U. S. Department of Commerce
John T. Connor, Secretary
National Bureau of Standards
A. V. Astin, Director

Certificate of Normal Spectral Emittance

Standard Reference Materials 1440 to 1447
Oxidized Inconel

Wavelength	At 800 °K			At 1100 °K			At 1300 °K		
Microns	ϵ	σ_m	σ_s	ϵ	σ_m	σ_s	ϵ	σ_m	σ_s
1.09	0.753	0.013	0.040	0.830	0.021	0.050	0.870	0.015	0.050
1.15	.751	.009	.039	.828	.020	.050	.871	.016	.049
1.22	.752	.009	.039	.829	.018	.050	.870	.015	.049
1.28	.755	.008	.042	.828	.015	.047	.869	.012	.050
1.36	.758	.009	.043	.827	.014	.046	.866	.012	.046
1.44	.763	.008	.044	.828	.016	.045	.862	.011	.044
1.52	.768	.009	.042	.829	.014	.042	.859	.012	.043
1.63	.770	.008	.042	.829	.015	.039	.857	.013	.038
1.74	.776	.007	.040	.830	.014	.039	.856	.012	.037
1.88	.781	.007	.038	.831	.014	.038	.855	.012	.035
2.10	.786	.007	.036	.831	.014	.035	.854	.012	.034
2.36	.791	.007	.034	.833	.012	.033	.854	.012	.033
2.60	.794	.007	.031	.834	.012	.034	.854	.012	.032
2.81	.798	.007	.031	.834	.013	.032	.854	.012	.031
3.02	.798	.006	.029	.834	.012	.033	.854	.012	.031
3.25	.802	.006	.027	.835	.012	.032	.855	.012	.030
3.45	.804	.006	.027	.837	.013	.032	.855	.012	.030
3.65	.806	.006	.027	.838	.013	.032	.855	.012	.030
3.87	.808	.006	.027	.839	.012	.032	.856	.012	.030
4.09	.809	.005	.025	.839	.012	.031	.856	.012	.030
4.30	.809	.006	.026	.837	.014	.030	.856	.011	.029
4.50	.812	.005	.025	.840	.012	.031	.857	.012	.030
4.67	.812	.005	.024	.839	.012	.031	.857	.012	.030
4.83	.812	.006	.024	.840	.012	.031	.856	.012	.029
4.99	.812	.006	.024	.839	.012	.030	.856	.012	.029
5.13	.812	.006	.024	.840	.011	.030	.857	.012	.030
5.27	.812	.006	.024	.839	.011	.030	.856	.012	.029
5.40	.813	.005	.024	.839	.011	.030	.856	.012	.029
5.45	.812	.005	.024	.839	.011	.030	.856	.012	.030
5.69	.812	.005	.024	.838	.011	.031	.855	.011	.030
5.83	.811	.005	.024	.838	.012	.030	.854	.012	.030
5.97	.811	.005	.024	.837	.012	.031	.854	.011	.029
6.10	.810	.005	.024	.837	.012	.031	.854	.011	.030
6.22	.810	.005	.024	.837	.012	.030	.854	.012	.030
6.35	.810	.005	.024	.837	.011	.030	.855	.012	.030
6.47	.809	.005	.024	.837	.012	.030	.854	.012	.030
6.58	.810	.005	.024	.838	.011	.031	.855	.012	.030
6.70	.812	.005	.024	.838	.011	.031	.856	.012	.030
6.80	.813	.005	.024	.839	.011	.031	.856	.011	.030
6.91	.814	.005	.024	.840	.010	.031	.857	.011	.031

Wavelength	At 800 °K			At 1100 °K			At 1300 °K		
Microns	ϵ	σ_m	σ_s	ϵ	σ_m	σ_s	ϵ	σ_m	σ_s
7.01	0.817	0.005	0.024	0.841	0.011	0.031	0.858	0.011	0.031
7.13	.819	.005	.024	.843	.011	.031	.859	.011	.031
7.25	.822	.005	.024	.845	.011	.030	.861	.011	.031
7.37	.823	.005	.024	.847	.011	.030	.863	.011	.031
7.49	.824	.005	.024	.848	.011	.030	.863	.011	.031
7.60	.826	.005	.024	.849	.012	.030	.864	.011	.031
7.71	.827	.005	.024	.850	.011	.031	.865	.011	.031
7.83	.829	.005	.024	.852	.011	.031	.867	.012	.032
7.94	.833	.005	.024	.854	.011	.030	.868	.011	.031
8.03	.839	.005	.024	.858	.012	.030	.871	.012	.031
8.12	.846	.006	.024	.863	.012	.030	.874	.011	.031
8.22	.852	.005	.024	.867	.011	.031	.878	.011	.031
8.32	.856	.005	.024	.872	.012	.030	.881	.011	.031
8.41	.859	.005	.025	.875	.011	.031	.883	.011	.032
8.50	.862	.005	.024	.878	.010	.030	.886	.011	.031
8.60	.864	.005	.024	.880	.011	.031	.888	.011	.032
8.70	.866	.005	.024	.881	.011	.030	.889	.011	.032
8.79	.868	.005	.025	.882	.011	.031	.890	.011	.032
8.88	.870	.005	.025	.885	.011	.031	.892	.011	.032
8.96	.872	.005	.025	.886	.011	.031	.893	.011	.031
9.05	.874	.005	.025	.888	.011	.031	.895	.012	.031
9.14	.875	.005	.025	.889	.011	.032	.896	.011	.031
9.22	.877	.005	.026	.891	.010	.032	.897	.011	.031
9.30	.876	.005	.025	.891	.010	.032	.898	.011	.031
9.38	.873	.005	.025	.891	.010	.031	.898	.012	.032
9.46	.870	.005	.025	.888	.010	.031	.897	.012	.031
9.55	.868	.005	.024	.887	.011	.031	.896	.011	.031
9.63	.866	.005	.025	.885	.010	.031	.895	.011	.032
9.71	.865	.005	.025	.884	.011	.031	.894	.011	.032
9.79	.863	.006	.024	.884	.011	.031	.894	.012	.032
9.87	.862	.005	.024	.883	.011	.031	.893	.011	.032
9.95	.861	.004	.024	.882	.011	.031	.893	.011	.032
10.03	.861	.005	.024	.882	.011	.031	.893	.011	.032
10.10	.862	.005	.024	.882	.011	.031	.893	.011	.032
10.18	.862	.004	.024	.882	.011	.031	.893	.011	.032
10.26	.863	.005	.024	.882	.011	.032	.893	.011	.032
10.34	.864	.005	.024	.883	.011	.031	.893	.011	.032
10.42	.866	.005	.024	.884	.010	.031	.894	.011	.032
10.50	.868	.005	.024	.885	.011	.031	.895	.011	.031
10.57	.868	.005	.024	.886	.011	.031	.896	.011	.031
10.64	.868	.005	.024	.887	.011	.031	.897	.011	.031
10.72	.868	.005	.024	.888	.011	.031	.898	.012	.031
10.80	.868	.005	.024	.888	.010	.031	.898	.011	.032
10.87	.869	.005	.025	.888	.010	.032	.898	.011	.032
10.94	.870	.005	.025	.888	.011	.032	.898	.011	.032
11.01	.871	.005	.024	.889	.011	.031	.899	.011	.031
11.08	.871	.006	.024	.889	.011	.032	.899	.011	.032
11.05	.872	.005	.024	.890	.010	.032	.899	.011	.031
11.22	.871	.006	.024	.890	.011	.032	.900	.011	.031
11.28	.871	.006	.024	.891	.011	.031	.900	.011	.031

Wavelength	At 800 °K			At 1100 °K			At 1300 °K		
Microns	ϵ	σ_m	σ_s	ϵ	σ_m	σ_s	ϵ	σ_m	σ_s
11.35	0.871	0.005	0.024	0.891	0.010	0.032	0.900	0.011	0.032
11.42	.871	.005	.024	.891	.011	.032	.901	.011	.032
11.49	.871	.005	.024	.891	.010	.032	.901	.011	.031
11.55	.871	.005	.024	.892	.011	.032	.901	.011	.031
11.62	.871	.005	.025	.891	.011	.031	.902	.011	.031
11.68	.871	.006	.024	.892	.011	.032	.902	.011	.032
11.74	.871	.005	.024	.892	.011	.032	.902	.011	.032
11.80	.871	.006	.024	.892	.011	.032	.902	.011	.032
11.87	.872	.006	.024	.892	.011	.032	.903	.011	.032
11.94	.872	.006	.024	.893	.011	.032	.903	.011	.032
12.00	.872	.005	.024	.893	.010	.032	.904	.012	.032
12.07	.873	.005	.024	.894	.010	.031	.904	.011	.032
12.13	.874	.005	.024	.894	.011	.032	.904	.011	.032
12.19	.874	.005	.024	.895	.011	.032	.904	.011	.032
12.26	.875	.005	.024	.895	.011	.032	.905	.011	.033
12.32	.877	.005	.024	.895	.010	.032	.906	.011	.032
12.38	.878	.005	.024	.896	.011	.032	.906	.011	.033
12.44	.879	.005	.024	.897	.010	.032	.907	.011	.033
12.50	.880	.005	.024	.898	.011	.032	.908	.011	.033
12.57	.881	.005	.024	.899	.010	.033	.908	.011	.033
12.63	.882	.005	.024	.899	.011	.032	.909	.011	.033
12.69	.883	.005	.024	.900	.011	.033	.910	.011	.033
12.75	.884	.005	.024	.902	.011	.033	.910	.011	.033
12.82	.885	.005	.024	.902	.010	.033	.911	.011	.034
12.88	.886	.005	.024	.903	.010	.033	.912	.011	.034
12.84	.887	.005	.025	.904	.011	.033	.913	.011	.034
13.00	.888	.005	.025	.904	.011	.033	.914	.011	.034
13.06	.889	.005	.025	.905	.011	.034	.915	.011	.035
13.12	.891	.005	.025	.906	.011	.034	.915	.011	.035
13.18	.892	.005	.025	.907	.010	.035	.916	.011	.035
13.24	.893	.005	.025	.908	.011	.034	.916	.011	.036
13.30	.894	.005	.025	.909	.011	.034	.918	.011	.036
13.36	.894	.005	.026	.910	.011	.035	.918	.011	.036
13.42	.895	.005	.026	.910	.011	.035	.918	.011	.037
13.48	.894	.004	.026	.910	.011	.035	.919	.011	.037
13.54	.894	.005	.027	.911	.011	.035	.920	.011	.038
13.60	.893	.005	.026	.911	.011	.036	.920	.011	.038
13.66	.892	.005	.027	.910	.011	.037	.920	.011	.038
13.72	.890	.005	.027	.910	.011	.037	.920	.010	.039
13.78	.887	.005	.028	.909	.011	.037	.920	.011	.040
13.84	.883	.005	.028	.908	.011	.038	.919	.011	.041
13.89	.878	.005	.029	.906	.011	.038	.918	.011	.041
13.95	.873	.005	.029	.904	.011	.039	.918	.012	.042
14.00	.867	.005	.030	.902	.011	.039	.917	.012	.043
14.06	.860	.005	.030	.898	.010	.039	.915	.012	.044
14.11	.853	.005	.031	.895	.011	.040	.913	.011	.044
14.17	.845	.005	.031	.890	.011	.040	.910	.011	.045
14.22	.838	.005	.031	.885	.011	.040	.907	.011	.046
14.28	.831	.005	.032	.879	.011	.041	.904	.011	.047
14.33	.825	.005	.033	.873	.011	.041	.900	.011	.047

Wavelength	At 800 °K			At 1100 °K			At 1300 °K		
Microns	ϵ	σ_m	σ_s	ϵ	σ_m	σ_s	ϵ	σ_m	σ_s
14.38	0.818	0.005	0.033	0.867	0.010	0.042	0.896	0.011	0.048
14.44	.811	.005	.034	.861	.010	.042	.891	.011	.050
14.49	.806	.005	.034	.854	.011	.043	.886	.011	.051
14.55	.800	.005	.035	.848	.011	.043	.881	.011	.051
14.60	.795	.005	.036	.842	.011	.044	.875	.011	.052
14.65	.789	.005	.037	.834	.011	.045	.871	.011	.053
14.71	.784	.005	.038	.831	.010	.045	.865	.011	.054
14.76	.779	.005	.039	.825	.012	.046	.861	.011	.055
14.82	.774	.005	.040	.820	.011	.047	.855	.011	.056
14.87	.768	.004	.042	.813	.011	.048	.850	.011	.057
14.92	.762	.004	.044	.805	.012	.049	.844	.011	.058
14.98	.756	.004	.044	.799	.011	.048	.838	.012	.058
15.03	.753	.004	.043	.796	.011	.047	.834	.012	.058
15.08	.751	.004	.044	.794	.011	.048	.831	.012	.060
15.14	.746	.004	.046	.789	.011	.050	.826	.012	.061
15.20	.740	.004	.048	.783	.012	.051	.822	.012	.062

The standards of normal spectral emittance are intended for use in calibrating equipment used in various laboratories for measuring this property of materials. All of the specimens were prepared from a single sheet of metal at one time, and were subjected as nearly as possible to identical preparation treatments. Because the equipment used for the calibration of these standards was suitable only for making measurements on ¼ inch by 8 inch strips, seven such specimens were prepared from selected locations in the sheet so that the strips measured were statistically representative of the entire lot of specimens.

Three measurements were made on each of the seven samples. The value listed for normal spectral emittance (ϵ) is the arithmetic average of the 21 measured values. The computed average standard deviation (σ_m) of the three measurements on each of the seven specimens about the average value for each specimen is a measure of the precision of measurement. The standard deviation (σ_s) of the average value for each of the seven specimens about the overall average, is indicative of the variation in specimens.

Procedures used for the measurements are described in detail "Standardization of Thermal Emittance Measurements, part 4, Normal Spectral Emittance, 800–1400 °K." Technical Report No. WADC–TR–59–510, Part IV, by William N. Harrison, Joseph C. Richmond, Frederick J. Shorten and Horace M. Joseph, available from the Clearinghouse for Federal Scientific and Technical Information, 5285 Port Royal Road, Springfield, Virginia 22171, as publication AD 426846, price $2.25.

Samples are available as ½ inch disks, SRM No. 1440; as ⅞ inch disks, SRM No. 1441; as 1 inch disks, SRM No. 1442; as 1⅛ inch disks, SRM No. 1443; as 1¼ inch disks, SRM No. 1444; as 2 inch by 2 inch squares, SRM No. 1445; as 1 inch by 10 inch strips, SRM No. 1446; and as ¾ inch by 10 inch strips, SRM No. 1447.

WASHINGTON, D. C.
December 16, 1965

W. Wayne Meinke, Chief
Office of Standard Reference Materials

Instructions for Handling Emittance Standards

1. Read the instructions, including discussion.

2. Leave standards in container except when in use.

3. Wear clean surgical rubber gloves while handling specimens. Handle as little as possible, and then by edges or ends only. Never touch the flat surfaces in the areas to be viewed.

4. Do not lay standards on a desk or bench top. If possible, return to plastic holder—if not, support by edges or ends only on clean glass or stainless steel.

5. In use avoid contamination by oil, grease, dust or condensed volatile materials.

Discussion

1. INTRODUCTION. The working standards of normal spectral emittance have been carefully prepared and calibrated. However, damage to the surface or contamination can significantly change the emittance.

2. STORAGE INSTRUCTIONS. Each standard is contained in a plastic holder, which supports it by the edges or ends only. The holder containing the specimen is in turn enclosed in a metal tube or plastic box. Each standard should remain in its individual container except during actual use, and the containers should be stored in a clean, dry place at room temperature.

3. HANDLING OF SPECIMENS. Extreme precautions should be taken to prevent contamination or damage to the surface of standards during use. Handling should be kept to the absolute minimum. Wear clean surgical rubber gloves when handling specimens, in order to avoid fingerprints, and touch the ends or edges only. Never touch the flat areas to be viewed, or permit them to come in contact with a bench or desk top. If a specimen must be laid down, return it to its holder, or support it by the ends or edges only on clean glass or stainless steel. Be particularly careful to avoid contamination by oil, grease, dust or condensed volatilized materials.

4. HEATING SPECIMENS. The specimens were heated in air during calibration, and should be heated only in a clean air atmosphere at atmospheric pressure. The Kanthal and Inconel specimens have been oxidized in air, and heating in other atmospheres may significantly change the character of the oxide layer, and hence the emittance. While there is no visible oxide layer on the platinum standards, they were calibrated in air, and may change in emittance if heated in other atmospheres.