

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Adobe</b>	68	20	0.90
<b>Alloys:</b>			
Alloy 24ST, polished	75	24	0.90
Alloy 75ST	75	24	0.11
20-Ni, 25-Cr, 55-Fe, oxidized	392	200	0.90
	932	500	0.97
60-Ni, 12-Cr, 28-Fe, oxidized	518	270	0.89
	1040	560	0.82
80-Ni, 20-Cr, oxidized	212	100	0.87
	1112	600	0.87
	2372	1300	0.89
<b>Aluminum:</b>			
Unoxidized	77	25	0.02
	212	100	0.03
	932	500	0.06
Oxidized	390	199	0.11
	1110	599	0.19
Oxidized @1110°F	390	199	0.11
	1110	599	0.19
Heavily oxidized	200	93	0.20
	940	504	0.31
Highly polished	212	100	0.09
Roughly polished	212	100	0.18
Commercial sheet	212	100	0.09
Highly polished plate	440	227	0.04
	1070	577	0.06
Bright rolled plate	338	170	0.04
	932	500	0.05
Alloy A3003, oxidized	600	315	0.40
	900	482	0.40
Alloy 1100-0	200 to 800	93 to 427	0.05
Alloy 24ST	75	24	0.09

Alloy 24ST, polished	75	24	0.09
Alloy 75ST	75	24	0.11
Alloy 75ST, polished	75	24	0.08
<b>MATERIAL</b>			
<b>TEMPERATURE</b>			
°F °C			
<b>EMISSIVITY</b>			
<b>Asphalt:</b>			
Pavement	100	38	0.93
Tar paper	68	20	0.93
<b>MATERIAL</b>			
<b>TEMPERATURE</b>			
°F °C			
<b>EMISSIVITY</b>			
<b>Basalt</b>			
	68	20	0.72
<b>MATERIAL</b>			
<b>TEMPERATURE</b>			
°F °C			
<b>EMISSIVITY</b>			
<b>Bismuth:</b>			
Bright	176	80	0.34
Unoxidized	77	25	0.05
	212	100	0.06
<b>MATERIAL</b>			
<b>TEMPERATURE</b>			
°F °C			
<b>EMISSIVITY</b>			
<b>Brass:</b>			
Matte	68	20	0.07
Burnished to brown color	68	20	0.40
Cu-Zn, brass oxidized	392	200	0.61
	752	400	0.60
	1112	600	0.61
Unoxidized	77	25	0.04
Unoxidized	212	100	0.04
<b>MATERIAL</b>			
<b>TEMPERATURE</b>			
°F °C			
<b>EMISSIVITY</b>			
<b>Brick:</b>			
Red, rough	70	21	0.93
Gault cream	2500 to 5000	1371 to 2760	0.26 to 0.30
Fire clay	2500	1371	0.75

Light buff	1000	538	0.80
Lime clay	2500	1371	0.43
Fire brick	1832	1000	0.75 to 0.80
Magnesite, refractory	1832	1000	0.38
Gray brick	2012	1100	0.75
Silica, glazed	2000	1093	0.88
Silica, unglazed	2000	1093	0.80
Sandime	2500 to 5000	1371 to 2760	0.59 to 0.63

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Cadmium</b>	77	25	0.02

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

**Carbon:**

Lamp black	77	25	0.95
Unoxidized	77	25	0.81
Unoxidized	212	100	0.81
	932	500	0.79
Candle soot	250	121	0.95
Filament	500	260	0.95
Graphitized	212	100	0.76
	572	300	0.75
	932	500	0.71

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Carborundum</b>	1850	1010	0.92

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

**Cast iron:**

Oxidized	390	199	0.64
	1110	599	0.78
Unoxidized	212	100	0.21
Strong oxidation	104	40	0.95
	482	250	0.95

Liquid	2795	1535	0.29
<b>MATERIAL</b>			
<b>TEMPERATURE</b>		<b>EMISSIVITY</b>	
<b>°F</b>	<b>°C</b>		
<b>Ceramic:</b>			
Alumina on Inconel	800 to 2000	427 to 1093	0.69 to 0.45
Earthenware, glazed	70	21	0.90
Earthenware, matte	70	21	0.93
Greens, No. 5210-2C	200 to 750	93 to 399	0.89 to 0.82
Coating, No. C20A	200 to 750	93 to 399	0.73 to 0.67
Porcelain	72	22	0.92
White, Al <sub>2</sub> O <sub>3</sub>	200	93	0.90
Zirconia on Inconel	800 to 2000	427 to 1093	0.62 to 0.45
<b>MATERIAL</b>			
<b>TEMPERATURE</b>		<b>EMISSIVITY</b>	
<b>°F</b>	<b>°C</b>		
<b>Chromium:</b>			
Chromium	100	38	0.08
	1000	538	0.26
Chromium, polished	302	150	0.06
<b>MATERIAL</b>			
<b>TEMPERATURE</b>		<b>EMISSIVITY</b>	
<b>°F</b>	<b>°C</b>		
<b>Clay:</b>			
Fired	68	20	0.39
Shale	158	70	0.91
Tiles, light red	68	20	0.69
Tiles, red	2500 to 5000	1371 to 2760	0.32 to 0.34
Tiles, red	2500 to 5000	1371 to 2760	0.40 to 0.51
Tiles, dark purple	2500 to 5000	1371 to 2760	0.78
<b>MATERIAL</b>			
<b>TEMPERATURE</b>		<b>EMISSIVITY</b>	
<b>°F</b>	<b>°C</b>		
<b>Columbium:</b>			
Unoxidized	1500	816	0.19
	2000	1093	0.24
<b>MATERIAL</b>			
<b>TEMPERATURE</b>		<b>EMISSIVITY</b>	
<b>°F</b>	<b>°C</b>		

<b>Concrete:</b>			
Rough	32 to 200	0 to 93	0.94
Tiles, natural	2500 to 5000	1371 to 2760	0.63 to 0.62
Tiles, brown	2500 to 5000	1371 to 2760	0.87 to 0.83
Tiles, black	2500 to 5000	1371 to 2760	0.94 to 0.91
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Copper:</b>			
Black, oxidized	100	38	0.78
Etched	100	38	0.09
Matte	100	38	0.22
Roughly polished	100	38	0.07
Polished	100	38	0.03
Highly polished	100	38	0.02
Rolled	100	38	0.64
Rough	100	38	0.74
Molten	1000	538	0.15
	1970	108	0.16
	2230	1221	0.13
Nickel plated	100 to 500	38 to 260	0.37
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Cotton cloth</b>	68	20	0.77
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Dolomite lime</b>	68	20	0.41
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Dow metal</b>	0 to 600	-18 to 315	0.15
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Emery corundum</b>	176	80	0.86

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Glass:</b>			
Convex D	212	100	0.80
	600	315	0.80
	932	500	0.76
Nonex	212	100	0.82
	600	315	0.82
	932	500	0.78
Smooth	32 to 200	0 to 93	0.92 to 0.94
<b>Gold:</b>			
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
Enamel	212	100	0.37
Plate (0.001) on 0.0005 silver	200 to 750	93 to 399	0.11 to 0.14
Plate (0.001) on 0.005 nickel	200 to 750	93 to 399	0.07 to 0.09
Polished	100 to 500	38 to 260	0.02
	1000 to 2000	538 to 1093	0.03
<b>Granite:</b>			
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
Granite	70	21	0.45
<b>Gravel:</b>			
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
Gravel	100	38	0.28
<b>Gypsum:</b>			
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
Gypsum	68	20	0.80 to 0.90
<b>Haynes Alloy C., oxidized:</b>			
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
Haynes Alloy C., oxidized	600 to 2000	316 to 1093	0.90 to 0.96
MATERIAL	TEMPERATURE		EMISSIVITY

	°F	°C	
<b>Haynes Alloy 25, oxidized</b>	600 to 2000	316 to 1093	0.86 to 0.89
<b>MATERIAL</b>			
	TEMPERATURE		EMISSIONIVITY
	°F	°C	
<b>Haynes Alloy X., oxidized</b>	600 to 2000	316 to 1093	0.85 to 0.88
<b>MATERIAL</b>			
	TEMPERATURE		EMISSIONIVITY
	°F	°C	
<b>Ice:</b>			
Smooth	32	0	0.97
Rough	32	0	0.98
<b>MATERIAL</b>			
	TEMPERATURE		EMISSIONIVITY
	°F	°C	
<b>Inconel:</b>			
Sheet	1000	538	0.28
	1200	649	0.42
	1400	760	0.58
Inconel X, polished	75	24	0.19
Inconel B, polished	75	24	0.21
<b>MATERIAL</b>			
	TEMPERATURE		EMISSIONIVITY
	°F	°C	
<b>Iron:</b>			
Oxidized	212	100	0.74
	930	499	0.89
	2190	1199	0.89
Unoxidized	212	100	0.05
Red rust	77	25	0.70
Rusted	77	25	0.65
Liquid	2760 to 3220	1516 to 1771	0.42 to 0.45
<b>MATERIAL</b>			
	TEMPERATURE		EMISSIONIVITY
	°F	°C	
<b>Lacquer:</b>			
Black	200	93	0.96
Blue, on aluminum foil	100	38	0.78

Clear, on aluminum foil, 2 coats	200	93	0.08 (0.09)
Clear, on bright copper	200	93	0.66
Clear, on tarnished copper	200	93	0.64
Red, on aluminum foil, 2 coats	100	38	0.61 (0.74)
White, on aluminum foil, 2 coats	100	38	0.69 (0.88)
White	200	93	0.95
Yellow, on aluminum foil, 2 coats	100	38	0.57 (0.79)

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

**Lead:**

Polished	100 to 500	38 to 260	0.06 to 0.08
Rough	100	38	0.43
Oxidized	100	38	0.43
Oxidized @ 1100;F	100	38	0.63
Oxidized, gray	100	38	0.28

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

<b>Lime mortar</b>	100 to 500	38 to 260	0.90 to 0.92
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MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

<b>Limestone</b>	100	38	0.95
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MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

<b>Magnesium</b>	100 to 500	38 to 260	0.07 to 0.13
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MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

<b>Magnesium oxide</b>	1800 to 3140	982 to 1727	0.16 to 0.20
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MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

**Marble:**

White	100	38	0.95
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Smooth	100	38	0.56
Polished gray	100	38	0.75
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Mercury</b>	32	0	0.09
	77	25	0.10
	100	38	0.10
	212	100	0.12
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Mica</b>	100	38	0.75
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Oil on nickel:</b>			
0.001 film	72	22	0.27
0.002 film	72	22	0.46
0.005 film	72	22	0.72
Thick film	72	22	0.82
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Oil, linseed:</b>			
On aluminum foil, uncoated	250	121	0.09
On aluminum foil, 1 coat	250	121	0.56
On aluminum foil, 2 coats	250	121	0.51
On polished iron, 0.001 film	100	38	0.22
On polished iron, 0.002 film	100	38	0.45
On polished iron, 0.004 film	100	38	0.65
On polished iron, thick film	100	38	0.83
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Paints:</b>			
Blue, CO <sub>2</sub> O <sub>3</sub>	75	24	0.94
Black, CuO	75	24	0.96

Green, Cu <sub>2</sub> O <sub>3</sub>	75	24	0.92
Red, Fe <sub>2</sub> O <sub>3</sub>	75	24	0.91
White, Al <sub>2</sub> O <sub>3</sub>	75	24	0.94
White, Y <sub>2</sub> O <sub>3</sub>	75	24	0.90
White, ZnO	75	24	0.95
White, MgCO <sub>3</sub>	75	24	0.91
White, ZrO <sub>2</sub>	75	24	0.95
White, ThCO <sub>2</sub>	75	24	0.90
White, MgO	75	24	0.91
White, PbCO <sub>3</sub>	75	24	0.93
Yellow, PbO	75	24	0.90
Yellow, PbCrO <sub>4</sub>	75	24	0.93

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Paints, aluminum:</b>	100	38	0.27 to 0.67
10% Al	100	38	0.52
26% Al	100	38	0.30
DOW XP-310	200	93	0.22

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Paints, bronze:</b>	Low		0.34 to 0.80
Gum varnish, 2 coats	70	21	0.53
Gum varnish, 3 coats	70	21	0.50
Cellulose binder, 2 coats	70	21	0.34

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Paints, oil:</b>			
All colors	200	93	0.92 to 0.96
Black	200	93	0.92
Black gloss	70	21	0.90
Camouflage green	125	52	0.85
Flat black	80	27	0.88
Flat white	80	27	0.91
Gray green	70	21	0.95

Green	200	93	0.95
Lamp black	209	98	0.96
Red	200	93	0.95
White	200	93	0.94
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Palladium plate (0.00005) on 0.0005 silver</b>	200 to 750	93 to 399	0.16 to 0.17
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Paper:</b>			
Kraft (average non-glass)	—	—	0.90
Offset (glass)	—	—	0.50 to 0.60
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Plastics (average)</b>	Low		0.95
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Platinum:</b>			
Platinum, black	100	38	0.93
	500	260	0.96
	2000	1093	0.97
Platinum, oxidized @ 1100°F	500	260	0.07
	1000	538	0.11
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Quartz:</b>			
Rough, fused:	70	21	0.93
Glass, 1.98 mm	540	282	0.90
	1540	838	0.41
Glass, 6.88 mm	540	282	0.93
	1540	838	0.47
Opaque	570	299	0.92
	1540	838	0.68

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Red lead</b>	212	100	0.93
<b>Rhodium flash: 0.0002 on 0.0005 Ni</b>			
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
	200 to 700	93 to 271	0.10 to 0.18
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Rubber:</b>			
Hard	74	23	0.94
Soft, gray	76	24	0.86
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Sand</b>	68	20	0.76
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Sawdust</b>	68	20	0.75
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Silica:</b>			
Glazed	1832	1000	0.85
Unglazed	2012	1100	0.75
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Silver:</b>			
Plate 0.0005 on nickel	200 to 700	93 to 271	0.06 to 0.07
Polished	100	38	0.01
	500	260	0.02
	1000	538	0.03
	2000	1093	0.03

<b>Slate</b>	100	38	0.67 to 0.80
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Snow:</b>			
Fine particles	20	7	0.82
Granular	18	8	0.89
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Soil:</b>			
Surface	100	38	0.38
Black loam	68	20	0.66
Plowed field	68	20	0.38
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Steel:</b>			
Cold rolled	200	93	0.75 to 0.85
Ground sheet	1720 to 2010	938 to 1099	0.55 to 0.61
Polished sheet	100	38	0.07
	500	260	0.10
	1000	538	0.14
Mild steel, polished	75	24	0.10
Mild steel, smooth	75	24	0.12
Mild steel, liquid	2910 to 3270	1599 to 1799	0.28
Unoxidized	77	25	0.80
	212	100	0.08
Oxidized	77	25	0.80
<b>MATERIAL</b>			
	<b>TEMPERATURE</b>		<b>EMISSIVITY</b>
	<b>°F</b>	<b>°C</b>	
<b>Steel alloys:</b>			
Type 301, polished	75	24	0.27
	450	232	0.57
	1740	949	0.55
Type 303, oxidized	600 to 2000	316 to 1093	0.74 to 0.87
Type 310, rolled	1500 to 2100	816 to 1149	0.56 to 0.81

Type 316, polished	75 450 1740	24 232 949	0.28 0.57 0.66
Type 321	200 to 800	93 to 427	0.27 to 0.32
Type 321, polished	300 to 1500	149 to 816	0.18 to 0.49
Type 321, with black oxide	200 to 800	93 to 427	0.66 to 0.76
Type 347, oxidized	600 to 2000	316 to 1093	0.87 to 0.91
Type 350	200 to 800	93 to 427	0.18 to 0.27
Type 350, polished	300 to 1800	149 to 982	0.11 to 0.35
Type 446, polished	300 to 1500	419 to 816	0.15 to 0.37
Type 17-7PH	200 to 600	93 to 315	0.44 to 0.51
Type 17-7PH, polished	300 to 1500	149 to 816	0.09 to 0.16
Type C1020, oxidized	600 to 2000	316 to 1093	0.87 to 0.91
Type PH-15-7MO	300 to 1200	149 to 649	0.07 to 0.19

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Stellite, polished</b>	68	20	0.18

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Stonework</b>	100	38	0.93

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

<b>Tantalum:</b>					
	TEMPERATURE		EMISSIVITY		
	°F	°C			
	Unoxidized	1340		727	0.14
		2000		1093	0.19
3600		1982	0.26		
5306		2930	0.30		

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

<b>Tin:</b>			
	TEMPERATURE		EMISSIVITY
	°F	°C	
Unoxidized	77	25	0.04
	212	100	0.05

MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	

<b>Tinned iron:</b>			
Bright	76	24	0.05
	212	100	0.08
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Titanium:</b>			
Alloy C110M, polished	300 to 1200	149 to 649	0.08 to 0.19
Alloy C110M, oxidized @ 1000°F	200 to 800	93 to 427	0.51 to 0.61
Alloy TI-95A, oxidized @ 1000°F	200 to 800	93 to 427	0.35 to 0.48
Anodized onto stainless steel	200 to 600	93 to 316	0.96 to 0.82
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Tungsten:</b>			
Unoxidized	77	25	0.02
	212	100	0.03
	932	500	0.07
	1832	1000	0.15
	2732	1500	0.23
	3632	2000	0.28
Filament (aged)	100	38	0.03
	1000	538	0.11
	5000	2760	0.35
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Uranium oxide</b>	1880	1027	0.79
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Water</b>	100	38	0.93
MATERIAL	TEMPERATURE		EMISSIVITY
	°F	°C	
<b>Wood:</b>	Low		0.80 to 0.90
Beech, planed	158	70	0.94
Oak, planed	100	38	0.91

Spruce, sanded	100	38	0.89
<b>MATERIAL</b>			
<b>TEMPERATURE</b>		<b>EMISSIVITY</b>	
	<b>°F</b>	<b>°C</b>	
<b>Wrought iron:</b>			
Dull	77	25	0.94
	660	349	0.94
Smooth	100	38	0.35
Polished	100	38	0.28
<b>MATERIAL</b>			
<b>TEMPERATURE</b>		<b>EMISSIVITY</b>	
	<b>°F</b>	<b>°C</b>	
<b>Zinc:</b>			
Bright galvanized	100	38	0.23
Commercial 99.1%	500	260	0.05
Galvanized	100	38	0.28
Oxidized	500 to 1000	260 to 538	0.11
Polished	100	38	0.02
	500	260	0.03
	1000	538	0.04
	2000	1093	0.06