

KLEIBER INFRARED GmbH – Emissivity table FERROUS AND NON FERROUS METALS

Material	Temp (°C)	Temp (°F)	ε-Emissivity
Alloys			
20-Ni, 24-CR, 55-FE, Oxidized	200	392	0.90
20-Ni, 24-CR, 55-FE, Oxidized	500	932	0.97
60-Ni, 12-CR, 28-FE, Oxidized	270	518	0.89
60-Ni, 12-CR, 28-FE, Oxidized	560	1040	0.82
80-Ni, 20-CR, Oxidized	100	212	0.87
80-Ni, 20-CR, Oxidized	600	1112	0.87
'0-Ni, 20-CR, Oxidized	1300	2372	0.89
Aluminium			
Unoxidized	25	77	0.02
Unoxidized	100	212	0.03
Unoxidized	500	932	0.06
Oxidized	199	390	0.11
Oxidized	599	1110	0.19
Oxidized at 599°C	199	390	0.11
Oxidized at 599°C	599	1110	0.19
Heavily Oxidized	93	200	0.20
Heavily Oxidized	504	940	0.31
Highly Polished	100	212	0.09
Roughly Polished	100	212	0.18
Commercial Sheet	100	212	0.09
Highly Polished Plate	227	440	0.04
Highly Polished Plate	577	1070	0.06
Bright Rolled Plate	170	338	0.04
Bright Rolled Plate	500	932	0.05
Alloy A3003, Oxidized	316	600	0.40
Alloy A3003, Oxidized	482	900	0.40
Alloy 1100-0	93-427	200-800	0.05
Alloy 24ST	24	75	0.09
Alloy 24ST Polished	24	75	0.09
Alloy 75ST	24	75	0.11
Alloy 75ST Polished	24	75	0.08
Bismuth, Bright			
Bismuth, Unoxidized	80	176	0.34
Bismuth, Unoxidized	25	77	0.05
Bismuth, Unoxidized	100	212	0.06
Brass			
73%Cu.27%Zn. Polished	247	476	0.03
73%Cu.27%Zn. Polished	357	674	0.03
62%Cu.37%Zn. Polished	257	494	0.03
62%Cu.37%Zn. Polished	377	710	0.04
83%Cu.17%Zn. Polished	277	530	0.03
Matte	20	68	0.07
Burnished to Brown Colour	20	68	0.40
Cu-Zn, Brass Oxidized	200	392	0.61
Cu-Zn, Brass Oxidized	400	752	0.60
Cu-Zn, Brass Oxidized	600	1112	0.61
Unoxidized	25	77	0.04
Unoxidized	100	212	0.04
Cadmium			
Cadmium	25	77	0.02
Carbon			
Lampblack	25	77	0.95
Unoxidized	25	77	0.81
Unoxidized	100	212	0.81
Unoxidized	500	932	0.79
Candle Soot	121	250	0.95

Material	Temp (°C)	Temp (°F)	e-Emissivity
Filament	260	500	0.95
Graphitized	100	212	0.76
Graphitized	300	572	0.75
Graphitized	500	932	0.71
Chromium	38	100	0.08
Chromium	538	1000	0.26
Chromium Polished	150	302	0.06
Cobalt. Unoxidized	500	932	0.13
Cobalt, Unoxidized	1000	1832	0.23
Columbium,Unoxidized	816	1500	0.19
Columbium.Unoxidized	1093	2000	0.24
Copper			
Cuprous Oxide	38	100	0.87
Cuprous Oxide	260	500	0.83
Cuprous Oxide	538	1000	0.77
Black, Oxidized	38	100	0.78
Etched	38	100	0.09
Matte	38	100	0.22
Roughly Polished	38	100	0.07
Polished	38	100	0.03
Highly Polished	38	100	0.02
Rolled	38	100	0.64
Rough	38	100	0.74
Molten	538	1000	0.15
Molten	1077	1970	0.16
Molten	1221	2230	0.13
Nickel Plated	38-260	100-500	0.37
Dow Metal	(18)-316	0-600	0.15
Gold			
Enamel	100	212	0.37
Plate (.0001)			
on .0005 Silver	93-399	200-750	11-.14
on .0005 Nickel	93-399	200-750	07-.09
Polished	38-260	100-500	0.02
Polished	538-1093	1000-2000	0.03
Haynes Alloy C, Oxidized	316-1093	600-2000	.90-.96
Haynes Alloy 25, Oxidized	316-1093	600-2000	.86-.89
Haynes Alloy X, Oxidized	316-1093	600-2000	.85-.88
Inconel Sheet	538	1000	0.28
Inconel Sheet	649	1200	0.42
Inconel Sheet	760	1400	0.58
Inconel X, Polished	24	75	0.19
Inconel B, Polished	24	75	0.21
Iron			
Oxidized	100	212	0.74
Oxidized	499	930	0.84
Oxidized	1199	2190	0.89
Unoxidized	100	212	0.05
Red Rust	25	77	0.70
Rusted	25	77	0.65
Liquid	1516-1771	2760-3220	42-.45
Cast Iron			
Oxidized	199	390	0.64
Oxidized	599	1110	0.78
Unoxidized	100	212	0.21
Stong Oxidation	40	104	0.95
Strong Oxidation	250	482	0.95
Liquid	1535	2795	0.29

Material	Temp (°C)	Temp (°F)	e-Emissivity
Wrought Iron			
Dull	25	77	0.94
Dull	349	660	0.94
Smooth	38	100	0.35
Polished	38	100	0.28
Lead			
Polished	38-260	100-500	.06-.08
Rough	38	100	0.43
Oxidized	38	100	0.43
Oxidized at 593°C	38	100	0.63
Gray Oxidized	38	100	0.28
Magnesium	38-260	100-500	.07-.13
Magnesium Oxide	1027-1727	1880-3140	.16-.20
Mercury	0	32	0.09
Mercury	25	77	0.10
Mercury	38	100	0.10
Mercury	100	212	0.12
Molybdenum	38	100	0.06
Molybdenum	260	500	0.08
Molybdenum	538	1000	0.11
Molybdenum	1093	2000	0.18
Molybdenum Oxidized at 538°C	316	600	0.80
Molybdenum Oxidized at 538°C	371	700	0.84
Molybdenum Oxidized at 538°C	427	800	0.84
Molybdenum Oxidized at 538°C	482	900	0.83
Molybdenum Oxidized at 538°C	538	1000	0.82
Monel, Ni-Cu	200	392	0.41
Monel, Ni-Cu	400	752	0.44
Monel, Ni-Cu	600	1112	0.46
Monel, Ni-Cu Oxidized	20	68	0.43
Monel, Ni-Cu Oxidized at 599°C	599	1110	0.46
Nickel			
Polished	38	100	0.05
Oxidized	38-260	100-500	31-.46
Unoxidized	25	77	0.05
Unoxidized	100	212	0.06
Unoxidized	500	932	0.12
Unoxidized	1000	1832	0.19
Electrolytic	38	100	0.04
Electrolytic	260	500	0.06
Electrolytic	538	1000	0.10
Electrolytic	1093	2000	0.16
Nickel Oxide	538-1093	1000-2000	59-.86
Palladium Plate			
(.00005 on .0005 silver)	93-399	200-750	.16-.17
Platinum	38	100	0.05
Platinum	260	500	0.05
Platinum	538	1000	0.10
Platinum Black	38	100	0.93
Platinum Black	260	500	0.96
Platinum Black	1093	2000	0.97
Platinum Black Oxidized at 593°C	260	500	0.07
Platinum Black Oxidized at 593°C	538	1000	0.11
Rhodium Flash			
(.0002 on .0005 Ni)	93-371	200-700	10-.18
Silver			
Plate (.0005 on Ni)	93-371	200-700	.06-.07
Polished	38	100	0.01

Material	Temp (°C)	Temp (°F)	e-Emissivity
Polished	260	500	0.02
Polished	538	1000	0.03
Polished	1093	2000	0.03
Steel			
Cold Rolled	93	200	.75-.85
Ground Sheet	938-1099	1720-2010	.55-.61
Polished Sheet	38	100	0.07
Polished Sheet	260	500	0.10
Polished Sheet	538	1000	0.14
Mild Steel, Polished	24	75	0.10
Mild Steel, Polished Smooth	24	75	0.12
Mild Steel, Liquid	1599-1799	2910-3270	0.28
Steel, Unoxidized	100	212	0.08
Steel Oxidized	25	77	0.80
Steel Alloys			
Type 301, Polished	24	75	0.27
Type 301, Polished	232	450	0.57
Type 301, Polished	949	1740	0.55
Type 303, Oxidized	316-1093	600-2000	.74-.87
Type 310, Rolled	816-1149	1500-2100	.56-.81
Type 316, Polished	24	75	0.28
Type 316, Polished	232	450	0.57
Type 316, Polished	949	1740	0.66
Type 321	93-427	200-800	.27-.32
Type 321 Polished	149-816	300-1500	.18-.49
Type 321 w/BK Oxide	93-427	200-800	.66-.76
Type 347, Oxidized	316-1093	600-2000	.87-.91
Type 350	93-427	200-800	.18-.27
Type 350, Polished	149-982	300-1800	.11-.35
Steel Alloys			
Type 446, Polished	149-816	300-1500	.15-.37
Type 17-7PH	93-316	200-600	.44-.51
Type 17-7PH Polished	149-816	300-1500	.09-.16
Type 020, Oxidised	316-1093	600-2000	.87-.91
Type PH-15-7MO	149-649	300-1200	.07-.19
Stellite, Polished	20	68	0.18
Tantalum			
Unoxidized	727	1340	0.14
Unoxidized	1093	2000	0.19
Unoxidized	1982	3600	0.26
Unoxidized	2930	5306	0.30
Tin, Unoxidized	25	77	0.04
Tin, Unoxidized	100	212	0.05
Tinned Iron, Bright	24	76	0.05
Tinned Iron Bright	100	212	0.08
Titanium			
Alloy C110M, Polished	149-649	300-1200	.08-.19
Alloy C110M, Oxidised at 538°	93-427	200-800	.51-.61
Alloy T1-95A Oxidised at 538°	93-427	200-800	.35-.48
Anodized onto SS	93-316	200-600	.96-.82
Tungsten			
Unoxidized	25	77	0.02
Unoxidized	100	212	0.03
Unoxidized	500	932	0.07
Unoxidized	1000	1832	0.15
Unoxidized	1500	2732	0.23
Unoxidized	2000	3632	0.28
Filament (Aged)	38	100	0.03

Material	Temp (°C)	Temp (°F)	e-Emissivity
Filament (Aged)	538	1000	0.11
Filament (Aged)	2760	5000	0.35
Uranium Oxide	1027	1880	0.79
Zinc			
Bright Galvanized	38	100	0.23
Commercial 99.1 %	260	500	0.05
Galvanized	38	100	0.28
Oxidized	260-538	500-1000	0.11
Polished	38	100	0.02
Polished	260	500	0.03
Polished	538	1000	0.04
Polished	1093	2000	0.06

Other Materials

Material	Temp (°C)	Temp (°F)	e-Emissivity
Adobe	20	68	0.90
Asbestos			
Board	38	100	0.96
Cement	0-200	32-392	0.96
Cement Red	1371	2500	0.67
Cement White	1371	2500	0.65
Cloth	93	199	0.90
Paper	38-371	100-700	0.93
Slate	20	68	0.97
Asphalt, pavement	38	100	0.93
Asphalt, tar paper	20	68	0.93
Basalt	20	68	0.72
Brick			
Red, rough	21	70	0.93
Gault Cream	1371-2760	2500-5000	.26-.30
FireClay	1371	2500	0.75
Light Buff	538	1000	0.80
Lime Clay	1371	2500	0.43
Fire Brick	1000	1832	.75-.80
Magnesite, Refractory	1000	1832	0.38
Gray Brick	1100	2012	0.75
Silica, Glazed	1093	2000	0.88
Silica, Unglazed	1093	2000	0.80
Sandlime	1371-2760	2500-5000	.59-.63
Carborundum	1010	1850	0.92
Ceramic			
Alumina on Inconel	427-1093	800-2000	.69-.45
Earthenware, Glazed	21	70	0.90
Earthenware, Matte	21	70	0.93
Greens No. 5210-2C	93-399	200-750	.89-.82
Coating No. C20A	93-399	200-750	.73-.87
Porcelain	22	72	0.92
White Aluminium Oxide	93	200	0.90

Material	Temp (°C)	Temp (°F)	e-Emissivity
Zirconia on Inconel	427-1093	800-2000	.62-.45
Clay	20	68	0.39
Clay Fired	70	158	0.91
Clay Shale	20	68	0.69
Clay Tiles, Light Red	1371-2760	2500-5000	.32-.34
Clay Tiles, Red	1371-2760	2500-5000	.40-.51
Clay Tiles, Dark Purple	1371-2760	2500-5000	0.78
Concrete			
Rough	0-1093	32-2000	0.94
Tiles, Natural	1371-2760	2500-5000	.63-.62
Tiles, Brown	1371-2760	2500-5000	.87-.83
Tiles Black	1371-2760	2500-5000	.94-.91
Cotton Cloth	20	68	0.77
Dolomite Lime	20	68	0.41
Emery Corundum	80	176	0.86
Glass			
Convex D	100	212	0.80
Convex D	316	600	0.80
Convex D	500	932	0.76
Nonex	100	212	0.82
Nonex	316	600	0.82
Nonex	500	932	0.78
Smooth	0-93	32-200	.92-.94
Granite	21	70	0.45
Gravel	38	100	0.28
Gypsum	20	68	80-90
Ice, Smooth	0	32	0.97
Ice Rough	0	32	0.96
Lacquer			
Black	93	200	0.96
Blue, on Aluminum Foil	38	100	0.78
Clear, on Aluminum Foil (2 coat)	93	200	08(.09)
Clear, on Bright Copper	93	200	0.66
Clear, on Tarnished Copper	93	200	0.64
Red, on Aluminum Foil (2 coat)	38	100	61(.74)
White	93	200	0.95
White, on Aluminum Foil (2 coat)	38	100	69(.88)
Yellow, on Aluminum Foil (2 coat)	38	100	57(.79)
Lime Mortar	38-260	100-500	90-.92
Limestone	38	100	0.95
Marble, White	38	100	0.95
Marble, Smooth, White	38	100	0.56
Marble, Polished Gray	38	100	0.75
Oil on Nickel			
.001 Film	22	72	0.27
.002 Film	22	72	0.46
.005 Film	22	72	0.72
Thick Film	22	72	0.82
Oil, Linseed			
On Aluminum Foil, uncoated	121	250	0.09
On Aluminum Foil, 1 coat	121	250	0.56
On Aluminum Foil, 2 coats	121	250	0.51
On Polished Iron, .001 Film	38	100	0.22
On Polished Iron, .002 Film	38	100	0.45
On Polished Iron, .004 Film	38	100	0.83

Material	Temp (°C)	Temp (°F)	e-Emissivity
On Polished Iron, Thick Film	38	100	
Paints			
Blue, Cu ₂ O ₃	24	75	0.94
Black, CuO	24	75	0.96
Green, Cu ₂ O ₃	24	75	0.92
Red, Fe ₂ O ₃	24	75	0.91
White Al ₂ O ₃	24	75	0.94
White Y ₂ O ₃	24	75	0.90
White ZnO	24	75	0.95
White MgCO ₃	24	75	0.91
White, ZrO ₂	24	75	0.95
White ThO ₂	24	75	0.90
White MgO ₂	4	75	0.91
White PbCO ₃	24	75	0.93
Yellow, PbO	24	75	0.90
Yellow PbCrO ₄	24	75	0.93
Paints, Aluminum	38	100	.27-67
10% Al	38	100	0.52
20% Al	38	100	0.30
Dow XP-310	93	200	0.22
Paints, Bronze	Low	Low	.34-.80
Gum Varnish (2 coats)	21	70	0.53
Gum Varnish (3 coats)	21	70	0.50
Cellulose Binder (2 coats)	21	70	0.34
Paints, Oil			
All colours	93	200	.92-.96
Black	93	200	0.92
Black Gloss	21	70	0.30
Camouflage Green	52	125	0.85
Flat Black	27	80	0.88
Flat White	27	80	0.91
Gray-Green	21	70	0.95
Green	93	200	0.95
Lamp Black	98	209	0.96
Red	93	200	0.95
White	93	200	0.94
Quartz, Rough, Fused	21	70	0.93
Glass, 1.96 mm	282	540	0.90
Glass, 1.96 mm	838	1540	0.41
Glass, 6.88 mm	282	540	0.93
Glass, 6.88 mm	838	1540	0.47
Opaque	299	570	0.92
Opaque	838	1540	0.68
Red Lead	100	212	0.93
Rubber, Hard	23	74	0.94
Rubber, Soft, Gray	24	76	0.86
Sand	20	68	0.76
Sandstone	38	100	0.67
Sandstone Red	38	100	.60-.83
Sawdust	20	68	0.75
Shale	20	68	0.69
Silica Glazed	1000	1832	0.85
Silica Unglazed	1100	2012	0.75
Silicon Carbide	149-649	300-1200	.83-.96
Silk Cloth	20	68	0.78

Material	Temp (°C)	Temp (°F)	e-Emissivity
Slate	38	100	.67-.80
Snow, Fine Particles	-7	20	0.82
Snow Granular	-8	18	0.89
Soil			
Surface	38	100	0.38
Black Loam	20	68	0.66
Plowed Field	20	68	0.38
Soot			
Acetylene	24	75	0.97
Camphor	24	75	0.94
Candle	121	250	0.95
Coal	20	68	0.95
Stonework	38	100	0.93
Water	38	100	0.67
Waterglass	20	68	0.96
Wood	Low	Low	.80-.90
Beech, Planed	70	158	0.94
Oak, Planed	38	100	0.91
Spruce, Sanded	38	100	0.89