APPENDIX B

TABLES FOR RADIATIVE PROPERTIES OF OPAQUE SURFACES

In this appendix, tables of total normal emittances, as well as a number of total normal solar absorptances, are given. The data have been collected from several surveys [1–8] that, in turn, have assembled their data from a multitude of references dating back all the way into the 1920s. As seen from the tables, there can sometimes be considerable differences in total emittance for ostensibly the same material, as reported by different researchers. While these discrepancies are partially due to varying accuracy, the primary reason is, as outlined in Chapter 3, the fact that surface layers, surface roughness, oxidation, etc., strongly affect the emittance of materials. Therefore, it should be realized that the total normal emittance or absorptance of a given surface may, in actuality, differ considerably from these reported values.

In estimating the total hemispherical emittance from total normal data, one should keep in mind that:

1. Materials with high emittance tend to behave like dielectrics, resulting in a hemispherical emittance that is 3% to 5% smaller than the normal one (cf. Fig. 3-19).
2. Materials with low emittance tend to behave like metals, resulting in hemispherical emittances that may be up to 25% larger than normal ones (cf. Fig. 3-9).

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TABLE B.1
Total emittance and solar absorptance of selected surfaces (compiled by Edwards *et al.* [1]).

	Temperature [°C]	Total normal emittance	Extraterrestrial solar absorptance
Alumina, flame-sprayed	−25	0.80	0.28
Aluminum foil, as received	20	0.04	
Bright dipped	20	0.025	0.10
Aluminum, vacuum-deposited on mylar	20	0.025	0.10
Aluminum alloy 6061, as received	20	0.03	0.37
Aluminum alloy 75S-T6, weathered 20,000 h on a DC6 aircraft	65	0.16	0.54
Aluminum, hard-anodized, 6061-T6	−25	0.84	0.92
Aluminum, soft-anodized, *Reflectal* alloy	−25	0.79	0.23
Aluminum, 7075-T6, sandblasted with 60 mesh silicon carbide grit	20	0.30	0.55
Aluminized silicone resin paint	95	0.20	0.27
Dow Corning XP-310	425	0.22	
Beryllium	150	0.18	0.77
	370	0.21	
	600	0.30	
Beryllium, anodized	150	0.90	
	370	0.88	
	600	0.82	
Black paint, Parson's optical black	−25	0.95	0.975
Black silicone, high-heat National Lead Co. 46H47	−25 to 750	0.93	0.94
Black epoxy paint, Cat-a-lac Finch Paint and Chem. Co. 463-1-8	−25	0.89	0.95
Black enamel paint, Rinshed-Mason	95	0.81	
Heated 1000 h at 375°C in air	425	0.80	
Chromium plate	95	0.12	
Heated 50 h at 600°C	400	0.15	
	35	0.15	0.78
Copper, electroplated	20	0.03	0.47
Black-oxidized in Ebonol C	35	0.16	0.91
Glass, second surface mirror			
Aluminized	−25	0.83	0.13
Silvered	−25	0.83	0.13
Gold, coated on stainless steel	95	0.09	
Heated in air at 540°C	400	0.14	
Coated on 3M tape Y9814	20	0.025	0.21
Graphite, crushed on sodium silicate	−25	0.91	0.96
Inconel X, oxidized 4 h at 1000°C	−25	0.71	0.90
Oxidized 10 h at 700°C	95	0.81	
	425	0.79	
Magnesium–thorium alloy	95	0.07	
	260	0.06	
Magnesium, Dow 7 coating	370	0.36	

TABLE B.1
Total emittance and solar absorptance of selected surfaces (cont'd).

	Temperature [°C]	Total normal emittance	Extraterrestrial solar absorptance
Mylar film, aluminized on second surface			
0.0625 mm thick	20	0.37	0.17
0.025 mm thick	20	0.63	0.17
0.075 mm thick	20	0.81	0.24
Nickel, electroplated	20	0.03	0.22
Nickel, electro-oxidized on copper			
110-30	35	0.05	0.85
125-30	35	0.11	0.85
Platinum-coated stainless steel	95	0.13	
	400	0.15	
Annealed in air 300 h at 375°C	95	0.11	
	425	0.13	
Silica, Corning Glass 7940M			
Sintered, powdered, fused silica	35	0.84	0.08
Silica, second surface mirror, aluminized	20	0.83	0.14
Silvered	20	0.83	0.07
Silicon solar cell, boron-doped, no coverglass	35	0.32	0.94
Silver, plated on nickel on stainless steel	95	0.06	
	400	0.08	
Heated 300 h at 375°C	95	0.11	
	425	0.13	
Silver Chromatone paint	20	0.24	0.20
Stainless steel			
Type 312, heated 300 h at 260°C	95	0.27	
	425	0.32	
Type 301 with Armco black oxide	−25	0.75	0.89
Type 410, heated to 700°C in air	35	0.13	0.76
Type 303, sandblasted heavily with 80 mesh aluminum oxide grit	95	0.42	0.68
Titanium, 75A	95	0.10	
	425	0.19	
75A, oxidized 300 h at 450°C	35	0.21	0.80
	425	0.25	
C-110M, oxidized 100 h at 425°C in air	35	0.16	0.52
C-110M, oxidized 300 h at 450°C in air	35	0.20	0.77
Evaporated 80–100 μm, oxidized 3 h at 400°C	35	0.14	0.75
Anodized	−25	0.73	0.51
White acrylic resin paint	95	0.92	
Sherwin-Williams M49WC8-CA-10144	200	0.87	
White epoxy paint, Cat-a-lac Finch Paint and Chemical Co. 483-1-8	−25	0.88	0.25
White potassium zirconium silicate coating	20	0.89	0.13
Zinc, blackened by electrochemical treatment	35	0.12	0.89

TABLE B.2
Total normal emittance of various surfaces.

	Temperature[a] [°C]	Total normal emittance[a]
A. Metals and their oxides		
Aluminum		
Highly polished plate, 98.3% pure	225–575	0.039–0.057
Commercial sheet	100	0.09
Rough polish	100	0.18
Rough plate	40	0.055–0.07
Oxidized at 600°C	200–600	0.11–0.19
Heavily oxidized	95–500	0.20–0.31
Aluminum oxide	275–500	0.63–0.42
	500–825	0.42–0.26
Al-surfaced roofing	40	0.216
Aluminum alloys[b]		
Alloy 75 ST: A, B_1, C	25	0.11, 0.10, 0.08
Alloy 75 ST: A[c]	230–480	0.22–0.16
Alloy 75 ST: B_1[c]	230–425	0.20–0.18
Alloy 75 ST: C[c]	230–500	0.22–0.15
Alloy 24 ST: A, B_1, C	25	0.09
Alloy 24 ST: A[c]	230–485	0.17–0.15
Alloy 24 ST: B_1[c]	230–505	0.20–0.16
Alloy 24 ST: C[c]	230–460	0.16–0.13
Calorized surfaces, heated at 600°C		
Copper	200–600	0.18–1.19
Steel	200–600	0.52–0.57
Antimony, polished	35–260	0.28–0.31
Beryllium, polished	1000–1200	0.37
Bismuth, bright	75	0.34
Brass		
Highly polished		
73.2% Cu, 26.7% Zn	245–355	0.028–0.031
62.4% Cu, 36.8% Zn, 0.4% Pb, 0.3% Al	255–375	0.033–0.037
82.9% Cu, 17.0% Zn	275	0.030
Polished	100	0.06
	40–315	0.10
Rolled plate, natural surface	22	0.06
Rolled plate, rubbed with coarse emery	22	0.20
Dull plate	50–350	0.22
Oxidized by heating at 600°C	200–600	0.61–0.59
Chromium, polished	40–1100	0.08–0.36
Copper		
Carefully polished electrolytic copper	80	0.018
Polished	115	0.023
	100	0.052
Commercial emeried, polished, pits remaining	19	0.030
Commercial, scraped shiny, not mirror-like	22	0.072
Plate heated long time, with thick oxide layer	25	0.78
Plate heated at 600°C	200–600	0.57
Cuprous oxide	800–1100	0.66–0.54
Molten copper	1075–1275	0.16–0.13

TABLE B.2
Total normal emittance of various surfaces (cont'd).

	Temperature[a] [°C]	Total normal emittance[a]
Dow metal:[b]		
A; B_1; C	25	0.15, 0.15, 0.12
A[c]	230–400	0.24–0.20
B_1[c]	230–425	0.16
C[c]	230–405	0.21–0.18
Germanium, polished	800	0.55
Gold, pure, highly polished	225–625	0.018–0.035
Hafnium, polished	1400	0.45
Inconel:[b]		
Types X and B: surface A, B_2, C	25	0.19–0.21
Type X: surface A[c]	230–880	0.55–0.78
Type X: surface B_2[c]	230–855	0.60–0.75
Type X: surface C[c]	230–900	0.62–0.73
Type B: surface A[c]	230–880	0.35–0.55
Type B: surface B_2[c]	230–950	0.32–0.51
Type B: surface C[c]	230–1000	0.35–0.40
Iron and steel (not including stainless)		
Metallic surfaces (or very thin oxide layer)		
Electrolytic iron, highly polished	175–225	0.052–0.064
Steel, polished	100	0.066
Iron, polished	425–1025	0.14–0.38
Iron, roughly polished	100	0.17
Iron, freshly emeried	20	0.24
Cast iron, polished	200	0.21
Cast iron, newly turned	22	0.44
Cast iron, turned and heated	880–990	0.60–0.70
Wrought iron, highly polished	40–250	0.28
Polished steel casting	770–1035	0.52–0.56
Ground sheet steel	935–1100	0.55–0.61
Smooth sheet iron	900–1040	0.55–0.60
Mild steel[b]: A, B_2, C	25	0.12, 0.15, 0.10
Mild steel[b]: A[c]	230–1065	0.20–0.32
Mild steel[b]: B_2[c]	230–1050	0.34–0.35
Mild steel[b]: C[c]	230–1065	0.27–0.31
Oxidized surfaces		
Iron plate, pickled, then rusted red	20	0.61
Iron plate, completely rusted	20	0.69
Iron, dark gray surface	100	0.31
Rolled sheet steel	21	0.66
Oxidized iron	100	0.74
Cast iron, oxidized at 600°C	200–600	0.64–0.78
Steel, oxidized at 600°C	200–600	0.79
Smooth, oxidized electrolytic iron	125–525	0.78–0.82
Iron oxide	500–1200	0.85–0.89
Rough ingot iron	925–1115	0.87–0.95
Sheet steel, strong, rough oxide layer	25	0.80
Dense, shiny oxide layer	25	0.82

TABLE B.2
Total normal emittance of various surfaces (cont'd).

	Temperature[a] [°C]	Total normal emittance[a]
Cast plate, smooth	23	0.80
Cast plate, rough	23	0.82
Cast iron, rough, strongly oxidized	40–250	0.95
Wrought iron, dull oxidized	20–360	0.94
Steel plate, rough	40–370	0.94–0.97
Molten surfaces		
Cast iron	1300–1400	0.29
Mild steel	1600–1800	0.28
Steel, several different kinds with 0.25–1.2% C (slightly oxidized surface)	1560–1710	0.27–0.39
Steel	1500–1650	0.42–0.53
	1520–1650	0.43–0.40
Pure iron	1515–1770	0.42–0.45
Armco iron	1520–1690	0.40–0.41
Lead		
Pure (99.96%), unoxidized	125–225	0.057–0.075
Gray oxidized	25	0.28
Oxidized at 150°C	200	0.63
Magnesium		
Magnesium oxide	275–825	0.55–0.20
	900–1705	0.20
Magnesium, polished	35–260	0.07–0.13
Mercury	0–100	0.09–0.12
Molybdenum		
Filament	725–2595	0.096–0.202
Massive, polished	100	0.071
Polished	35–260	0.05–0.08
	540–1370	0.10–0.18
	2750	0.29
Monel metal[b]		
Oxidized at 600°C	200–600	0.41–0.46
K Monel 5700: A, B_2, C	25	0.23, 0.17, 0.14
K Monel 5700: A[c]	230–875	0.46–0.65
K Monel 5700: B_2[c]	230–955	0.54–0.77
K Monel 5700: C[c]	230–975	0.35–0.53
Nickel		
Electroplated, polished	23	0.045
Technically pure (98.9% Ni, + Mn), polished	225–375	0.07–0.087
Polished	100	0.072
Electroplated, not polished	20	0.11
Wire	185–1005	0.096–0.186
Plate, oxidized by heating at 600°C	200–600	0.37–0.48
Nickel oxide	650–1255	0.59–0.86
Nickel alloys		
Chromnickel	50–1035	0.64–0.76
Copper–nickel, polished	100	0.059
Nichrome wire, bright	50–1000	0.65–0.79

TABLE B.2
Total normal emittance of various surfaces (cont'd).

	Temperature[a] [°C]	Total normal emittance[a]
Nichrome wire, oxidized	50–500	0.95–0.98
Nickel–silver, polished	100	0.135
Nickelin (18–32% Ni; 55–68% Cu; 20% Zn), gray oxidized	20	0.262
Type ACI-HW (60% Ni; 12% Cr), smooth, black, firm adhesive oxide coat from service	270–560	0.89–0.82
Platinum		
Pure, polished plate	225–625	0.054–0.104
Strip	925–1625	0.12–0.17
Filament	27–1225	0.036–0.192
Wire	225–1375	0.073–0.182
Silver		
Polished, pure	225–625	0.020–0.032
Polished	40–370	0.022–0.031
	100	0.052
Stainless steel[b]		
Polished	100	0.074
Type 301: A, B_2, C	25	0.21, 0.27, 0.16
Type 301: A[c]	230–950	0.57–0.55
Type 301: B_2[c]	230–940	0.54–0.63
Type 301: C[c]	230–900	0.51–0.70
Type 316: A, B_2, C	25	0.28, 0.28, 0.17
Type 316: A[c]	230–870	0.57–0.66
Type 316: B_2[c]	230–1050	0.52–0.50
Type 316: C[c]	230–1050	0.26–0.31
Type 347: A, B_2, C	25	0.39, 0.35, 0.17
Type 347: A[c]	230–900	0.52–0.65
Type 347: B_2[c]	230–875	0.51–0.65
Type 347: C[c]	230–900	0.49–0.64
Type 304: (8% Cr; 18% Ni)		
Light silvery, rough, brown after heating	215–490	0.44–0.36
After 42 h heating at 525°C	215–525	0.62–0.73
Type 310 (25% Cr; 20% Ni), brown, splotched, oxidized from furnace service	215–525	0.90–0.97
Allegheny metal no. 4, polished	100	0.13
Allegheny alloy no. 66, polished	100	0.11
Tantalum filament	1340–3000	0.19–0.31
Thorium oxide	275–500	0.58–0.36
	500–825	0.36–0.21
Tin		
Bright tinned iron	25	0.043, 0.064
Bright	50	0.06
Commercial tin-plated sheet iron	100	0.07, 0.08
Tungsten		
Filament, aged	27–3300	0.032–0.35
Filament	3300	0.39
Polished coat	100	0.066
Yttrium	1400	0.35

TABLE B.2
Total normal emittance of various surfaces (cont'd).

	Temperature[a] [°C]	Total normal emittance[a]
Zinc		
Commercial 99.1% pure, polished	225–325	0.045–0.053
Oxidized by heating at 400°C	400	0.11
Galvanized sheet iron, fairly bright	27	0.23
Galvanized sheet iron, gray oxidized	25	0.28
Zinc, galvanized sheet	100	0.21
B. Refractories, building materials, paints, and miscellaneous		
Alumina (99.5–85% Al_2O_3; 0–12% SiO_2; 0–1% Fe_2O_3)		
Effect of mean grain size	1010–1565	
10 μm		0.30–0.18
50 μm		0.39–0.28
100 μm		0.50–0.40
Alumina on Inconel	540–1100	0.65–0.45
Alumina–silica (showing effect of Fe)	1010–1565	
80–58% Al_2O_3; 16–38% SiO_2; 0.4% Fe_2O_3		0.61–0.43
36–26% Al_2O_3; 50–60% SiO_2; 1.7% Fe_2O_3		0.73–0.62
61% Al_2O_3; 35% SiO_2; 2.9% Fe_2O_3		0.78–0.68
Asbestos		
Board	23	0.96
Paper	35–370	0.93–0.94
Brick		
Red, rough, but no gross irregularities	20	0.93
Grog brick, glazed	1100	0.75
Building	1000	0.45
Fireclay	1000	0.75
White refractory	1100	0.29
Carbon		
Filament	1040–1405	0.526
Rough plate	100–320	0.77
	320–500	0.77–0.72
Graphitized	100–320	0.76–0.75
	320–500	0.75–0.71
Candle soot	95–270	0.952
Lampblack–waterglass coating	100–275	0.96–0.95
Thin layer on iron plate	20	0.927
Thick coat	20	0.967
Lampblack, 0.075 mm or thicker	40–370	0.945
Lampblack, rough deposit	100–500	0.84–0.78
Lampblack, other blacks	50–1000	0.96
Graphite, pressed, filed surface	250–510	0.98
Carborundum (87% SiC; density 2.3 g/cm^3)	1010–1400	0.92–0.81
Concrete tiles	1000	0.63
Concrete, rough	38	0.94
Enamel, white fused, on iron	20	0.90
Glass		
Smooth	20	0.94
Pyrex, lead, and soda	260–540	0.95–0.85

TABLE B.2
Total normal emittance of various surfaces (cont'd).

	Temperature[a] [°C]	Total normal emittance[a]
Gypsum, 5 mm thick on smooth or blackened plate	20	0.903
Ice		
Smooth	0	0.966
Rough crystals	0	0.985
Magnesite refractory brick	1000	0.38
Marble, light gray, polished	20	0.93
Paints, lacquers, varnishes		
White enamel varnish on rough iron plate	72	0.906
Black shiny lacquer, sprayed on iron	25	0.875
Black shiny shellac on tinned iron sheet	20	0.821
Black matte shellac	75–145	0.91
Black or white lacquer	35–95	0.80–0.95
Flat black lacquer	35–95	0.96–0.98
Oil paints, 16 different, all colors	100	0.92–0.96
Aluminum paints and lacquers		
10% Al, 22% lacquer body, on rough or smooth surface	100	0.52
Other Al paints, varying age and Al content	100	0.27–0.67
Al lacquer, varnish binder, on rough plate	20	0.39
Al paint, after heating at 325°C	150–315	0.35
Lacquer coatings, 0.025–0.37 mm thick on aluminum alloys	35–150	0.87–0.97
Clear silicone vehicle coatings, 0.025–0.375 mm		
On mild steel	260	0.66
On stainless steels, 316, 301, 347	260	0.68, 0.75, 0.75
On Dow metal	260	0.74
On Al alloys 24 ST, 75 ST	260	0.77, 0.82
Aluminum paint with silicone vehicle, two coats on Inconel	260	0.29
Paper		
White	35	0.95
Thin, pasted on tinned or blackened plate	20	0.92, 0.94
Roofing	20	0.91
Plaster, rough lime	10–88	0.91
Porcelain, glazed	20	0.92
Quartz		
Rough, fused	20	0.93
Glass, 1.98 mm thick	280–840	0.90–0.41
Glass, 6.88 mm thick	280–840	0.93–0.47
Opaque	280–840	0.92–0.68
Rubber		
Hard, glossy plate	23	0.94
Soft, gray, rough (reclaimed)	25	0.86
Sandstone	35–260	0.83–0.90
Silica (98% SiO_2; Fe-free), grain size 10 μm	1010–1565	0.42–0.33
70–600 μm	1010–1565	0.62–0.46

TABLE B.2
Total normal emittance of various surfaces (cont'd).

	Temperature[a] [°C]	Total normal emittance[a]
Silicon carbide	150–650	0.83–0.96
Slate	35	0.67–0.80
Soot, candle	90–260	0.95
Water	0–100	0.95–0.963
Wood, sawdust	35	0.75
Oak, planed	20	0.90
Beech	70	0.94
Zirconium silicate	240–500	0.92–0.80
	500–830	0.80–0.52

[a] Temperatures and emittances in pairs separated by dashes correspond; use linear interpolation.

[b] Surface treatment: A, cleaned with toluene, then methanol; B_1, cleaned with soap and water, toluene, then methanol; B_2, cleaned with abrasive soap and water, toluene, and methanol; C, polished, then cleaned with soap and water.

[c] Results after repeated heating and cooling.

TABLE B.3
Spectral, normal emittance of metals at room temperature [9].

	Wavelength, μm					
Metal	0.5	0.6	1.0	3.0	5.0	10.0
Aluminum	-	-	0.08–0.27	0.03–0.12	0.03–0.08	0.02–0.04
Antimony	-	0.47	0.45	0.35	0.31	0.28
Bismuth	0.75	0.76	0.72	0.26	0.12	0.08
Cadmium	-	-	0.30	0.07	0.04	0.02
Chromium	0.45	0.44	0.43	0.30	0.19	0.08
Cobalt	-	-	0.32	0.23	0.15	0.04
Copper	0.36	0.080	0.030	0.026	0.024	0.021
Gold	0.45	0.080	0.020	0.015	0.015	0.015
Iridium	-	-	0.22	0.09	0.06	0.04
Iron	0.49	0.48	0.41	-	-	-
Lead	-	-	-	-	0.08	0.06
Magnesium	0.28	0.27	0.26	0.20	0.14	0.07
Molybdenum	-	-	0.42	0.19	0.16	0.15
Nickel	-	-	0.27	0.12	0.06	0.04
Niobium	-	0.55	0.29	0.14	0.06	0.04
Palladium	0.42	0.37	0.28	0.12	0.10	0.03
Platinum	0.40	0.36	0.24	0.11	0.06	0.05
Rhodium	0.24	0.21	0.16	0.08	0.07	0.05
Silver	0.03	0.03	0.03	0.02	0.02	0.02
Tantalum	0.62	0.55	0.22	0.08	0.07	0.06
Tellurium	-	0.51	0.50	0.47	0.43	0.22
Tin	-	-	0.46	0.32	0.24	0.14
Titanium	-	-	0.37–0.49	0.25–0.33	0.10–0.18	0.05–0.12
Tungsten	-	0.44–0.49	0.40	0.07	0.05	0.03
Vanadium	0.43–0.59	0.42–0.57	0.36–0.50	0.10–0.17	0.07–0.11	0.06–0.09
Zinc	-	0.42–0.58	0.50–0.61	0.08	0.05	0.03

TABLE B.4
Total, normal emittance of metals for elevated temperatures [9].

	Temperature, [°C]						
Metal	100	500	1000	1200	1400	1600	2000
Aluminum	0.038	0.064	-	-	-	-	-
Beryllium	-	-	0.55	0.87	-	-	-
Bismuth	0.06	-	-	-	-	-	-
Chromium	0.08	0.11–0.14	-	-	-	-	-
Cobalt	0.15–0.24	0.34–0.46	-	-	-	-	-
Copper	-	0.02	-	0.12[m]	-	-	-
Germanium	-	0.54	-	-	-	-	-
Gold	0.02	0.02	-	-	-	-	-
Hafnium	-	-	-	0.30	0.31	0.32	-
Iron	0.07	0.14	0.24	-	-	-	-
Lead	0.63	-	-	-	-	-	-
Magnesium	0.12[h]	-	-	-	-	-	-
Mercury	0.12	-	-	-	-	-	-
Molybdenum	0.08	0.13	0.19	0.22	0.24	0.27	-
Nickel	-	0.09–0.15	0.14–0.22	-	-	-	-
Niobium	-	-	0.12	0.14	0.16	0.18	0.21
Palladium	-	0.06	0.12	0.15	-	-	-
Platinum	-	0.086	0.14	0.16	-	-	-
Rhenium	-	-	0.22	0.25	0.27	0.29	-
Rhodium	-	0.035	0.07	0.08	0.09	-	-
Silver	0.02–0.03	0.02–0.03	-	-	-	-	-
Tantalum	0.04	0.06	0.11	0.13	0.15	0.18	0.23
Tin	0.07	-	-	-	-	-	-
Titanium	0.11	-	-	-	-	-	-
Tungsten	-	0.05	0.11	0.14	0.17	0.19	0.23
α-Uranium	-	0.33[h]	-	-	-	-	-
γ-Uranium	-	-	0.29–0.40[h]	-	-	-	-
Zinc	0.07	-	-	-	-	-	-
Zirconium	-	-	0.22	0.25	0.27	-	-
Alloys							
Brass	0.059	-	-	-	-	-	-
Cast iron, cleaned	0.21	-	-	-	-	0.29[m]	-
Nichrome	-	0.95	0.98	-	-	-	-
Steel, polished	0.13–0.21	0.18–0.26	0.55–0.80	-	-	-	-
cleaned	0.21–0.38	0.25–0.42	0.50–0.77	-	-	-	-

[h]Total, hemispherical emittance [m]Value for molten state

TABLE B.5
Spectral, normal emittance of metals at a wavelength of 0.65 μm [9].

	Temperature, [°C]									
Metal	600	800	1000	1200	1400	1600	1800	2000	2500	3000
Chromium	-	-	-	-	-	0.39	-	-	0.39	-
Cobalt	-	-	0.33–0.38	0.34–0.37	0.35–0.37	0.37^m	-	-	-	-
Copper	-	0.11	0.10	0.10^m	0.11^m	0.12^m	0.14^m	-	-	-
Erbium	-	-	0.55	0.55	0.55	0.38^m	-	-	-	-
Gold	0.16–0.18	0.16–0.19	0.16–0.21	0.13^m	-	-	-	-	-	-
Iridium	-	-	0.36	0.34	0.32	-	-	0.30	-	-
Iron	-	0.37	0.36	0.35	0.35	0.37^m	-	-	-	-
Manganese	-	-	-	0.59	0.59^m	-	-	-	-	-
Molybdenum	-	0.37–0.43	0.36–0.42	0.35–0.42	0.34–0.41	0.34–0.41	0.33–0.40	0.32–0.39	0.31–0.37	-
Niobium	-	-	0.37	0.37	0.37	0.37	0.37	0.37	0.40	-
Osmium	-	-	0.52	0.44	0.40	0.38	0.38	0.38	-	-
Palladium	-	0.40	0.37	0.34	0.30	0.37^m	-	-	-	-
Platinum	-	0.29–0.31	0.29–0.31	0.29–0.31	0.29–0.31	0.29–0.31	-	-	-	-
Rhenium	-	-	-	-	0.42	0.42	0.41	0.41	0.40	-
Rhodium	-	0.25	0.22	0.19	0.18	0.16	-	-	-	-
Ruthenium	-	-	0.42	0.35	0.32	0.31	0.31	0.31	-	-
Silicon	-	0.63	0.57	0.52	0.46	0.48^m	-	-	-	-
Silver	-	0.055	0.055	-	-	-	-	-	-	-
Tantalum	0.47	0.46	0.45	0.44	0.42	0.41	0.40	0.39	0.38	0.36
Thorium	-	-	0.38	0.38	0.38	-	-	-	-	-
Titanium	-	0.48	0.48	0.48	0.47	-	-	-	-	-
Tungsten	-	-	0.46–0.48	0.43–0.48	0.42–0.47	0.42–0.47	0.41–0.47	0.40–0.47	0.38–0.46	0.36–0.45
Uranium	-	0.19–0.36	0.19–0.36	0.34^m	0.34^m	-	-	-	-	-
Zirconium	-	-	0.48	0.45	0.42	0.39	0.36	-	-	-
Alloys										
Cast iron	-	0.37	0.37	0.37	0.37	0.40^m	-	-	-	-
Nichrome	-	0.35	0.35	0.35	0.35	-	-	-	-	-
Steel	-	0.35–0.40	0.32–0.40	0.30–0.40	-	0.37^m	-	-	-	-

^{m}Value for molten state

TABLE B.6
Spectral, normal emittance of metals at high temperatures [9].

Metal	Temperature [°C]	Wavelength, μm											
		1.0	1.2	1.4	1.5	1.6	1.8	2.0	2.5	3.0	3.5	4.0	4.5
Cobalt	800	-	0.26	-	-	-	-	0.21	-	-	-	-	-
	1000	-	0.26	-	-	-	-	0.21	-	0.18	-	-	-
	1200	-	0.26	-	-	-	-	0.22	-	0.19	-	-	-
Copper	762	-	-	-	0.031	-	-	0.029	-	-	-	0.025	-
	901	-	-	-	0.079	-	-	0.065	0.052	0.043	0.038	0.032	-
	985	0.049	-	-	0.037	-	0.034	-	0.032	0.031	-	0.030	-
Iron	800	-	0.294	-	-	0.264	-	0.237	0.217	-	-	-	-
	1000	-	0.294	-	-	0.267	-	0.245	0.227	-	-	-	-
	1200	-	0.291	-	-	0.300	-	0.252	0.235	-	-	-	-
	1245	0.340	0.316	0.298	0.290	0.282	0.268	0.260	0.248	0.240	0.235	0.225	0.218
Molybdenum	1327	0.335	-	-	0.185	-	-	0.140	-	0.115	-	0.114	-
	1727	0.300	-	-	0.195	-	-	0.170	-	0.155	-	0.145	-
	2527	0.260	-	-	0.210	-	-	0.193	-	0.185	-	0.185	-
Nickel	800	-	0.295	0.267	-	0.250	0.230	0.215	-	-	-	-	-
	1000	-	0.293	0.269	-	0.252	0.232	0.219	-	-	-	-	-
	1200	-	0.290	0.271	-	0.253	0.235	0.223	-	-	-	-	-
	1110	-	0.292	0.270	0.250	-	-	0.290	0.205	0.187	0.174	0.162	-
Platinum	1127	-	0.257	-	0.227	-	-	0.193	-	0.151	-	0.130	-
Rhenium	1537	0.36	-	-	0.29	-	-	0.25	0.23	-	-	-	-
	2118	0.36	-	-	0.30	-	-	0.27	0.24	-	-	-	-
	2772	0.36	-	-	0.32	-	-	0.29	0.26	-	-	-	-
Titanium	750	0.490	-	0.510	0.500	-	-	0.455	-	0.525	0.575	0.600	-
Tungsten	1327	0.385	-	-	0.28	-	-	0.21	-	0.13	-	0.095	-
	2127	0.37	-	-	0.292	-	-	0.245	-	0.18	-	0.15	-
	2527	0.36	-	-	0.30	-	-	0.26	-	-	-	-	-
Zirconium	1127	0.46	-	-	0.422	-	-	0.386	0.360	0.348	-	-	-
	1327	0.444	-	-	-	-	-	0.368	-	0.343	-	0.325	-
	1727	0.442	-	-	0.375	-	-	0.357	0.351	0.342	0.330	-	-