

Table of Total Emissivity

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

Table of Total Emissivity cont'd

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Material	Temp °F (°C)	ε Emmissivity	Material	Temp °F (°C)	ε Emmissivity	Material	Temp °F (°C)	ε Emmissivity
Titanium			Tungsten			Uranium Oxide	1880 (1027)	.79
Alloy C110M, Polished	300-1200 (149-649)	.08-.19	Unoxidized	77 (25)	.02	Zinc		
" Oxidized at 538°C (1000°F)	200-800 (93-427)	.51-.61	Unoxidized	212 (100)	.03	Bright, Galvanized	100 (38)	.23
Alloy Ti-95A, Oxid. at			Unoxidized	932 (500)	.07	Commercial 99.1%	500 (260)	.05
538°C (1000°F)			Unoxidized	1832 (1000)	.15	Galvanized	100 (38)	.28
Anodized onto SS	200-600 (93-316)	.96-.82	Unoxidized	2732 (1500)	.23	Oxidized	500-1000 (260-538)	.11
			Unoxidized	3632 (2000)	.28	Polished	100 (38)	.02
			Filament (Aged)	100 (38)	.03	Polished	500 (260)	.03
			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 Emmissivity	Material	Temp °F (°C)	ε Emmissivity	Material	Temp °F (°C)	ε Emmissivity
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	Ice, Smooth	32 (0)	.97	Black	200 (93)	.92
Cement	32-392 (0-200)	.96	Ice, Rough	32 (0)	.98	Black Gloss	70 (21)	.90
Cement, Red	2500 (1371)	.67	Lacquer			Camouflage Green	125 (52)	.85
Cement, White	2500 (1371)	.65	Black	200 (93)	.96	Flat Black	80 (27)	.88
Cloth	199 (93)	.90	Blue, on Al Foil	100 (38)	.78	Flat White	80 (27)	.91
Paper	100-700 (38-371)	.93	Clear, on Al Foil (2 coats)	200 (93)	.08 (.09)	Gray-Green	70 (21)	.95
Slate	68 (20)	.97	Clear, on Bright Cu	200 (93)	.66	Green	200 (93)	.95
Asphalt, pavement	100 (38)	.93	Clear, on Tarnished Cu	200 (93)	.64	Lamp Black	209 (98)	.96
Asphalt, tar paper	68 (20)	.93	Red, on Al Foil (2 coats)	100 (38)	.61 (.74)	Red	200 (93)	.95
Basalt	68 (20)	.72	White	200 (93)	.95	White	200 (93)	.94
Brick			White, on Al Foil (2 coats)	100 (38)	.69 (.88)	Quartz, Rough, Fused	70 (21)	.93
Red, rough	70 (21)	.93	Yellow, on Al Foil (2 coats)	100 (38)	.57 (.79)	Glass, 1.98 mm	540 (282)	.90
Gault Cream	2500-5000 (1371-2760)	.26-.30	Lime Mortar	100-500 (38-260)	.90-.92	Glass, 1.98 mm	1540 (838)	.41
Fire Clay	2500 (1371)	.75	Limestone	100 (38)	.95	Glass, 6.88 mm	540 (282)	.93
Light Buff	1000 (538)	.80	Marble, White	100 (38)	.95	Glass, 6.88 mm	1540 (838)	.47
Lime Clay	2500 (1371)	.43	" Smooth, White	100 (38)	.56	Opaque	570 (299)	.92
Fire Brick	1832 (1000)	.75-.80	" Polished Gray	100 (38)	.75	Opaque	1540 (838)	.68
Magnesite, Refractory	1832 (1000)	.38	Mica	100 (38)	.75	Red Lead	212 (100)	.93
Gray Brick	2012 (1100)	.75	Oil on Nickel			Rubber, Hard	74 (23)	.94
Silica, Glazed	2000 (1093)	.88	0.001 Film	72 (22)	.27	Rubber, Soft, Gray	76 (24)	.86
Silica, Unglazed	2000 (1093)	.80	0.002 "	72 (22)	.46	Sand	68 (20)	.76
Sandlime	2500-5000 (1371-2760)	.59-.63	0.005 "	72 (22)	.72	Sandstone	100 (38)	.67
Carborundum	1850 (1010)	.92	Thick "	72 (22)	.82	Sandstone, Red	100 (38)	.60-.83
Ceramic			Oil, Linseed			Sawdust	68 (20)	.75
Alumina on Inconel	800-2000 (427-1093)	.69-.45	On Al Foil, uncoated	250 (121)	.09	Shale	68 (20)	.69
Earthenware, Glazed	70 (21)	.90	On Al Foil, 1 coat	250 (121)	.56	Silica, Glazed	1832 (1000)	.85
Earthenware, Matte	70 (21)	.93	On Al Foil, 2 coats	250 (121)	.51	Silica, Unglazed	2012 (1100)	.75
Greens No. 5210-2C	200-750 (93-399)	.89-.82	On Polished Iron, .001 Film	100 (38)	.22	Silicon Carbide	300-1200 (149-649)	.83-.96
Coating No. C20A	200-750 (93-399)	.73-.67	On Polished Iron, .002 Film	100 (38)	.45	Silk Cloth	68 (20)	.78
Porcelain	72 (22)	.92	On Polished Iron, .004 Film	100 (38)	.65	Slate	100 (38)	.67-.80
White Al2O3	200 (93)	.90	On Polished Iron, Thick Film	100 (38)	.83	Snow, Fine Particles	20 (-7)	.82
Zirconia on Inconel	800-2000 (427-1093)	.62-.45	Paints			Snow, Granular	18 (-8)	.89
Clay	68 (20)	.39	Blue, Cu2O3	75 (24)	.94	Soil		
" Fired	158 (70)	.91	Black, CuO	75 (24)	.96	Surface	100 (38)	.38
" Shale	68 (20)	.69	Green, Cu2O3	75 (24)	.92	Black Loam	68 (20)	.66
" Tiles, Light Red	2500-5000 (1371-2760)	.32-.34	Red, Fe2O3	75 (24)	.91	Plowed Field	68 (20)	.38
" Tiles, Red	2500-5000 (1371-2760)	.40-.51	White, Al2O3	75 (24)	.94	Soot		
" Tiles, Dark Purple	2500-5000 (1371-2760)	.78	White, Y2O3	75 (24)	.90	Acetylene	75 (24)	.97
Concrete			White, ZnO	75 (24)	.95	Camphor	75 (24)	.94
Rough	32-2000 (0-1093)	.94	White, MgCO3	75 (24)	.91	Candle	250 (121)	.95
Tiles, Natural	2500-5000 (1371-2760)	.63-.62	White, ZrO2	75 (24)	.95	Coal	68 (20)	.95
" Brown	2500-5000 (1371-2760)	.87-.83	White, ThO2	75 (24)	.90	Stonework	100 (38)	.93
" Black	2500-5000 (1371-2760)	.94-.91	White, MgO	75 (24)	.91	Water	100 (38)	.67
Cotton Cloth	68 (20)	.77	White, PbCO3	75 (24)	.93	Waterglass	68 (20)	.96
Dolomite Lime	68 (20)	.41	Yellow, PbO	75 (24)	.90	Wood	Low	.80-.90
Emery Corundum	176 (80)	.86	Yellow, PbCrO4	75 (24)	.93	Beech Planed	158 (70)	.94
Glass			Paints, Aluminium	100 (38)	.27-.67	Oak, Planed	100 (38)	.91
Convex D	212 (100)	.80	10% Al	100 (38)	.52	Spruce, Sanded	100 (38)	.89
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			