

# Table of Total Emissivity

These tables are presented for use as a guide when making infrared temperature measurements with the OMEGASCOPE® or other infrared pyrometers. The total emissivity (ε) for Metals, Non-metals and Common Building Materials are given.

Since the emissivity of a material will vary as a function of temperature and surface finish, the values in these tables should be used only as a guide for relative or delta measurements.

The exact emissivity of a material should be determined when absolute measurements are required.

## METALS

Material	Temp °F (°C)	ε-Emissivity	Material	Temp °F (°C)	ε-Emissivity	Material	Temp °F (°C)	ε-Emissivity
Alloys			Polished	100 (38)	.03	Monel, Ni-Cu Oxid. at 1110°F (599)	1110 (599)	.46
20-Ni, 24-CR, 55-FE, Oxid.	392 (200)	.90	Highly Polished	100 (38)	.02	Nickel		
20-Ni, 24-CR, 55-FE, Oxid.	932 (500)	.97	Rolled	100 (38)	.64	Polished	100 (38)	.05
60-Ni, 12-CR, 28-FE, Oxid.	518 (270)	.89	Rough	100 (38)	.74	Oxidized	100-500 (38-260)	.31-.46
60-Ni, 12-CR, 28-FE, Oxid.	1040 (560)	.82	Molten	1000 (538)	.15	Unoxidized	77 (25)	.05
80-Ni, 20-CR, Oxidized	212 (100)	.87	Molten	1970 (1077)	.16	Unoxidized	212 (100)	.06
80-Ni, 20-CR, Oxidized	1112 (600)	.87	Molten	2230 (1221)	.13	Unoxidized	932 (500)	.12
80-Ni, 20-CR, Oxidized	2372 (1300)	.89	Nickel Plated	100-500 (38-260)	.37	Unoxidized	1832 (1000)	.19
Aluminium			Dow Metal	0.4-600 (-18-316)	.15	Electrolytic	100 (38)	.04
Unoxidized	77 (25)	.02	Gold			Electrolytic	500 (260)	.06
Unoxidized	212 (100)	.03	Enamel	212 (100)	.37	Electrolytic	1000 (538)	.10
Unoxidized	932 (500)	.06	Plate (.0001)			Electrolytic	2000 (1093)	.16
Oxidized	390 (199)	.11	Plate on .0005 Silver	200-750 (93-399)	.11-.14	Nickel Oxide	1000-2000 (538-1093)	.59-.86
Oxidized	1110 (599)	.19	Plate on .0005 Nickel	200-750 (93-399)	.07-.09	Palladium Plate (.00005		
Oxidized at 599°C (1110°F)	390 (199)	.11	Polished	100-500 (38-260)	.02	on .0005 silver)	200-750 (93-399)	.16-.17
Oxidized at 599°C (1110°F)	1110 (599)	.19	Polished	1000-2000 (538-1093)	.03	Platinum	100 (38)	.05
Heavily Oxidized	200 (93)	.20	Haynes Alloy C,			"	500 (260)	.05
Heavily Oxidized	940 (504)	.31	Oxidized	600-2000 (316-1093)	.90-.96	"	1000 (538)	.10
Highly Polished	212 (100)	.09	Haynes Alloy 25,			Platinum, Black	100 (38)	.93
Roughly Polished	212 (100)	.18	Oxidized	600-2000 (316-1093)	.86-.89	"	500 (260)	.96
Commercial Sheet	212 (100)	.09	Haynes Alloy X,			"	2000 (1093)	.97
Highly Polished Plate	440 (227)	.04	Oxidized	600-2000 (316-1093)	.85-.88	" Oxidized at 1100°F	500 (260)	.07
Highly Polished Plate	1070 (577)	.06	Inconel Sheet	1000 (538)	.28	"	1000 (538)	.11
Bright Rolled Plate	338 (170)	.04	Inconel Sheet	1200 (649)	.42	Rhodium Flash (0.0002		
Bright Rolled Plate	932 (500)	.05	Inconel Sheet	1400 (760)	.58	on 0.0005 Ni)	200-700 (93-371)	.10-.18
Alloy A3003, Oxidized	600 (316)	.40	Inconel X, Polished	75 (24)	.19	Silver		
Alloy A3003, Oxidized	900 (482)	.40	Inconel B, Polished	75 (24)	.21	Plate (0.0005 on Ni)	200-700 (93-371)	.06-.07
Alloy 1100-0	200-800 (93-427)	.05	Iron			Polished	100 (38)	.01
Alloy 24ST	75 (24)	.09	Oxidized	212 (100)	.74	"	500 (260)	.02
Alloy 24ST, Polished	75 (24)	.09	Oxidized	930 (499)	.84	"	1000 (538)	.03
Alloy 75ST	75 (24)	.11	Oxidized	2190 (1199)	.89	"	2000 (1093)	.03
Alloy 75ST, Polished	75 (24)	.08	Unoxidized	212 (100)	.05	Steel		
Bismuth, Bright	176 (80)	.34	Red Rust	77 (25)	.70	Cold Rolled	200 (93)	.75-.85
Bismuth, Unoxidized	77 (25)	.05	Rusted	77 (25)	.65	Ground Sheet	1720-2010 (938-1099)	.55-.61
Bismuth, Unoxidized	212 (100)	.06	Liquid	2760-3220 (1516-1771)	.42-.45	Polished Sheet	100 (38)	.07
Brass			Cast Iron			"	500 (260)	.10
73% Cu, 27% Zn, Polished	476 (247)	.03	Oxidized	390 (199)	.64	"	1000 (538)	.14
73% Cu, 27% Zn, Polished	674 (357)	.03	Oxidized	1110 (599)	.78	Mild Steel, Polished	75 (24)	.10
62% Cu, 37% Zn, Polished	494 (257)	.03	Unoxidized	212 (100)	.21	Mild Steel, Smooth	75 (24)	.12
62% Cu, 37% Zn, Polished	710 (377)	.04	Strong Oxidation	40 (104)	.95	Mild Steel,		
83% Cu, 17% Zn, Polished	530 (277)	.03	Strong Oxidation	482 (250)	.95	Liquid	2910-3270 (1599-1793)	.28
Matte	68 (20)	.07	Liquid	2795 (1535)	.29	Steel, Unoxidized	212 (100)	.08
Burnished to Brown Colour	68 (20)	.40	Wrought Iron			Steel, Oxidized	77 (25)	.80
Cu-Zn, Brass Oxidized	392 (200)	.61	Dull	77 (25)	.94	Steel Alloys		
Cu-Zn, Brass Oxidized	752 (400)	.60	Dull	660 (349)	.94	Type 301, Polished	75 (24)	.27
Cu-Zn, Brass Oxidized	1112 (600)	.61	Smooth	100 (38)	.35	Type 301, Polished	450 (232)	.57
Unoxidized	77 (25)	.04	Polished	100 (38)	.28	Type 301, Polished	1740 (949)	.55
Unoxidized	212 (100)	.04	Lead			Type 303, Oxidized	600-2000 (316-1093)	.74-.87
Cadmium	77 (25)	.02	Polished	100-500 (38-260)	.06-.08	Type 310, Rolled	1500-2100 (816-1149)	.56-.81
Carbon			Rough	100 (38)	.43	Type 316, Polished	75 (24)	.28
Lampblack	77 (25)	.95	Oxidized	100 (38)	.43	Type 316, Polished	450 (232)	.57
Unoxidized	77 (25)	.81	Oxidized at 1100°F	100 (38)	.63	Type 316, Polished	1740 (949)	.66
Unoxidized	212 (100)	.81	Gray Oxidized	100 (38)	.28	Type 321	200-800 (93-427)	.27-.32
Unoxidized	932 (500)	.79	Magnesium	100-500 (38-260)	.07-.13	Type 321 Polished	300-1500 (149-815)	.18-.49
Candle Soot	250 (121)	.95	Magnesium Oxide 1880-3140 (1027-1727)		.16-.20	Type 321 w/BK Oxide	200-800 (93-427)	.66-.76
Filament	500 (260)	.95	Mercury	32 (0)	.09	Type 347, Oxidized	600-2000 (316-1093)	.87-.91
Graphitized	212 (100)	.76	"	77 (25)	.10	Type 350	200-800 (93-427)	.18-.27
Graphitized	572 (300)	.75	"	100 (38)	.10	Type 350 Polished	300-1800 (149-982)	.11-.35
Graphitized	932 (500)	.71	"	212 (100)	.12	Type 446, Polished	300-1500 (149-815)	.15-.37
Chromium	100 (38)	.08	Molybdenum	100 (38)	.06	Type 17-7 PH	200-600 (93-316)	.44-.51
Chromium	1000 (538)	.26	"	500 (260)	.08	Type 17-7 PH		
Chromium, Polished	302 (150)	.06	"	1000 (538)	.11	Polished	300-1500 (149-815)	.09-.16
Cobalt, Unoxidized	932 (500)	.13	"	2000 (1093)	.18	Type C1020,		
Cobalt, Unoxidized	1832 (1000)	.23	" Oxidized at 1000°F	600 (316)	.80	Oxidized	600-2000 (316-1093)	.87-.91
Columbium, Unoxidized	1500 (816)	.19	" Oxidized at 1000°F	700 (371)	.84	Type PH-15-7 MO	300-1200 (149-649)	.07-.19
Columbium, Unoxidized	2000 (1093)	.24	" Oxidized at 1000°F	800 (427)	.84	Stellite, Polished	68 (20)	.18
Copper			" Oxidized at 1000°F	900 (482)	.83	"		
Cuprous Oxide	100 (38)	.87	" Oxidized at 1000°F	1000 (538)	.82	Tantalum, Unoxidized	1340 (727)	.14
Cuprous Oxide	500 (260)	.83	Monel, Ni-Cu	392 (200)	.41	"	2000 (1093)	.19
Cuprous Oxide	1000 (538)	.77	Monel, Ni-Cu	752 (400)	.44	"	3600 (1982)	.26
Black, Oxidized	100 (38)	.78	Monel, Ni-Cu	1112 (600)	.46	"	5306 (2930)	.30
Etched	100 (38)	.09	Monel, Ni-Cu Oxidized	68 (20)	.43	Tin, Unoxidized	77 (25)	.04
Matte	100 (38)	.22				"	212 (100)	.05
Roughly Polished	100 (38)	.07				Tinned Iron, Bright	76 (24)	.05
						"	212 (100)	.08

# Table of Total Emissivity cont'd

## METALS

Material	Temp °F (°C)	ε-Emissivity	Material	Temp °F (°C)	ε-Emissivity	Material	Temp °F (°C)	ε-Emissivity
Titanium			Tungsten			Uranium Oxide	1880 (1027)	.79
Alloy C110M,			Unoxidized	77 (25)	.02	Zinc		
Polished	300-1200 (149-649)	.08-.19	Unoxidized	212 (100)	.03	Bright, Galvanized	100 (38)	.23
* Oxidized at			Unoxidized	932 (500)	.07	Commercial 99.1%	500 (260)	.05
538°C (1000°F)	200-800 (93-427)	.51-.61	Unoxidized	1832 (1000)	.15	Galvanized	100 (38)	.28
Alloy Ti-95A,			Unoxidized	2732 (1500)	.23	Oxidized	500-1000 (260-538)	.11
Oxid. at			Unoxidized	3632 (2000)	.28	Polished	100 (38)	.02
538°C (1000°F)	200-800 (93-427)	.35-.48	Filament (Aged)	100 (38)	.03	Polished	500 (260)	.03
Anodized onto SS	200-600 (93-316)	.96-.82	Filament (Aged)	1000 (538)	.11	Polished	1000 (538)	.04
			Filament (Aged)	5000 (2760)	.35	Polished	2000 (1093)	.06

## NON-METALS

Material	Temp °F (°C)	ε-Emissivity	Material	Temp °F (°C)	ε-Emissivity	Material	Temp °F (°C)	ε-Emissivity
Adobe	68 (20)	.90	Granite	70 (21)	.45	Paints, Oil		
Asbestos			Gravel	100 (38)	.28	All colors	200 (93)	.92-.96
Board	100 (38)	.96	Gypsum	68 (20)	.80-.90	Black	200 (93)	.92
Cement	32-392 (0-200)	.96	Ice, Smooth	32 (0)	.97	Black Gloss	70 (21)	.90
Cement, Red	2500 (1371)	.67	Ice, Rough	32 (0)	.98	Camouflage Green	125 (52)	.85
Cement, White	2500 (1371)	.65	Lacquer			Flat Black	80 (27)	.88
Cloth	199 (93)	.90	Black	200 (93)	.96	Flat White	80 (27)	.91
Paper	100-700 (38-371)	.93	Blue, on Al Foil	100 (38)	.78	Gray-Green	70 (21)	.95
Slate	68 (20)	.97	Clear, on Al Foil (2 coats)	200 (93)	.08 (.09)	Green	200 (93)	.95
Asphalt, pavement	100 (38)	.93	Clear, on Bright Cu	200 (93)	.66	Lamp Black	209 (98)	.96
Asphalt, tar paper	68 (20)	.93	Clear, on Tarnished Cu	200 (93)	.64	Red	200 (93)	.95
Basalt	68 (20)	.72	Red, on Al Foil (2 coats)	100 (38)	.61 (.74)	White	200 (93)	.94
Brick			White	200 (93)	.95	Quartz, Rough, Fused	70 (21)	.93
Red, rough	70 (21)	.93	White, on Al Foil (2 coats)	100 (38)	.69 (.88)	Glass, 1.98 mm	540 (282)	.90
Gault Cream	2500-5000 (1371-2760)	.26-.30	Yellow, on Al Foil (2 coats)	100 (38)	.57 (.79)	Glass, 1.98 mm	1540 (838)	.41
Fire Clay	2500 (1371)	.75	Lime Mortar	100-500 (38-260)	.90-.92	Glass, 6.88 mm	540 (282)	.93
Light Buff	1000 (538)	.80	Limestone	100 (38)	.95	Glass, 6.88 mm	1540 (838)	.47
Lime Clay	2500 (1371)	.43	Marble, White	100 (38)	.95	Opaque	570 (299)	.92
Fire Brick	1832 (1000)	.75-.80	* Smooth, White	100 (38)	.56	Opaque	1540 (838)	.68
Magnesite, Refractory	1832 (1000)	.38	* Polished Gray	100 (38)	.75	Red Lead	212 (100)	.93
Gray Brick	2012 (1100)	.75	Mica	100 (38)	.75	Rubber, Hard	74 (23)	.94
Silica, Glazed	2000 (1093)	.88	Oil on Nickel			Rubber, Soft, Gray	76 (24)	.86
Silica, Unglazed	2000 (1093)	.80	0.001 Film	72 (22)	.27	Sand	68 (20)	.76
Sandlime	2500-5000 (1371-2760)	.59-.63	0.002 *	72 (22)	.46	Sandstone	100 (38)	.67
Carborundum	1850 (1010)	.92	0.005 *	72 (22)	.72	Sandstone, Red	100 (38)	.60-.83
Ceramic			Thick *	72 (22)	.82	Sawdust	68 (20)	.75
Alumina on Inconel	800-2000 (427-1093)	.69-.45	Oil, Linseed			Shale	68 (20)	.69
Earthenware, Glazed	70 (21)	.90	On Al Foil, uncoated	250 (121)	.09	Silica, Glazed	1832 (1000)	.85
Earthenware, Matte	70 (21)	.93	On Al Foil, 1 coat	250 (121)	.56	Silica, Unglazed	2012 (1100)	.75
Greens No. 5210-2C	200-750 (93-399)	.89-.82	On Al Foil, 2 coats	250 (121)	.51	Silicon Carbide	300-1200 (149-649)	.83-.96
Coating No. C20A	200-750 (93-399)	.73-.67	On Polished Iron, .001 Film	100 (38)	.22	Silk Cloth	68 (20)	.78
Porcelain	72 (22)	.92	On Polished Iron, .002 Film	100 (38)	.45	Slate	100 (38)	.67-.80
White Al <sub>2</sub> O <sub>3</sub>	200 (93)	.90	On Polished Iron, .004 Film	100 (38)	.65	Snow, Fine Particles	20 (-)	.82
Zirconia on Inconel	800-2000 (427-1093)	.62-.45	On Polished Iron, Thick Film	100 (38)	.83	Snow, Granular	18 (-8)	.89
Clay	68 (20)	.39	Paints			Soil		
* Fired	158 (70)	.91	Blue, Cu <sub>2</sub> O <sub>3</sub>	75 (24)	.94	Surface	100 (38)	.38
* Shale	68 (20)	.69	Black, CuO	75 (24)	.96	Black Loam	68 (20)	.66
* Tiles, Light Red	2500-5000 (1371-2760)	.32-.34	Green, Cu <sub>2</sub> O <sub>3</sub>	75 (24)	.92	Plowed Field	68 (20)	.38
* Tiles, Red	2500-5000 (1371-2760)	.40-.51	Red, Fe <sub>2</sub> O <sub>3</sub>	75 (24)	.91	Soot		
* Tiles,			White, Al <sub>2</sub> O <sub>3</sub>	75 (24)	.94	Acetylene	75 (24)	.97
Dark Purple	2500-5000 (1371-2760)	.78	White, Y <sub>2</sub> O <sub>3</sub>	75 (24)	.90	Camphor	75 (24)	.94
Concrete			White, ZnO	75 (24)	.95	Candle	250 (121)	.95
Rough	32-2000 (0-1093)	.94	White, MgCO <sub>3</sub>	75 (24)	.91	Coal	68 (20)	.95
Tiles, Natural	2500-5000 (1371-2760)	.63-.62	White, ZrO <sub>2</sub>	75 (24)	.95	Stonework	100 (38)	.93
* Brown	2500-5000 (1371-2760)	.87-.83	White, ThO <sub>2</sub>	75 (24)	.90	Water	100 (38)	.67
* Black	2500-5000 (1371-2760)	.94-.91	White, MgO	75 (24)	.91	Waterglass	68 (20)	.96
Cotton Cloth	68 (20)	.77	White, PbCO <sub>3</sub>	75 (24)	.93	Wood	Low	.80-.90
Dolomite Lime	68 (20)	.41	Yellow, PbO	75 (24)	.90	Beech Planed	158 (70)	.94
Emery Corundum	176 (80)	.86	Yellow, PbCrO <sub>4</sub>	75 (24)	.93	Oak, Planed	100 (38)	.91
Glass			Paints, Aluminium	100 (38)	.27-.67	Spruce, Sanded	100 (38)	.89
Convex D	212 (100)	.80	10% Al	100 (38)	.52			
Convex D	600 (316)	.80	26% Al	100 (38)	.30			
Convex D	932 (500)	.76	Dow XP-310	200 (93)	.22			
Nonex	212 (100)	.82	Paints, Bronze	Low	.34-.80			
Nonex	600 (316)	.82	Gum Varnish (2 coats)	70 (21)	.53			
Nonex	932 (500)	.78	Gum Varnish (3 coats)	70 (21)	.50			
Smooth	32-200 (0-93)	.92-.94	Cellulose Binder (2 coats)	70 (21)	.34			



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