakou, 2015</a>	<a href="#">Kyriakou, 2015</a>	<a href="#">Kyriakou, 2015</a>

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