

Thermal Properties

The following physiological properties were compiled by Professor Kenneth R. Holmes <krholmes@ux1.cso.uiuc.edu> and were published in part previously.ⁿ The tabulation includes values for both the native thermal conductivity of biomaterials (Appendix A) and the blood perfusion rates for specific tissues and organs (Appendix B). Original sources are documented in the dedicated list of references at the end of each appendix. Knowledge of the perfusion behavior of tissues is important in that the flow of blood can have a direct quantitative effect on the temperature distribution within living tissue.

APPENDIX A

THERMAL CONDUCTIVITY DATA FOR SPECIFIC TISSUES AND ORGANS FOR HUMANS AND OTHER MAMMALIAN SPECIES

Professor Kenneth R. Holmes

<u>TISSUE</u>	<u>k (W/mK)</u>	<u>%H₂O</u>	<u>Reference</u>	
Kidney	whole (rabbit)	.502	6	
	whole (rabbit)	.495	16	
	whole (human)	.543	4	
	cortex (rabbit)	.465 - .490 (n=7)	76.6 - 79.8	1
	cortex (dog)	.491		16
	cortex (human)	.499		16
	medulla (rabbit)	.502 - .544 (n=7)	82.0 - 86.0	1
	medulla (dog)	.507		16
	medulla (human)	.499		16
Aorta	human	.476 ± .041 (SD) (n=12)	2	
Arterial plaque	fatty	.484 ± .044 (SD) (n=13)	2	
	fibrous	.485 ± .022 (SD) (n=12)	2	

	calcified	.502 ± .059 (SD) (n=17)		2
Artery	femoral (dog)	.391		2
	carotid (dog)	.448		2
Blood	whole	.505		10
	whole (human)	.492 ± .009 (SD) (n=10)		5
	plasma	.582		10
	plasma (human)	.570 ± .010 (SD) (n=10)		5
Spleen	(human)	.543	80	4
Liver	(rabbit)	.493	72	6
	(rat)	.498 - .528 (n=4)		3
	(sheep)	.495 ± .017 (SD) (n=9)		5
	(dog)	.550 ± .010 (SD) (n=7)		5
	(dog)	.574		11
	(pig)	.498		16
	(human)	.469		16
	(human)	.564	77	4
Heart	(rat)	.521 - .531 (n=2)		3
	(dog)	.527		11
	(dog)	.487		16
	(pig)	.484		16
	(human)	.493		16
	(human)	.585	81	4
	<u>TISSUE</u>	<u>k (W/mK)</u>	<u>%H₂O</u>	<u>Reference</u>
Muscle	(rat)	.505 - .530 (n=7)		3
	(cow)	.410 - .426		7
	(pig)	.518 - .618		7
	(pig)	.460		17
	(sheep)	.478 ± .019 (SD) (n=10)		5
Fat (cow)		.185 - .233		7
	(cow)	.222		17
	(pig)	.317 - .402		7
	(pig)	.159		17
	blubber (Minke whale)	.200 - .280	3 - 30	8
	blubber (Harp seal)	.190 ± .010		9
	(human)	.201 - .217		17

Brain	whole	.527	78	4
	cerebral cortex	.564	83	4
	cerebral cortex	.504		16
	white matter	.502	71	4
Tumor	periphery	.511		11
	core	.561		11
	colon cancer (human)	.545		16
Bone		.410 - .630		15
Skin		.210 - .410		15
	crocodile, middle of back	.432		12
	crocodile, tail, ventral	.334		12
	epidermis			
	foot pad (cat)	.116 - .290		13
	(hydrated)	.295 - .580		13
	elephant (freeze/thaw)	.475	62.5	14
	rhinoceros "	.452	60.1	14
	Giraffe (formalin fixed)	.442	60.0	14
	epidermis (human)	.209		17
	epidermis (pig)	.209		17
	dermis (human)	.293 - .322		17
Pure water		.627		17
c = [%H ₂ O + 0.4 * (100 - %H ₂ O)] * 41.9 J/kg K				4
= 1.05(10 ³) kg/m ³				4

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APPENDIX B

BLOOD PERFUSION DATA FOR SPECIFIC TISSUES AND ORGANS

FOR HUMANS AND OTHER MAMMALIAN SPECIES

Professor Kenneth R. Holmes

ORGAN	BLOOD FLOW (ml/min/gm)	SPECIES (¶ unanesthetized)	Ref.	Technique
Brain	0.36 ± 0.04 (SE)	dog (n=11)	36	µs (pentobarbital)
Brain	0.78 ± 0.06 (SE)	rat (n=7)	30	µs
Brain	1.52 ± 0.23 (SE)	fetal sheep [¶] (n=12)	32	µs
Brain	0.82 ± 0.06 (SE)	neonatal sheep [¶] (n=13)	37	µs
Brain	0.64 ± 0.03 (SE)	sheep [¶] (n=7)	37	µs
Brain	1.14 ± 0.14 (SD)	rat [¶] (12 mo old)(n=5)	33	µs
Brain	0.65 ± 0.07 (SD)	rat (n=10)	33	µs (pentobarbital)
Brain	1.31 ± 0.22 (SD)	rat [¶] (24 mo old)(n=5)	33	µs
Brain	0.43 ± 0.14 (SD)	rat (n=7)	33	µs (decerebrate)
Mean Cerebral	0.373 ± 0.062	dog	2	
Mean Cerebral	0.491 ± 0.078	baboon	2	
Cerebrum	0.48 ± 0.03	cat	18	
Cerebrum	0.53 ± 0.06	cat	18	
Cerebrum	0.32 ± 0.06	monkey	18	
Cerebrum	0.39 ± 0.03	monkey	18	
Cerebrum	0.79 ± 0.12	pig [¶]	19	
Cerebrum	1.17 ± 0.11 (SE)	rat [¶] (n=8)	31	µs
Cerebrum	0.61 ± 0.06 (SE)	rat (n=7)	31	µs (pentobarbital)
Cerebrum	0.72 ± 0.05 (SE)	rat (n=7)	31	µs (chlor.-urethan)
Cerebrum	0.50 ± 0.04 (SE)	rat (n=7)	31	µs (decerebrate)
Cerebrum	0.60 ± 0.06 (SE)	cat (n=8)	34	µs (-chloralose)
Cerebrum	1.29 ± 0.03 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
cerebral cortex	0.446 ± 0.061	dog	2	
cerebral cortex	0.447 ± 0.036	dog	3	
cerebral cortex	0.64 ± 0.05	cat	18	
cerebral cortex	0.75 ± 0.11	cat	18	
cerebral cortex	0.40 ± 0.11	monkey	18	
cerebral cortex	0.50 ± 0.11	monkey	18	
frontal cortex	1.06 ± 0.05	rat	4	
parietal cortex	1.07 ± 0.05	rat	4	
occipital cortex	0.98 ± 0.08	rat	4	
cerebral white	0.240 ± 0.037	dog	2	
cerebral white	0.305 ± 0.022	dog	3	
cerebral white	0.20 ± 0.05	monkey	18	
cerebral white	0.21 ± 0.06	monkey	18	
cerebral white	0.29 ± 0.03	cat	18	
cerebral white	0.20 ± 0.03 (SE)	cat (n=8)	34	µs (-chloralose)

cerebral white	0.35 ± 0.09 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
White matter	0.164 ± 0.022	baboon	2	
corpus callosum	0.249 ± 0.035	dog	3	
corpus callosum	0.62 ± 0.03	rat	4	
Grey matter	0.552 ± 0.077	baboon	2	
cortical grey	0.87 ± 0.11 (SE)	cat (n=8)	34	µs (-chloralose)
cortical grey	1.94 ± 0.37 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
caudate nucleus	0.88 ± 0.03	rat	4	
caudate nucleus	0.65 ± 0.06	cat	18	
caudate nucleus	0.87 ± 0.11	cat	18	
caudate nucleus	0.39 ± 0.05	monkey	18	
caudate nucleus	0.47 ± 0.05	monkey	18	
caudate nucleus	0.85 ± 0.10 (SE)	cat (n=8)	34	µs (-chloralose)
caudate nucleus	1.31 ± 0.19 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
Choroid plexus	4.18 ± 0.60 (SE)	neonatal sheep [¶] (n=13)	37	µs
Choroid plexus	7.53 ± 1.11 (SE)	sheep [¶] (n=7)	37	µs
Hypothalamus	1.03 ± 0.06	rat	4	
Pituitary	1.08 ± 0.24 (SE)	neonatal sheep [¶] (n=13)	37	µs
Pituitary	1.13 ± 0.16 (SE)	sheep [¶] (n=7)	37	µs
Thalamus	0.92 ± 0.07	rat	4	
thalamus-midbrain	0.62 ± 0.07 (SE)	cat (n=8)	34	µs (-chloralose)
thalamus-midbrain	1.64 ± 0.32 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
Hippocampus	0.68 ± 0.06	rat	4	
Cerebellum	0.63 ± 0.04	cat	18	
Cerebellum	0.70 ± 0.07	cat	18	
Cerebellum	0.60 ± 0.08 (SE)	cat (n=8)	34	µs (-chloralose)
Cerebellum	1.63 ± 0.31 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
Cerebellum	0.40 ± 0.08	monkey	18	
Cerebellum	0.50 ± 0.02	monkey	18	
Cerebellum	0.78 ± 0.06	pig [¶]	19	
Cerebellum	1.31 ± 0.19 (SE)	rat [¶] (n=8)	31	µs
Cerebellum	1.02 ± 0.12 (SE)	rat (n=7)	31	µs (pentobarbital)
Cerebellum	1.04 ± 0.08 (SE)	rat (n=7)	31	µs (chlor.-urethan)
Cerebellum	0.78 ± 0.07 (SE)	rat (n=7)	31	µs (decerebrate)
Pons	0.50 ± 0.03 (SE)	cat (n=8)	34	µs (-chloralose)
Pons	1.18 ± 0.25 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
Medulla	0.37 ± 0.06 (SE)	cat (n=8)	34	µs (-chloralose)
Medulla	1.07 ± 0.20 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
Medulla	0.84 ± 0.04	rat	4	
Brain stem	0.52 ± 0.03	cat	18	
Brain stem	0.58 ± 0.03	cat	18	
Brain stem	0.33 ± 0.06	monkey	18	
Brain stem	0.36 ± 0.03	monkey	18	
Brain stem	0.46 ± 0.06	pig [¶]	19	
Brain stem	0.55 ± 0.05 (SE)	cat (n=8)	34	µs (-chloralose)
Brain stem	1.44 ± 0.28 (SE)	cat (n=8) (hypercapnic)	34	µs (-chloralose)
Spinal cord	0.22 ± 0.02	cat	18	
Spinal cord	0.31 ± 0.03	cat	18	
Spinal cord	0.20 ± 0.03	monkey	18	
Spinal cord	0.21 ± 0.03	monkey	18	
Nerve, sciatic	0.27 ± 0.03 (SE)	rat (n=14)	29	[¹⁴ C]iodoantipyrine

Kidney	3.018 ± 0.412 (SE)	dog (n=11)	36	μs (pentobarbital)
Kidney	3.99 ± 0.88 (SD)	rat [†] (12 mo old)(n=5)	33	μs
Kidney	3.64 ± 0.92 (SD)	rat (n=10)	33	μs (pentobarbital)
Kidney	4.82 ± 1.39 (SD)	rat [†] (24 mo old)(n=5)	33	μs
Kidney	2.31 ± 0.82 (SD)	rat (n=7)	33	μs (decerebrate)
Kidney	1.54 ± 0.12 (SE)	fetal sheep [†] (n=12)	32	μs
Kidney	3.00 ± 0.14 (SE)	neonatal sheep [†] (n=13)	37	μs
Kidney	4.19 ± 0.32 (SE)	sheep [†] (n=7)	37	μs
Kidney	4.32 ± 0.30	dog	3	
Kidney	3.2 ± 0.3	rabbit	17	
Kidney	2.80 ± 0.05	pig [†]	19	
Kidney	4.7 ± 0.3	rat	13	
Kidney	5.55 (4.87-8.76)	rat (n=14)	26	
Kidney	6.23 ± 0.49	rat (n=9)	27	
Kidney	4.38 ± 0.51 (SE)	rat (n=7)	30	μs
Kidney	4.38 ± 0.44 (SE)	rat (n=7)	30	μs
Kidney	7.63 ± 0.46 (SE)	rat [†] (n=8)	31	μs
Kidney	6.16 ± 0.39 (SE)	rat (n=7)	31	μs (pentobarbital)
Kidney	5.96 ± 0.42 (SE)	rat (n=7)	31	μs (chlor.-urethan)
Kidney	5.46 ± 0.53 (SE)	rat (n=7)	31	μs (decerebrate)
whole cortex	4.0-5.0	human [†]	6	
whole cortex	3.63 ± 0.54	pig	8	
	(range = 3.0-4.4)			
whole cortex	3.71 ± 0.284	pig (n=4)	25	
whole cortex	4.69 ± 0.347	pig (n=6)	25	
whole cortex	5.06 ± 0.251	pig (n=6)	25	
whole cortex	3.25 ± 0.20 (SE)	sheep [†] (n=6)	40	μs
outer cortex	3.81 ± 0.23 (SE)	sheep [†] (n=6)	40	μs
outer cortex	6.32 ± 0.33	dog	3	
outer cortex	7.56 ± 0.70	dog	11	
outer cortex	4.62	dog	7	
outer cortex	8.84 ± 0.014	rabbit	5	
outer cortex	8.7 ± 0.6	rat	13	
middle cortex	9.53 ± 0.013	rabbit	5	
inner cortex	2.57 ± 0.22 (SE)	sheep [†] (n=6)	40	μs
inner cortex	4.38 ± 1.19	dog	11	
inner cortex	3.35 ± 0.42	dog	3	
inner cortex	3.96	dog	7	
inner cortex	3.24 ± 0.004	rabbit	5	
inner cortex	4.7 ± 0.4	rat	13	
outer 1/4 cortex	4.24 ± 0.40	dog	12	
next 1/4	6.24 ± 0.61	dog	12	
next 1/4	3.55 ± 0.45	dog	12	
inner 1/4	1.73 ± 0.13	dog	12	
medulla	0.35 ± 0.09 (SE)	sheep [†] (n=6)	40	μs
medulla	0.77 ± 0.064	dog	3	
outer medulla	1.2	human [†]	6	
outer medulla	1.30	dog	7	
outer medulla	2.10 ± 0.28	dog	11	
inner medulla	0.25	human [†]	6	
Adrenal gland	7.62 ± 2.55 (SE)	fetal sheep [†] (n=12)	32	μs

Adrenal gland	1.83 ± 0.12 (SE)	neonatal sheep (n=13)	37	μs
Adrenal gland	1.99 ± 0.13 (SE)	sheep [†] (n=7)	37	μs
Adrenal gland	1.341 ± 0.297 (SE)	dog (n=11)	36	μs (pentobarbital)
Muscle				
skeletal	0.027 (average)	human [†]	16	
skeletal	0.12 ± 0.02 (SE)	neonatal sheep [†] (n=13)	37	μs
skeletal	0.04 ± 0.01 (SE)	sheep [†] (n=7)	37	μs
skeletal	0.18 ± 0.07 (SD)	rat [†] (12 mo old)(n=5)	33	μs
skeletal	0.03 ± 0.01 (SD)	rat (n=10)	33	μs (pentobarbital)
skeletal	0.22 ± 0.12 (SD)	rat [†] (24 mo old)(n=5)	33	μs
skeletal	0.05 ± 0.02 (SD)	rat (n=7)	33	μs (decerebrate)
skeletal	0.39 ± 0.20 (SD)	rat (n=12)	41	¹³³ Xe (ether)
resting thigh				
1.5 cm depth	0.018 ± 0.011	human [†]	14	
3.0 cm depth	0.026 ± 0.013	human [†]	14	
resting thigh	0.020-0.022	human [†]	15	
vastus medialis & triceps				
	0.14 ± 0.03	pig [†]	19	
gracilis				
	0.049 ± 0.064	dog	2	
masseter				
	0.09 ± 0.01 (SE)	rat (n=7)	30	μs
cremaster				
	0.16 ± 0.03 (SE)	rat (n=7)	30	μs
	0.07 ± 0.018 (SE)	rat [†] (n=8)	31	μs
	0.06 ± 0.008 (SE)	rat (n=7)	31	μs (pentobarbital)
	0.05 ± 0.013 (SE)	rat (n=7)	31	μs (chlor.-urethan)
	0.04 ± 0.012 (SE)	rat (n=7)	31	μs (decerebrate)
diaphragm				
	0.93 ± 0.19 (SE)	rat [†] (n=8)	31	μs
	0.22 ± 0.02 (SE)	rat (n=7)	31	μs (pentobarbital)
	0.24 ± 0.04 (SE)	rat (n=7)	31	μs (chlor.-urethan)
	0.35 ± 0.04 (SE)	rat (n=7)	31	μs (decerebrate)
	0.144 ± 0.017 (SE)	dog (n=11)	36	μs (pentobarbital)
rectus abdominus				
	0.18 ± 0.029 (SE)	rat [†] (n=8)	31	μs
	0.04 ± 0.008 (SE)	rat (n=7)	31	μs (pentobarbital)
	0.09 ± 0.025 (SE)	rat (n=7)	31	μs (chlor.-urethan)
	0.09 ± 0.027 (SE)	rat (n=7)	31	μs (decerebrate)
gastrocnemius				
	0.11 ± 0.022 (SE)	rat [†] (n=8)	31	μs (decerebrate)
	0.04 ± 0.003 (SE)	rat (n=7)	31	μs (decerebrate)
	0.15 ± 0.084 (SE)	rat (n=7)	31	μs (decerebrate)
	0.06 ± 0.019 (SE)	rat (n=7)	31	μs (decerebrate)
tibialis anterior				
	0.36 ± 0.068 (SE)	rat [†] (n=8)	31	μs (decerebrate)
	0.03 ± 0.004 (SE)	rat (n=7)	31	μs (decerebrate)

tibialis anterior	0.17 ± 0.11 (SE)	rat (n=7)	31	µs (decerebrate)
tibialis anterior	0.08 ± 0.03 (SE)	rat (n=7)	31	µs (decerebrate)
psoas	0.26 ± 0.034 (SE)	rat [¶] (n=8)	31	µs (decerebrate)
psoas	0.04 ± 0.004 (SE)	rat (n=7)	31	µs (decerebrate)
psoas	0.09 ± 0.037 (SE)	rat (n=7)	31	µs (decerebrate)
psoas	0.07 ± 0.022 (SE)	rat (n=7)	31	µs (decerebrate)
heart	3.72 ± 0.45 (SE)	fetal sheep [¶] (n=12)	32	µs
heart	2.16 ± 0.23 (SE)	neonatal sheep [¶] (n=13)	37	µs
heart	1.13 ± 0.09 (SE)	sheep [¶] (n=7)	37	µs
heart	5.45 ± 0.59 (SE)	rat (n=7)	30	µs
heart	5.31 ± 0.59 (SE)	rat [¶] (n=8)	31	µs
heart	2.83 ± 0.60 (SE)	rat (n=7)	31	µs (pentobarbital)
heart	2.23 ± 0.37 (SE)	rat (n=7)	31	µs (chlor.-urethan)
heart	3.19 ± 0.55 (SE)	rat (n=7)	31	µs (decerebrate)
heart	6.61 ± 2.20 (SD)	rat [¶] (12 mo old)(n=5)	33	µs
heart	5.45 ± 1.62 (SD)	rat (n=10)	33	µs (pentobarbital)
heart	8.66 ± 2.74 (SD)	rat [¶] (24 mo old)(n=5)	33	µs
heart	3.67 ± 1.03 (SD)	rat (n=7)	33	µs (decerebrate)
right ventricle	0.92 ± 0.12	pig [¶]	19	
left ventricle	1.45 ± 0.09	pig [¶]	19	
left ventricle	1.58 ± 0.13	dog	20	
left ventricle	1.09 ± 0.35	dog	21	
left ventricle	0.61 ± 0.41	dog	22	
left ventricle	0.88 ± 0.14	dog	23	
epicardium	0.89 ± 0.14	dog	24	
epicardium	0.86 ± 0.14	dog	24	
endocardium	1.14 ± 0.18	dog	24	
endocardium	1.08 ± 0.18	dog	24	
GI				
intestine	0.47 ± 0.05 (SE)	fetal sheep [¶] (n=12)	32	µs
intestine	0.389 ± 0.04	dog	3	
tract	2.05 ± 0.25	rat [¶] (n=8)	31	µs
tract	1.31 ± 0.11	rat (n=7)	31	µs (pentobarbital)
tract	1.26 ± 0.09	rat (n=7)	31	µs (chlor.-urethan)
tract	1.19 ± 0.14	rat (n=7)	31	µs (decerebrate)
stomach	1.27 ± 0.21 (SE)	rat [¶] (n=8)	31	µs
stomach	0.46 ± 0.04 (SE)	rat (n=7)	31	µs (pentobarbital)
stomach	0.53 ± 0.05 (SE)	rat (n=7)	31	µs (chlor.-urethan)
stomach	0.52 ± 0.07 (SE)	rat (n=7)	31	µs (decerebrate)
stomach	1.31 ± 0.30 (SD)	rat [¶] (12 mo old)(n=5)	33	µs
stomach	0.55 ± 0.21 (SD)	rat (n=10)	33	µs (pentobarbital)
stomach	1.50 ± 0.45 (SD)	rat [¶] (24 mo old)(n=5)	33	µs
stomach	0.42 ± 0.21 (SD)	rat (n=7)	33	µs (decerebrate)
stomach	0.53 ± 0.26 (SD)	dog (n=12)	39	Rb ⁸⁶ (pentobarbital)

duodenum	1.11 ± 0.46 (SD)	dog (n=12)	39	Rb ⁸⁶ (pentobarbital)
duodenum	0.901 ± 0.132 (SE)	dog (n=11)	36	µs (pentobarbital)
duodenum	3.63 ± 0.70 (SD)	rat [†] (12 mo old)(n=5)	33	µs
duodenum	2.33 ± 0.89 (SD)	rat (n=10)	33	µs (pentobarbital)
duodenum	3.31 ± 0.64 (SD)	rat [†] (24 mo old)(n=5)	33	µs
duodenum	2.00 ± 0.76 (SD)	rat (n=7)	33	µs (decerebrate)
jejunum	0.642 ± 0.086 (SE)	dog (n=11)	36	µs (pentobarbital)
jejunum	0.263 ± 0.034 (SE)	cat (n=12)	35	µs (pentobarbital)
ileum	0.498 ± 0.083 (SE)	dog (n=11)	36	µs (pentobarbital)
small bowel	1.00 ± 0.45 (SD)	dog (n=12)	39	Rb ⁸⁶ (pentobarbital)
small bowel	2.09 ± 0.17 (SE)	neonatal sheep [†] (n=13)	37	µs
small bowel	0.81 ± 0.06 (SE)	sheep [†] (n=7)	37	µs
small bowel	2.81 ± 0.46 (SE)	rat [†] (n=8)	31	µs
small bowel	1.73 ± 0.18 (SE)	rat (n=7)	31	µs (pentobarbital)
small bowel	1.67 ± 0.13 (SE)	rat (n=7)	31	µs (chlor.-urethan)
small bowel	1.52 ± 0.20 (SE)	rat (n=7)	31	µs (decerebrate)
cecum	1.89 ± 0.19 (SE)	rat [†] (n=8)	31	µs
cecum	1.52 ± 0.08 (SE)	rat (n=7)	31	µs (pentobarbital)
cecum	1.51 ± 0.15 (SE)	rat (n=7)	31	µs (chlor.-urethan)
cecum	1.55 ± 0.22 (SE)	rat (n=7)	31	µs (decerebrate)
colon	1.24 ± 0.57 (SD)	dog (n=12)	39	Rb ⁸⁶ (pentobarbital)
colon	0.711 ± 0.065 (SE)	dog (n=11)	36	µs (pentobarbital)
large bowel	0.92 ± 0.06 (SE)	neonatal sheep [†] (n=13)	37	µs
large bowel	0.55 ± 0.09 (SE)	sheep [†] (n=7)	37	µs
large bowel	1.33 ± 0.29 (SE)	rat [†] (n=8)	31	µs
large bowel	0.66 ± 0.09 (SE)	rat (n=7)	31	µs (pentobarbital)
large bowel	0.59 ± 0.07 (SE)	rat (n=7)	31	µs (chlor.-urethan)
large bowel	0.70 ± 0.13 (SE)	rat (n=7)	31	µs (decerebrate)
Pancreas	0.008-0.016	dog	1	
Pancreas	0.545 ± 0.070 (SE)	dog (n=11)	36	µs (pentobarbital)
Pancreas	0.652 ± 0.26 (SD)	dog (n=12)	39	Rb ⁸⁶ (pentobarbital)
Liver				
hep art. + portal	2.65 ± 0.530	pig (n=4)	25	
hep art. + portal	2.53 ± 0.184	pig (n=6)	25	
hep art. + portal	3.17 ± 0.228	pig (n=6)	25	
hep art. + portal	1.40 ± 0.15 (SE)	rat [†] (n=8)	31	µs
hep art. + portal	1.19 ± 0.07 (SE)	rat (n=7)	31	µs (pentobarbital)
hep art. + portal	1.22 ± 0.09 (SE)	rat (n=7)	31	µs (chlor-urethan)
hep art. + portal	1.25 ± 0.16 (SE)	rat (n=7)	31	µs (decerebrate)
via portal vein	1.25	rat	25	
via portal vein	1.19 ± 0.12 (SE)	rat [†] (n=8)	31	µs
via portal vein	0.98 ± 0.05 (SE)	rat (n=7)	31	µs (pentobarbital)
via portal vein	0.98 ± 0.10 (SE)	rat (n=7)	31	µs (chlor.-urethan)
via portal vein	0.93 ± 0.12 (SE)	rat (n=7)	31	µs (decerebrate)

via hepatic art.	0.24 ± 0.04	pig	3	
via hepatic art.	0.22 ± 0.04	pig [†]	19	
via hepatic art.	0.15 ± 0.03	rat (n=9)	27	
via hepatic art.	0.22 ± 0.05 (SE)	rat [†] (n=8)	31	µs
via hepatic art.	0.21 ± 0.05 (SE)	rat (n=7)	31	µs (pentobarbital)
via hepatic art.	0.23 ± 0.02 (SE)	rat (n=7)	31	µs (chlor.-urethan)
via hepatic art.	0.31 ± 0.07 (SE)	rat (n=7)	31	µs (decerebrate)
via hepatic art.	0.10 ± 0.05 (SE)	fetal sheep [†] (n=12)	32	µs
via hepatic art.	0.10 ± 0.03 (SE)	neonatal sheep [†] (n=13)	37	µs
via hepatic art.	0.14 ± 0.05 (SE)	sheep [†] (n=7)	37	µs
via hepatic art.	0.02 ± 0.02 (SD)	rat [†] (12 mo old)(n=5)	33	µs
via hepatic art.	0.07 ± 0.04 (SD)	rat (n=10)	33	µs (pentobarbital)
via hepatic art.	0.03 ± 0.01 (SD)	rat [†] (24 mo old)(n=5)	33	µs
via hepatic art.	0.11 ± 0.07 (SD)	rat (n=7)	33	µs (decerebrate)
via hepatic art.	0.178 ± 0.050 (SE)	dog (n=11)	36	µs (pentobarbital)
via hepatic art.	0.31 ± 0.30 (SD)	rabbit (n=5)	42	µs
Spleen	1.46 ± 0.14	dog	3	
Spleen	1.381 ± 0.199 (SE)	dog (n=11)	36	µs (pentobarbital)
Spleen	3.60 ± 0.16	pig [†]	19	
Spleen	1.64 ± 0.14 (SE)	rat [†] (n=8)	31	µs
Spleen	1.52 ± 0.22 (SE)	rat (n=7)	31	µs (pentobarbital)
Spleen	2.35 ± 0.49 (SE)	rat (n=7)	31	µs (chlor.-urethan)
Spleen	2.01 ± 0.22 (SE)	rat (n=7)	31	µs (decerebrate)
Spleen	5.43 ± 1.13 (SE)	fetal sheep [†] (n=12)	32	µs
Spleen	4.03 ± 0.73 (SE)	neonatal sheep [†] (n=13)	37	µs
Spleen	1.88 ± 0.27 (SE)	sheep [†] (n=7)	37	µs
Spleen	1.51 ± 0.54 (SD)	rat [†] (12 mo old)(n=5)	33	µs
Spleen	0.75 ± 0.37 (SD)	rat (n=10)	33	µs (pentobarbital)
Spleen	1.13 ± 0.38 (SD)	rat [†] (24 mo old)(n=5)	33	µs
Spleen	0.40 ± 0.15 (SD)	rat (n=7)	33	µs (decerebrate)
Prostate	0.17 (.11-.21)	rat (n=14)	26	
Prostate	0.18 ± 0.02	rat (n=9)	27	
Prostate	0.31-0.79	dog (n=11)	38	(pentobarb, halothane or nembutal)
Bone				
Femur	0.096 ± 0.039	rat	9	
Tibia	0.083 ± 0.032	rat	9	
Femur	0.14 ± 0.01	pig [†]	19	
Skin	0.20 ± 0.02 (SE)	neonatal sheep [†] (n=13)	37	µs
Skin	0.09 ± 0.01 (SE)	sheep [†] (n=7)	37	µs
Skin	0.18 ± 0.03 (SE)	rat [†] (n=8)	31	µs
Skin	0.12 ± 0.03 (SE)	rat (n=7)	31	µs (pentobarbital)
Skin	0.15 ± 0.02 (SE)	rat (n=7)	31	µs (chlor.-urethan)
Skin	0.17 ± 0.02 (SE)	rat (n=7)	31	µs (decerebrate)
Skin in the cold	approx. 0.02	human forearm [†]	10	

thermoneutral	0.04-0.05	human forearm [†]	10	
hyperthermic	near or >0.20	human forearm [†]	10	
thermoneutral	0.9 ± 0.09	pig [†]	19	
Subcutaneous tissue	0.48 ± 0.15	rat (n=29)	41	¹³³ Xe (ether)
Tumor	0.25 ± 0.11	rat (n=12)	41	¹³³ Xe (ether)
	1.79 ± 0.70	rabbit (n=5)	42	μs
Fat	0.21 ± 0.06	pig [†]	19	
Testes	0.45 ± 0.06	rat (n=9)	27	
Lungs	1.14 ± 0.14 (SE)	fetal sheep [†] (n=12)	32	μs

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