



# Emissivity of Common Materials

Emissivity of a given material will vary with temperature and surface finish, the values in this table should be used only as a guide for relative or differential temperature measurements. The exact emissivity of a material should be determined when high accuracy is required.

METALS					
Material	Temp °F (°C)	e-Emissivity	Material	Temp °F (°C)	e-Emissivity
<b>Alloys</b>			<b>Cadmium</b>	77 (25)	.02
20-Ni, 24-CR, 55-FE, Oxidized	392 (200)	.90	<b>Carbon</b>		
20-Ni, 24-CR, 55-FE, Oxidized	932 (500)	.97	Lampblack	77 (25)	.95
60-Ni, 12-CR, 28-FE, Oxidized	518 (270)	.89	Unoxidized	77 (25)	.81
60-Ni, 12-CR, 28-FE, Oxidized	1040 (560)	.82	Unoxidized	212 (100)	.81
80-Ni, 20-CR, Oxidized	212 (100)	.87	Unoxidized	932 (500)	.79
80-Ni, 20-CR, Oxidized	1112 (600)	.87	Candle Soot	250 (121)	.95
80-Ni, 20-CR, Oxidized	2372 (1300)	.89	Filament	500 (260)	.95
<b>Aluminium</b>			Graphitized	212 (100)	.76
Unoxidized	77 (25)	.02	Graphitized	572 (300)	.75
Unoxidized	212 (100)	.03	Graphitized	932 (500)	.71
Unoxidized	932 (500)	.06	<b>Chromium</b>	<b>100 (38)</b>	<b>.08</b>
Oxidized	390 (199)	.11	Chromium	1000 (538)	.26
Oxidized	1110 (599)	.19	Chromium, Polished	302 (150)	.06
Oxidized at 1110°F (599°C)	390 (199)	.11	Cobalt, Unoxidized	932 (500)	.13
Oxidized at 1110°F (599°C)	1110 (599)	.19	Cobalt, Unoxidized	1832 (1000)	.23
Heavily Oxidized	200 (93)	.20	<b>Columbium</b>		
Heavily Oxidized	940 (504)	.31	Unoxidized	1500 (816)	.19
Highly Polished	212 (100)	.09	Unoxidized	2000 (1093)	.24
Roughly Polished	212 (100)	.18	<b>Copper</b>		
Commercial Sheet	212 (100)	.09	Cuprous Oxide	100 (38)	.87
Highly Polished Plate	440 (227)	.04	Cuprous Oxide	500 (260)	.83
Highly Polished Plate	1070 (577)	.06	Cuprous Oxide	1000 (538)	.77
Bright Rolled Plate	338 (170)	.04	Black, Oxidized	100 (38)	.78
Bright Rolled Plate	932 (500)	.05	Etched	100 (38)	.09
Alloy A3003, Oxidized	600 (316)	.40	Matte	100 (38)	.22
Alloy A3003, Oxidized	900 (482)	.40	Roughly Polished	100 (38)	.07
Alloy 1100-0	200-800 (93-427)	.05	Polished	100 (38)	.03
Alloy 24ST	75 (24)	.09	Highly Polished	100 (38)	.02
Alloy 24ST, Polished	75 (24)	.09	Rolled	100 (38)	.64
Alloy 75ST	75 (24)	.11	Rough	100 (38)	.74
Alloy 75ST, Polished	75 (24)	.08	Molten	1000 (538)	.15
<b>Bismuth</b>			Molten	1970 (1077)	.16
Bright	176 (80)	.34	Molten	2230 (1221)	.13
Unoxidized	77 (25)	.05	Nickel Plated	100-500 (38-260)	.37
Unoxidized	212 (100)	.06	<b>Dow Metal</b>	<b>0.4-600 (-18-316)</b>	<b>.15</b>
<b>Brass</b>			<b>Gold</b>		
73% Cu, 27% Zn, Polished	476 (247)	.03	Enamel	212 (100)	.37
73% Cu, 27% Zn, Polished	674 (357)	.03	Plate(.0001)		
62% Cu, 37% Zn, Polished	494 (257)	.03	Plate on .0005 Silver	200-750 (93-399)	.11-.14
62% Cu, 37% Zn, Polished	710 (377)	.04	Plate on .0005 Nickel	200-750 (93-399)	.07-.09
83% Cu, 17% Zn, Polished	530 (277)	.03	Polished	100-500 (38-260)	.02
Matte	68 (20)	.07	Polished	1000-2000 (538-1093)	.03
Burnished to Brown Color	68 (20)	.40	<b>Haynes Alloy C</b>		
Cu-Zn, Brass Oxidized	392 (200)	.61	Oxidized	600-2000 (316-1093)	.90-.96
Cu-Zn, Brass Oxidized	752 (400)	.60	<b>Haynes Alloy 25</b>		
Cu-Zn, Brass Oxidized	1112 (600)	.61	Oxidized	600-2000 (316-1093)	.86-.89
Unoxidized	77 (25)	.04	<b>Haynes Alloy X</b>		
Unoxidized	212 (100)	.04	Oxidized	600-2000 (316-1093)	.85-.88

<b>METALS</b>					
Material	Temp °F (°C)	e-Emissivity	Material	Temp °F (°C)	e-Emissivity
<b>Inconel</b>			<b>Nickel</b>		
Sheet	1000 (538)	.28	Polished	100 (38)	.05
Sheet	1200 (649)	.42	Oxidized	100-500 (38-260)	.31-.46
Sheet	1400 (760)	.58	Unoxidized	77 (25)	.05
X, Polished	75 (24)	.19	Unoxidized	212 (100)	.06
B, Polished	75 (24)	.21	Unoxidized	932 (500)	.12
<b>Iron</b>			Unoxidized	1832 (1000)	.19
Oxidized	212 (100)	.74	Electrolytic	100 (38)	.04
Oxidized	930 (499)	.84	Electrolytic	500 (260)	.06
Oxidized	2190 (1199)	.89	Electrolytic	1000 (538)	.10
Unoxidized	212 (100)	.05	Electrolytic	2000 (1093)	.16
Red Rust	77 (25)	.70	<b>Nickel Oxide</b>	<b>1000-2000 (538-1093)</b>	<b>.59-.86</b>
Rusted	77 (25)	.65	<b>Palladium Plate</b>		
Liquid	2700-3220 (1516-1771)	.42-.45	Nickel (.00005 on .0005 silver)	200-750 (93-399)	.16-.17
<b>Iron, Cast</b>			<b>Platinum</b>		
Oxidized	390 (199)	.64	Platinum	500 (260)	.05
Oxidized	1110 (599)	.78	Platinum	1000 (538)	.10
Unoxidized	212 (100)	.21	<b>Platinum, Black</b>	<b>100 (38)</b>	<b>.93</b>
Strong Oxidation	40 (104)	.95	Platinum, Black	500 (260)	.96
Strong Oxidation	482 (250)	.95	Platinum, Black	2000 (1093)	.97
Liquid	2795 (1535)	.29	Oxidized at 1100°F (593°C)	500 (260)	.07
<b>Iron, Wrought</b>			Oxidized at 1100°F (593°C)	1000 (538)	.11
Dull	77 (25)	.94	<b>Rhodium Flash (0.0002 on 0.0005Ni)</b>		
Dull	660 (349)	.94	0.0005Ni)	200-700 (93-371)	.10-.18
Smooth	100 (38)	.35	<b>Silver</b>		
Polished	100 (38)	.28	Plate (0.0005 on Ni)	200-700 (93-371)	.06-.07
Lead			Polished	100 (38)	.01
Polished	100-500 (38-260)	.06-.08	Polished	500 (260)	.02
Rough	100 (38)	.43	Polished	1000 (538)	.03
Oxidized	100 (38)	.43	Polished	2000 (1093)	.03
Oxidized at 1100°F	100 (38)	.63	<b>Steel</b>		
Gray Oxidized	100 (38)	.28	Cold Rolled	200 (93)	.75-.85
<b>Magnesium</b>	<b>100-500 (38-260)</b>	<b>.07-.13</b>	Ground Sheet	1720-2010 (938-1099)	.55-.61
<b>Magnesium Oxide</b>	<b>1880-3140 (1027-1727)</b>	<b>.16-.20</b>	Polished Sheet	100 (38)	.07
<b>Mercury</b>	<b>32 (0)</b>	<b>.09</b>	Polished Sheet	500 (260)	.10
Mercury	77 (25)	.10	Polished Sheet	1000 (538)	.14
Mercury	100 (38)	.10	Mild Steel, Polished	75 (24)	.10
Mercury	212 (100)	.12	Mild Steel, Smooth	75 (24)	.12
<b>Molybdenum</b>			Mild Steel, Liquid	2910-3270 (1599-1793)	.28
Molybdenum	500 (260)	.08	Steel, Unoxidized	212 (100)	.08
Molybdenum	1000 (538)	.11	Steel Oxidized	77 (25)	.80
Molybdenum	2000 (1093)	.18	<b>Steel Alloys</b>		
Oxidized at 1000°F	600 (316)	.80	Type 301, Polished	75 (24)	.27
Oxidized at 1000°F	700 (371)	.84	Type 301, Polished	450 (232)	.57
Oxidized at 1000°F	800 (427)	.84	Type 301, Polished	1740 (949)	.55
Oxidized at 1000°F	900 (482)	.83	Type 303, Oxidized	600-2000 (316-1093)	.74-.87
Oxidized at 1000°F	1000 (538)	.82	Type 310, Rolled	1500-2100 ((816-1149)	.56-.81
<b>Monel</b>			Type 316, Polished	75 (24)	.28
Monel, Ni-Cu	392 (200)	.41	Type 316, Polished	450 (232)	.57
Monel, Ni-Cu	752 (400)	.44	Type 316, Polished	1740 (949)	.66
Monel, Ni-Cu	1112 (600)	.46	Type 321	200-800 (93-427)	.27-.32
Oxidized	68 (20)	.43	Type 321, Polished	300-1500 (149-815)	.18-.49
Oxidized at 1110°F	1110 (599)	.46	Type 321 w/BK Oxide	200-800 (93-427)	.66-.76
			Type 347, Oxidized	600-2000 (316-1093)	.87-.91
			Type 350	200-800 (93-427)	.18-.27

METALS					
Material		Temp °F (°C)	e-Emissivity	Material	
				Temp °F (°C)	e-Emissivity
<b>Steel Alloys (cont.)</b>				<b>Monel</b>	
Type 350 Polished	300-1800 (149-982)		.11-.35	Unoxidized	77 (25) .02
Type 446, Polished	300-1500 (149-815)		.15-.37	Unoxidized	212 (100) .03
Type 17-7 PH	200-600 (93-316)		.44-.51	Unoxidized	932 (500) .07
Type 17-7 PH Polished	300-1500 (149-815)		.09-.16	Unoxidized	1832 (1000) .15
Type C1020, Oxidized	600-2000 (316-1093)		.87-.91	Unoxidized	2732 (1500) .23
Type PH-15-7 MO	300-1200 (149-649)		.07-.19	Unoxidized	3632 (2000) .28
Stellite, Polished	68 (20)		.18	Filament (Aged)	100 (38) .03
<b>Tantalum</b>				Filament (Aged)	1000 (538) .11
Unoxidized	1340 (727)		.14	Filament (Aged)	5000 (2760) .35
Unoxidized	2000 (1093)		.19	<b>Uranium Oxide</b>	<b>1880 (1027) .79</b>
Unoxidized	3600 (1982)		.26	<b>Zinc</b>	
Unoxidized	5306 (2930)		.30	Bright, Galvanized	100 (38) .23
<b>Tin</b>				Commercial 99.1%	500 (260) .05
Unoxidized	77 (25)		.04	Galvanized	100 (38) .28
Unoxidized	212 (100)		.05	Oxidized	500-1000 (260-538) .11
Tinned Iron, Bright	76 (24)		.05	Polished	100 (38) .02
Tinned Iron, Bright	212 (100)		.08	Polished	500 (260) .03
<b>Titanium</b>				Polished	1000 (538) .04
Alloy C110M, Polished	300-1200 (149-649)		.08-.19	Polished	2000 (1093) .06
Alloy C110M, Oxidized at 1000°F (538°C)	200-800 (93-427)		.51-.61		
Alloy Ti-95A, Oxidized at 1000°F (538°C)	200-800 (93-427)		.35-.48		
Anodized onto SS	200-600 (93-316)		.96-.82		

NON-METALS					
Material	Temp °F (°C)	e-Emissivity	Material	Temp °F (°C)	e-Emissivity
Adobe	68 (20)	.90	Granite	70 (21)	.45
<b>Asbestos</b>			Gravel	100 (38)	.28
Board	100 (38)	.96	Gypsum	68 (20)	.80-.90
Cement	32-392 (0-200)	.96	<b>Ice</b>		
Cement, Red	2500 (1371)	.67	Smooth	32 (0)	.97
Cement, White	2500 (1371)	.65	Rough	32 (0)	.98
Cloth	199 (93)	.90	<b>Lacquer</b>		
Paper	100-700 (38-371)	.93	Black	200 (93)	.96
Slate	68 (20)	.97	Blue, on Al Foil	100 (38)	.78
Asphalt, pavement	100 (38)	.93	Clear, on Al Foil (2 coats)	200 (93)	.08 (.09)
Asphalt, tar paper	68 (20)	.93	Clear, on Bright Cu	200 (93)	.66
<b>Basalt</b>	68 (20)	.72	Clear, on Tarnished Cu	200 (93)	.64
<b>Brick</b>			Red, on Al Foil (2 coats)	100 (38)	.61 (.74)
Red, rough	70 (21)	.93	White	200 (93)	.95
Gault Cream	2500-5000 (1371-2760)	.26-.30	White, on Al Foil (2 coats)	100 (38)	.69 (.88)
Fire Clay	2500 (1371)	.75	Yellow, on Al Foil (2 coats)	100 (38)	.57 (.79)
Light Buff	1000 (538)	.80	<b>Lime Mortar</b>	100-500 (38-260)	.90-.92
Lime Clay	2500 (1371)	.43	<b>Limestone</b>	100 (38)	.95
Fire Brick	1832 (1000)	.75-.80	<b>Marble</b>		
Magnesite, Refractory	1832 (1000)	.38	White	100 (38)	.95
Grey Brick	2012 (1100)	.75	Smooth, White	100 (38)	.56
Silica, Glazed	2000 (1093)	.88	Polished Gray	100 (38)	.75
Silica, Unglazed	2000 (1093)	.80	<b>Mica</b>	100 (38)	.75
Sandlime	2500-5000 (1371-2760)	.59-.63	<b>Oil on Nickel</b>		
<b>Carborundum</b>	1850 (1010)	.92	0.001 Film	72 (22)	.27
<b>Ceramic</b>			0.002 Film	72 (22)	.46
Alumina on Inconel	800-2000 (427-1093)	.69-.45	0.005 Film	72 (22)	.72
Earthenware, Glazed	70 (21)	.90	Thick Film	72 (22)	.82
Earthenware, Matte	70 (21)	.93	<b>Oil, Linseed</b>		
Greens No. 5210-2C	200-750 (93-399)	.89-.82	On Al Foil, uncoated	250 (121)	.09
Coating No. C20A	200-750 (93-399)	.73-.67	On Al Foil, 1 coat	250 (121)	.56
Porcelain	72 (22)	.92	On Al Foil, 2 coats	250 (121)	.51
White Al2O3	200 (93)	.90	On Polished Iron, .001 Film	100 (38)	.22
Zirconia on Inconel	800-2000 (427-1093)	.62-.45	On Polished Iron, .002 Film	100 (38)	.45
<b>Clay</b>	68 (20)	.39	On Polished Iron, .004 Film	100 (38)	.65
Fired	158 (70)	.91	On Polished Iron, Thick Film	100 (38)	.83
Shale	68 (20)	.69	<b>Paints</b>		
Tiles, Light Red	2500-5000 (1371-2760)	.32-.34	Blue, Cu2O3	75 (24)	.94
Tiles, Red	2500-5000 (1371-2760)	.40-.51	Black, CuO	75 (24)	.96
Tiles, Dark Purple	2500-5000 (1371-2760)	.78	Green, Cu2O3	75 (24)	.92
<b>Concrete</b>			Red, Fe2O3	75 (24)	.91
Rough	32-2000 (0-1093)	.94	White, Al2O3	75 (24)	.94
Tiles, Natural	2500-5000 (1371-2760)	.63-.62	White, Y2O3	75 (24)	.90
Brown	2500-5000 (1371-2760)	.87-.83	White, ZnO	75 (24)	.95
Black	2500-5000 (1371-2760)	.94-.91	White, MgCO3	75 (24)	.91
<b>Cotton Cloth</b>	68 (20)	.77	White ZrO2	75 (24)	.95
<b>Dolomite Lime</b>	69 (20)	.41	White, ThO2	75 (24)	.90
<b>Emery Corundum</b>	176 (80)	.86	White, MgO	75 (24)	.91
<b>Glass</b>			White PbCO3	75 (24)	.93
Convex D	212 (100)	.80	Yellow, PbO	75 (24)	.90
Convex D	600 (316)	.80	Yellow, PbCrO4	75 (24)	.93
Convex D	932 (500)	.76	<b>Paints, Aluminium</b>	100 (38)	.27-.67
Nonex	212 (100)	.82	10% Al	100 (38)	.52
Nonex	600 (316)	.82	26% Al	100 (38)	.30
Nonex	932 (500)	.78	Dow XP-310	200 (93)	.22
Smooth	32-200 (0-93)	.92-.94			

NON-METALS					
Material	Temp °F (°C)	e-Emissivity	Material	Temp °F (°C)	e-Emissivity
<b>Paints, Bronze</b>			<b>Silica</b>		
Gum Varnish (2 coats)	70 (21)	.53	Glazed	1832 (1000)	.85
Gum Varnish (3 coats)	70 (21)	.50	Unglazed	2012 (1100)	.75
Cellulose Binder (2 coats)	70 (21)	.34	<b>Silicon Carbide</b>	<b>300-1200 (149-169)</b>	<b>.83-.96</b>
<b>Paints, Oil</b>			<b>Silk Cloth</b>	<b>68 (20)</b>	<b>.78</b>
All colors	200 (93)	.92-.96	<b>Slate</b>	<b>100 (38)</b>	<b>.67-.80</b>
Black	200 (93)	.92	<b>Snow</b>		
Black Gloss	70 (21)	.90	Fine Particles	20 (-7)	.82
Camouflage Green	125 (52)	.85	Granular	18 (-8)	.89
Flat Black	80 (27)	.88	<b>Soil</b>		
Flat White	80 (27)	.91	Surface	100 (38)	.38
Grey-Green	70 (21)	.95	Black Loam	68 (20)	.66
Green	200 (93)	.95	Plowed Field	68 (20)	.38
Lamp Black	209 (98)	.96	<b>Soot</b>		
Red	200 (93)	.95	Acetylene	75 (24)	.97
White	200 (93)	.94	Camphor	75 (24)	.94
<b>Quartz, Rough, Fused</b>	<b>70 (21)</b>	<b>.93</b>	Candle	250 (121)	.95
Glass, 1.98 mm	540 (282)	.90	Coal	68 (20)	.95
Glass, 1.98 mm	1540 (838)	.41	<b>Stonework</b>	<b>100 (38)</b>	<b>.93</b>
Glass, 6.88 mm	540 (282)	.93	<b>Water</b>	<b>100 (38)</b>	<b>.67</b>
Glass, 6.88 mm	1540 (838)	.47	<b>Waterglass</b>	<b>68 (20)</b>	<b>.96</b>
Opaque	570 (299)	.92	<b>Wood</b>	<b>Low</b>	<b>.80-.90</b>
Opaque	1540 (838)	.68	Beech, Planed	158 (70)	.94
<b>Red Lead</b>	<b>212 (100)</b>	<b>.933</b>	Oak, Planed	100 (38)	.91
<b>Rubber</b>			Spruce, Sanded	100 (38)	.89
Hard	74 (23)	.94			
Soft, Gray	76 (24)	.86			
<b>Sand</b>	<b>68 (20)</b>	<b>.76</b>			
<b>Sandstone</b>	<b>100 (38)</b>	<b>.67</b>			
<b>Sandstone, Red</b>	<b>100 (38)</b>	<b>.60-.83</b>			
<b>Sawdust</b>	<b>68 (20)</b>	<b>.75</b>			
<b>Shale</b>	<b>68 (20)</b>	<b>.69</b>			