DATA SET CATALOG # 47

Extraterrestrial solar spectral irradiance at earths mean solar distance

D-4899
CORRSSI

1 tape

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1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP’s).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

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Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC INFORMATION SYSTEM:

http://nssdc.gsfc.nasa.gov/nmc/

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

a. Associated Documents — To find associated documents you will need to know the document ID number and then click here.
http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/

b. Core Catalog Materials

REQ. AGENT
DAD

ACQ. AGENT
JRJ

EXTRATERRESTRIAL SOLAR SPECTRAL IRRADIANCE

MS-12A

This data set is contained on 1 file on a 9-track, 1600 BPI, ASCII magnetic tape created on the MODCOMP IV computer from card images. The file consists of solar spectral irradiance data covering the wavelength range 300 - 2500 nanometers. This data was originally created at 556 BPI, 7-track BCD on the IBM 7094 computer but was converted to 9-track ASCII because of the phasing out of 7-track tape drives. The document number is B-04225-000A. The D and C numbers follow below:

D#	C#
D-04899	C-02555

EXTRATERRESTRIAL SOLAR SPECTRAL IRRADIANCE TAPE FORMAT

RECORDS 1 - 15
COLUMNS

1 - 76	Alphameric Data for Title Page
77 - 80	Sequence Number (Integer)

RECORDS 16 - 19
COLUMNS

1 - 76	Alphameric Data for Page Headings
77 - 80	Sequence Number (Integer)

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COLUMNS

1 - 11	Blank
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39 - 55	Blank
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Determination of Extraterrestrial Solar Spectral Irradiance from a Research Aircraft

John C. Arvesen, Roy N. Griffin, Jr.,
and B. Douglas Pearson, Jr.

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Determination of Extraterrestrial Solar Spectral Irradiance from a Research Aircraft

John C. Arvesen, Roy N. Griffin, Jr., and B. Douglas Pearson, Jr.

Results are presented of an experiment to determine extraterrestrial solar spectral irradiance at the earth's mean solar distance within the 300–2500 nm wavelength region. Spectroradiometric measurements were performed during eleven research flights on board a NASA CV-990 aircraft at altitudes between 11.6 km and 12.5 km. Precision of the measurements was better than ±1%. Absolute accuracy of the resultant extraterrestrial solar spectral irradiance is approximately ±3% over most of the measurement range. A listing of results is presented at intervals varying from 0.1 nm throughout most of the uv–visible Fraunhofer region to 5 nm in the continuum region of the ir. Additionally, a listing of solar spectral irradiance, smoothed over the detailed Fraunhofer structure, is presented for engineering use.

I. Introduction

The National Aeronautics and Space Administration (NASA) has a strong interest in a more accurate determination of the total and spectral intensity of sunlight in space. This interest stems from the fact that absorbed solar radiation constitutes the primary source of power and heat for spacecraft. In addition, the degrading influence of solar uv radiation on materials used in spacecraft construction requires that this important spectral region be known to a higher accuracy than at present. Research currently under way at NASA in solar physics, terrestrial and atmospheric physics, and meteorology also requires accurate knowledge of solar spectral irradiance at the top of the earth's atmosphere.

The present knowledge of extraterrestrial solar spectral irradiance has been obtained primarily through ground-based measurements from various locations around the world during a period of over fifty years. In performing these measurements, the observer has been severely handicapped by atmospheric opacity and variability due to the presence of smoke, haze, dust, water vapor, and other constituents found near ground level. The extrapolation to outside the atmosphere involves performing measurements through different amounts of atmosphere corresponding to different times of day; thus, variable transmittance significantly affects the accuracy of the results.

A way to partially circumvent the problems encountered in ground-based experiments is to perform measurements from an altitude where atmospheric transparency and constancy allow accurate extrapolation to extraterrestrial conditions. A platform suitable for these measurements is the CV-990 jet aircraft (commercial designation: Convair CV-990) owned by NASA and specially modified for use in astronomical and space sciences research.[1]

Recent advances in spectroradiometry, including the establishment of a Standard of Spectral Irradiance by the National Bureau of Standards[2] and an improved understanding of subtle errors in spectral irradiance measurements,[3] have made possible significant improvements in instrumentation with resultant improvements in accuracy. The improved instrumentation, coupled with the ability to perform measurements from altitudes where variable components, such as water vapor and aerosol, are reduced to an insignificant level, gave promise that a significant reduction in the uncertainty of solar spectral irradiance could be achieved. To this end, an experiment was designed and flown on a series of eleven flights in the summer and autumn of 1967 to perform solar spectral irradiance measurements as part of a total effort directed toward reducing present uncertainties in total and spectral solar irradiance. This paper presents the most significant results of that experiment.

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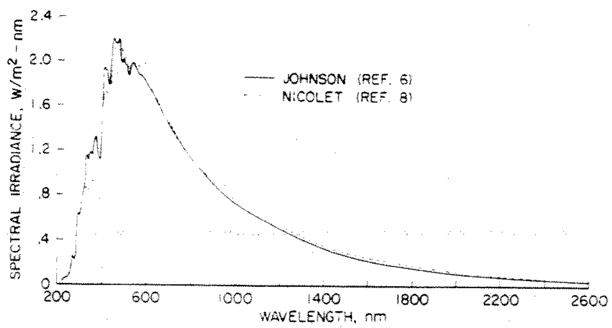

Fig. 1. Comparison of solar spectral irradiance, Johnson and Nicolet.

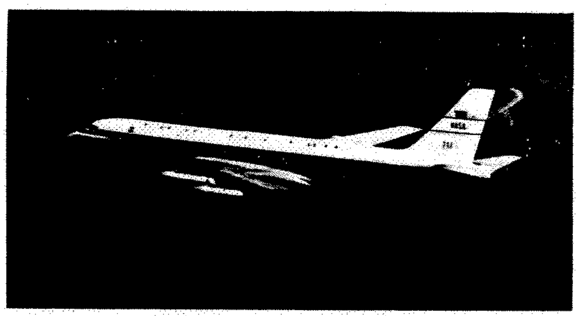

Fig. 2. NASA CV-990 jet aircraft showing upper and side observation windows.

II. Present Knowledge of Solar Spectral Irradiance

The absolute spectral intensity of radiation from the sun has been obtained primarily through ground-based measurements. Rocket spectrograph measurements have been made in uv spectral regions inaccessible to earth-based observations. However, because of the lack of adequate spectral standards in the uv below 250 nm, these measurements were performed on a relative basis and adjusted to ground-based data in a region of overlap. When a comparison of existing measurements is made, it is apparent that discrepancies, especially in the uv below 400 nm, exist as large as 20–30%. In addition, most of the measurements on an absolute energy scale are integrated over 10-nm bands. While this resolution is adequate for certain purposes, a measurement of spectral irradiance on an absolute scale with greatly improved resolution would be beneficial in many areas.

Several excellent reviews of the present state of knowledge of solar spectral irradiance in the 200–7000 nm wavelength range are available in the literature.[4,5] In addition to outlining the historical aspects of the principal measurements, the reviews present a critical evaluation of the possible uncertainties existing in the measurements and the analyses based on the measurements. Therefore, only a brief discussion will be presented herein concerning the principal contributions that are finding widest acceptance today. These are the contributions of Johnson[6] and Nicolet.[7,8]

In 1954, Johnson published an analysis of available solar measurements and a listing of extraterrestrial solar spectral irradiance at the earth's mean distance from the sun. This listing has been in wide use to the present time. The data in different spectral regions are attributable to different researchers whose instrumentation and absolute accuracy varied widely. At wavelengths longer than 600 nm, values based on Moon's analysis[9] of previous measurements, primarily those performed by the Smithsonian Institution,[10] were used. Moon's results contain the assumption that the sun radiates as a 6000-K greybody for all wavelengths beyond 1250 nm. The measurements of Dunkelman and Scolnik,[11] adjusted upward 9% to agree with the Smithsonian data at 600 nm and to incorporate a radiometric scale change, covered the spectral region down to 318 nm. Rocket spectrograph measurements obtained by the Naval Research Laboratory[12] were used to 220 nm. These short-wavelength data were obtained on a relative energy scale and were adjusted to the Dunkelman and Scolnik data at 318 nm. Further rocket measurements[13] with improved instrumentation and calibration procedures have revised these early data. However, the subsequent measurements were still adjusted to the revised Dunkelman and Scolnik data in the 300–330 nm spectral region.

In 1951, Nicolet derived extraterrestrial solar spectral irradiance by noting that the intensity at the center of the disk could be closely approximated by a smooth 7200-K continuum with superimposed Fraunhofer absorption. He applied corrections for the fraction attenuated due to Fraunhofer absorption and for the variation from the center to the limb of the disk. In the region below 300 nm, he used early NRL rocket data directly.

A major problem associated with Nicolet's analysis is that the continuum cannot be directly located in regions of intense Fraunhofer absorption. This is particularly important in the region between 300 nm and 450 nm and is reflected in a greater uncertainty in this region than at longer wavelengths. A comparison of solar spectral

Table I. Flight Parameters

Flight date 1967	Type of flight	Solar zenith angle, deg.	Altitude, km	Air mass
Aug. 3	Afternoon	56.4–72.5	11.7	[illegible]
Aug. 8	Sunset	51.7–80.0	11.6	[illegible]
Aug. 10	Sunrise	79.9–60.2	11.6	[illegible]
Aug. 14	Afternoon	34.3–50.0	11.6	[illegible]
Aug. 16	Solar transit	27.8–31.0	11.6	[illegible]
Aug. 19	Afternoon	28.3–43.4	11.6	[illegible]
Aug. 22	Solar transit	23.5–26.0	11.6	[illegible]
Oct. 10	Solar transit	33.5–34.3	11.6	[illegible]
Oct. 12	Solar transit	29.8–30.4	12.0	[illegible]
Oct. 22	Solar transit	22.7–23.5	12.2	[illegible]
Nov. 1	Solar transit	53.6–64.0	12.5	[illegible]

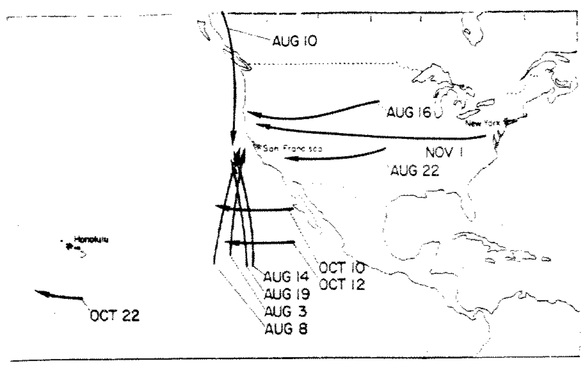

Fig. 3. Flight paths during 1967 solar observations.

irradiance as derived by Nicolet and Johnson is shown in Fig. 1.

III. Solar Spectral Irradiance Measurements

The measurements performed from the NASA CV-990 aircraft circumvented many of the difficulties encountered by previous investigators. The excellent observational conditions at flight altitude allowed the spectroradiometer system to be used to its full capabilities.

A brief description of the aircraft and the observational conditions during the experiment will be presented to illustrate the suitability of high-altitude aircraft for solar studies. This description will be followed by a discussion of the spectroradiometer system and the data reduction technique.

A. Aircraft and Observational Conditions

A specially modified four-engine jet aircraft was used for the experiment. Figure 2 is a photograph of the aircraft in flight. With an equipment payload of 7000 kg, the aircraft is capable of providing 4 h of stable observation at 11 km or 2 h at about 12 km at a speed of approximately 900 km/h. During solar observation, the aircraft heading is 90° to the solar vector and can be maintained to within $\pm\frac{1}{4}°$. The stability in roll is within $\pm\frac{3}{4}°$. The overall stability is well within the $\pm 3°$ required for the measurements.

Flights were made at various times of day to achieve a wide variation in atmospheric path length so that the measurements could be extrapolated outside the atmosphere. Latitude and longitude of the observations were measured at 10-min intervals to an accuracy of 1 min of arc. From these data, and tabulated ephemeris data,[14] a continuous determination of solar zenith angle vs time was computed. All observational data were related to Universal Time as a reference base. Information pertinent to the flights is given in Table I.

The flight paths during observational periods are shown in Fig. 3. The primary base of operations was Moffett Field, California, near San Francisco. A typical data flight profile would include a climbing outbound leg to the starting point of observations and an observation run at constant solar bearing on the homeward leg. One exception was the final 1 November solar transit flight that originated on the east coast of the United States and terminated on the west coast.

Figure 4 shows the arrangement within the aircraft of the spectroradiometer and mirror used in the experiment. Solar observations were made from the left side of the aircraft through either an upper (65° elevation) window or a side (14° elevation) window, depending on the solar zenith angle. The windows were 2.5-cm thick fused-silica flats (Corning 7940) with clear apertures of 30 cm by 36 cm and 25 cm by 36 cm for the upper and side, respectively. Windows were cleaned prior to takeoff and externally sealed with removable shutters until observational altitude was achieved. Warm air from the cabin air conditioner was directed over the interior of the windows to prevent the condensation of cabin moisture, since the outside air temperature is about $-50°C$. The mirror was a 40-cm diam aluminized optical flat. An accurate calibration of the reflectance of the mirror and the transmittance of the windows as a function of wavelength and angle of incidence is extremely important for absolute intensity measurements. A detailed discussion of the calibration procedures for the windows and mirror is presented in Appendix A.

Spectral irradiance measurements were made from pressure altitudes between 11.6 km and 12.5 km during eleven data flights. Pressure altitude, rather than geometric altitude, was used in the data analysis as it is indicative of the total amount of atmosphere above the flight level. In general, the atmosphere showed excellent clarity and stability. The atmospheric transmission values derived from the data clearly bear out this point. At these altitudes, the observer is above 80% of the permanent gases in the atmosphere and virtually all variable components, including water vapor, clouds, smoke, haze, and dust. Measurements of atmospheric precipitable water vapor above the flight level indicated a total path length ranging from 8×10^{-4} precipitable-cm to 14×10^{-4} precipitable-cm.

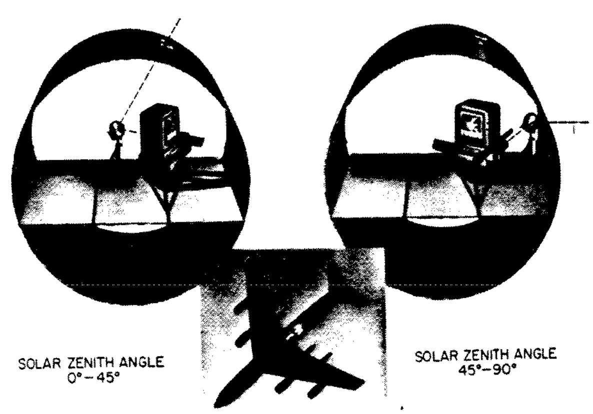

Fig. 4. Aft view showing arrangement of spectroradiometer and mirror within the aircraft for observations through the upper window ($0° < z < 45°$) and side window ($45° < z < 90°$). Inset shows spectroradiometer location within the aircraft.

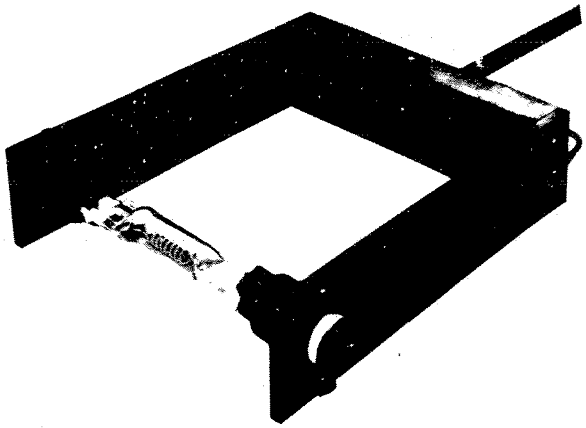

Fig. 5. Standard of spectral irradiance mounted in its holder.

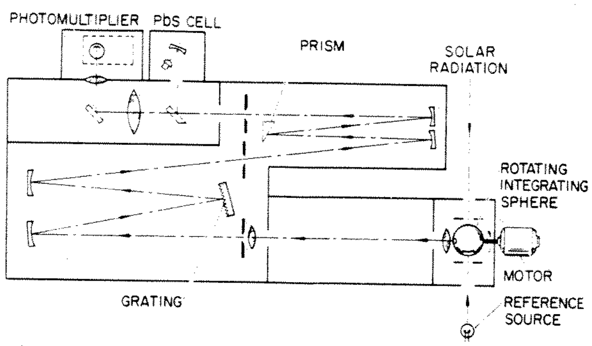

Fig. 6. · Optical schematic drawing of Cary spectroradiometer showing rotating integrating sphere for alternate viewing of reference and solar radiation.

Approximately 4×10^{-4} precipitable-cm was in the path of observation within the aircraft. The corrections due to such low amounts of water vapor had negligible effect on the results. The total CO_2 content above flight altitude was approximately 40 atm-cm, while 0.5 atm-cm was attributable to CO_2 within the aircraft. Small corrections to the data were necessary at the strong absorption bands centered at 1960 nm, 2010 nm, and 2060 nm. The flights were conducted in the summer and fall when the ozone concentration is near minimum in its annual cycle. The total ozone content above an altitude of 11.6 km was derived from atmospheric transmission measurements to be 0.24 atm-cm, based on the ozone absorption coefficients of Vigroux.[15]

B. Spectroradiometer System

The establishment of the Standard of Spectral Irradiance in 1963 by the National Bureau of Standards[2] provided a common basis for spectral irradiance measurements that can be conveniently and accurately used. This Standard is a 1000-W lamp consisting of a coiled tungsten filament (3000 K) enclosed in a 1-cm by 7-cm quartz envelope containing a small amount of halogen gas. The Standard is issued at the present time through The Eppley Laboratory, Newport, Rhode Island. Figure 5 is a photograph of the lamp in its holder. A calibration is performed over the 250–2500 nm wavelength interval at a distance of 50 cm from the lamp, based on the spectral radiance of a blackbody computed from Planck's equation.

The spectroradiometer used is a recently developed instrument whose calibration is based directly on the Standard of Spectral Irradiance. A schematic drawing of the instrument is shown in Fig. 6 and a detailed description is given by Hedelman and Nelson.[16] The spectroradiometer is a modification of the Cary Model 14 ratio-recording spectrophotometer. It utilizes a prism-grating double monochromator, providing 1-nm/mm reciprocal dispersion in the uv and 3 nm/mm-reciprocal dispersion in the near ir. Resolving power is 0.1 nm in the uv and 0.3 nm in the near ir. Stray light is extremely low, less than 0.0001% throughout much of its operating range.

The most significant feature of the spectroradiometer is the incorporation of a 5-cm diam rotating integrating sphere that alternately views the reference and solar sources at a frequency of 30 Hz (see Fig. 6). The interior of the sphere is coated with magnesium oxide to diffuse the incoming radiation and provide a source of uniform intensity at the entrance to the monochromator. This feature eliminates the different geometry existing between collimated solar radiation and the divergent radiation from the reference source. This differs from the widely used practice of reimaging the source on the entrance slit, which has been determined to be a primary factor contributing to the inaccuracies previously associated with spectral irradiance measurements.[3] The rotating integrating sphere, in addition to diffusing the incoming radiation, serves as an optical chopper for the solar and reference beams. Thus, the ratio between the two sources is measured at 30 Hz, and all errors due to detector and amplifier drift are minimized. The detector-amplification system is capable of measuring the ratio of the monochromatic intensities of the reference and solar sources to an accuracy of 0.2%.

A photograph of the spectroradiometer in operation during one of the flights is shown in Fig. 7. A spectral

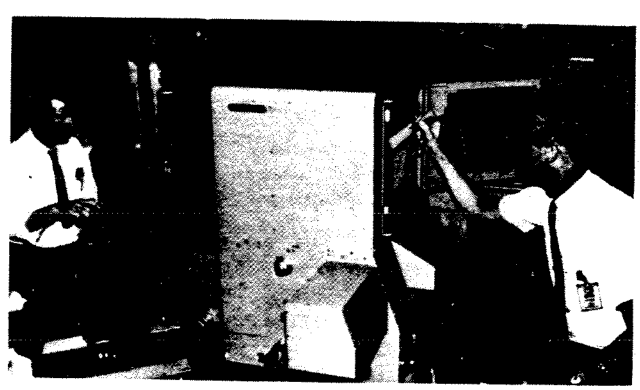

Fig. 7. Photograph of spectroradiometer system in operation during solar observation.

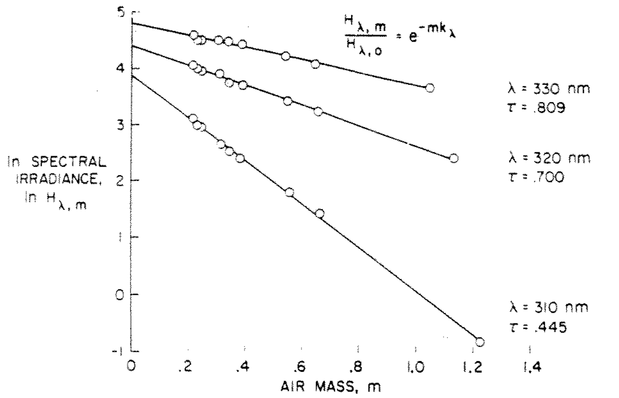

Fig. 8. Extrapolation procedure based on the Langley method.

scan took approximately 2 h to cover the wavelength range from 290 nm to 2500 nm. A 1P28 photomultiplier was used below 700 nm and a lead sulfide cell was used at longer wavelengths. In addition to a real-time strip chart display of the data, spectral irradiance, wavelength, and slitwidth were recorded every 0.1-nm wavelength interval by a Datex Model SDS-1 digital data acquisition system and a Teletype Model BRPE high-speed paper-tape punch. Data were transferred to magnetic tape on a Honeywell 200 computer and subsequently analyzed on IBM 7040-7094DCS and IBM System/360 computers.

C. Data Reduction

The classical Langley method[17] was used to extrapolate the measurements to extraterrestrial conditions. This method, in addition to giving the extraterrestrial spectral irradiance level, yields atmospheric transmission coefficients from flight altitude to space.

The spectral irradiance at flight altitude, $H_{\lambda,m}$, is related to the extraterrestrial spectral irradiance level, $H_{\lambda,0}$, by

$$H_{\lambda,m} = H_{\lambda,0}e^{-mk_\lambda} \tag{1}$$

or

$$\ln H_{\lambda,m} = \ln H_{\lambda,0} - mk_\lambda. \tag{2}$$

The absolute air mass m is defined as the path length of atmosphere between the observer and the sun relative to the vertical path length at sea level. The atmospheric attenuation coefficient k_λ indicates the degree of absorption and scattering above the observational altitude.

The method of Kasten,[18] corrected for flight altitude, was used to evaluate the variation in relative air mass as a function of solar zenith angle. Air mass varies as the secant of the solar zenith angle, z, with higher order corrections due to atmospheric curvature and refraction. As shown by Kasten, the greatest contribution to these corrections results from the lower atmosphere. The absolute air mass used in data reduction was obtained by the relationship

$$m = (P/P_0)[\sec z + (P/P_0)(m_k - \sec z)], \tag{3}$$

where m_k is the relative air mass at sea level as derived by Kasten and P/P_0 is the ratio of the pressure at altitude to the standard sea level pressure of 760 Torr. The pressure ratio P/P_0 was obtained with high precision from one observation to another by means of the aircraft altimeter, which has resolution better than 1 part in 2000. At altitudes above 11.6 km the correction term, $P/P_0\ (m_k - \sec z)$, is smaller than 0.5% of $\sec z$ for $0° \leq z \leq 78°$.

The spectral irradiance at observational altitude, $H_{\lambda,m}$, was directly determined from the measured spectral irradiance within the aircraft, $H^*_{\lambda,m}$, by accounting for attenuation at the window and mirror. A further correction of the data to the earth's mean distance from the sun was also made. The result can be expressed as

$$H_{\lambda,m} = (a_0^2/\rho_\lambda\tau_\lambda)H^*_{\lambda,m}. \tag{4}$$

The values of window transmittance τ_λ and mirror reflectance ρ_λ were measured at their respective angles of incidence by methods described in Appendix A. The solar radius vector a_0 was obtained from Ref. 14 for the particular date of the measurement.

Table II. Atmospheric Transmittance from Space to 11.6 km (Zenith Direction)

Wavelength, nm	Transmittance	Wavelength, nm	Transmittance
298	0.036	650	0.960
299	0.055	700	0.972
300	0.083	757	0.976
302	0.134	761	0.913
304	0.195	768	0.980
306	0.285	800	0.980
308	0.371	900	0.988
310	0.445	1000–1930	0.99+
315	0.595	1940	0.972
320	0.700	1950	0.935
325	0.763	1960	0.920
330	0.809	1970	0.988
335	0.822	1980	0.99+
340	0.840	1990	0.99+
350	0.864	2000	0.889
360	0.879	2010	0.887
380	0.891	2020	0.982
400	0.897	2030	0.99+
450	0.925	2040	0.99+
500	0.940	2050	0.966
550	0.948	2060	0.920
575	0.932	2070	0.959
600	0.932	2080–2500	0.99+
625	0.942		

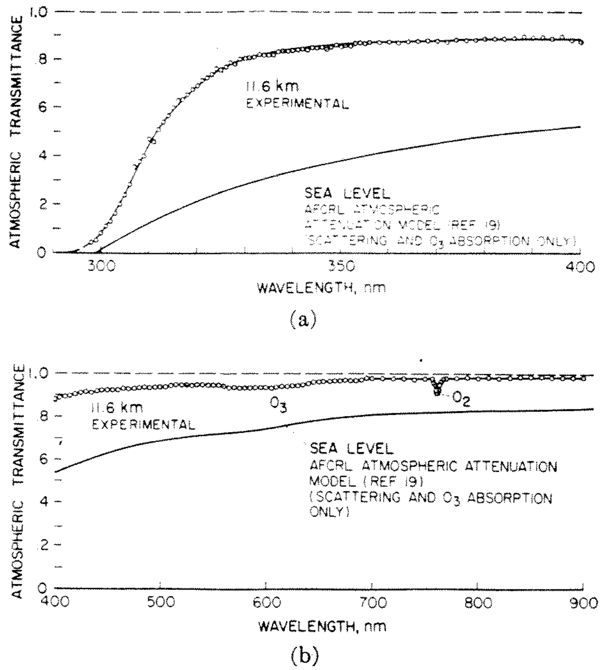

Fig. 9. Atmospheric transmittance to space from an altitude of 11.6 km: (a) uv region, (b) visible, near ir region.

Equation (2) shows the linear relationship that exists between the natural logarithm of spectral irradiance and air mass. Extrapolations to zero air mass were performed by a least-squares linear fit to the data at selected wavelengths from 300 nm to 2500 nm. Figure 8 illustrates the extrapolation procedure used. Data from each flight at several wavelengths in the Hartley-Huggins ozone bands are plotted to show the rapidly decreasing transmittance in the uv due to ozone absorption in the upper atmosphere. The variability of the ozone from flight to flight, although small, results in significantly more scatter in the data below 340 nm than at longer wavelengths. The ordinate intercept yields the natural logarithm of extraterrestrial solar spectral irradiance at the earth's mean distance from the sun, and the negative of the slope yields the atmospheric attenuation coefficient, k_λ.

Vertical atmospheric transmittance values from space to an altitude of 11.6 km ($m = 0.204$) were derived from the measured values of k_λ by the relationship

$$\tau_{\lambda,m} = e^{-mk_\lambda}. \tag{5}$$

These values are tabulated in Table II and plotted in Figs. 9(a) and 9(b) for the uv and visible-near ir regions, respectively.

Atmospheric transmittance was found to be above 0.99 for essentially all wavelengths longer than 1000 nm and greater than 0.90 for wavelengths longer than 410 nm. The average deviation of the experimental atmospheric transmittance values from a smoothed curve varies from 0.02 in the ozone absorption region below 340 nm to less than 0.005 at longer wavelengths. The Chappuis ozone band between 550 nm and 600 nm, resulting in a decrease in atmospheric transmittance of less than 2%, is readily seen in the measurements. The only atmospheric absorption detected, other than ozone, was O_2 at 760 nm and CO_2 at 1960 nm, 2010 nm, and 2060 nm. Water vapor absorption at 1380 nm was not detected due to the presence of absorption by the fused-silica window within the same wavelength region. As shown in Fig. 9(a), ozone absorption becomes apparent for wavelengths shorter than 340 nm and virtually complete at wavelengths shorter than 295 nm. The practical limit of meaningful measurements is 300 nm.

The advantage of performing measurements from an aircraft or other high-altitude platform is obvious when a comparison is made with the transmittance to sea level. Such a comparison is made in Figs. 9(a) and 9(b) between the experimental atmospheric transmittance values from 11.6 km altitude to space and the values from sea level to space predicted by the AFCRL Atmospheric Attenuation Model.[19] For example, at 340 nm the transmittance to space from 11.6 km is 0.84 compared with a maximum of 0.33 from sea level. The high atmospheric transparency at all wavelengths beyond the primary ozone absorption region enables extrapolation to zero air mass to be performed with a high degree of accuracy.

IV. Experimental Results

The resultant extraterrestrial spectral irradiance in the 300–2500 nm wavelength interval, obtained from extrapolation of all measurements to zero air mass, is presented in both tabular and graphical form in Appendix B. The wavelength interval in Table VII, which is somewhat representative of the spectral resolution of the data, varies from 0.1 nm over most of the uv and visible to 5 nm in the smooth continuum region of the ir. This relatively high resolution allows identification of the major Fraunhofer lines through the use of the Rowland Table.[20] The identities of selected major absorption lines are indicated in the spectrum.

Most applications of solar spectral irradiance do not require resolution as high as that presented in Appendix B. For that reason, the percentage of total irradiance at wavelengths shorter than the printout wavelength is included in the listing to provide a simple method of calculating the total irradiance or average spectral irradiance within an arbitrary wavelength interval.

A listing of extraterrestrial solar spectral irradiance, smoothed over relatively wide wavelength intervals, will be presented for engineering use and the uncertainties in the spectral irradiance values will be discussed in the following sections.

A. Solar Spectral Irradiance Listing for Engineering Use

The engineering technology presently being applied to space research does not, in general, require the relatively high resolution given in Appendix B. In many instances it is desirable to use values of solar spectral

Table III. Extraterrestrial Solar Spectral Irradiance at the Earth's Mean Distance from the Sun

λ, nm	H_λ, W/m²-nm	P_λ, %	λ, nm	H_λ, W/m²-nm	P_λ, %	λ, nm	H_λ, W/m²-nm	P_λ, %	λ, nm	H_λ, W/m²-nm	P_λ, %
200*	0.012	0.01	375	1.13	6.12	600	1.79	35.69	950	0.799	67.06
205*	0.016	0.02	380	1.11	6.56	610	1.78	36.98	960	0.792	67.63
210*	0.026	0.03	385	1.05	6.92	620	1.72	38.23	970	0.781	68.20
215*	0.043	0.04	390	1.10	7.32	630	1.70	39.47	980	0.776	68.76
220*	0.055	0.06	395	1.21	7.71	640	1.67	40.68	990	0.758	69.31
225*	0.062	0.08	400	1.54	8.19	650	1.61	41.85	1000	0.741	69.95
230*	0.064	0.10	405	1.77	8.82	660	1.56	42.98	1050	0.669	72.39
235*	0.057	0.12	410	1.83	9.46	670	1.58	44.13	1100	0.602	74.66
240*	0.061	0.14	415	1.88	10.14	680	1.57	45.27	1150	0.546	76.72
245*	0.069	0.17	420	1.85	10.82	690	1.49	46.36	1200	0.496	78.59
250*	0.068	0.19	425	1.76	11.47	700	1.50	47.45	1250	0.451	80.30
255*	0.100	0.22	430	1.67	12.08	710	1.43	48.50	1300	0.419	81.86
260*	0.125	0.26	435	1.75	12.67	720	1.39	49.51	1350	0.379	83.30
265*	0.178	0.31	440	1.92	13.34	730	1.37	50.51	1400	0.349	84.60
270*	0.22	0.39	445	2.01	14.05	740	1.32	51.48	1450	0.320	85.81
275*	0.20	0.46	450	2.06	14.79	750	1.30	52.42	1500	0.296	86.91
280*	0.21	0.54	455	2.10	15.54	760	1.28	53.35	1600	0.253	88.58
285*	0.30	0.63	460	2.11	16.30	770	1.22	54.25	1700	0.215	90.57
290*	0.46	0.76	465	2.08	17.06	780	1.21	55.12	1800	0.170	91.95
295*	0.56	0.95	470	2.07	17.80	790	1.19	55.99	1900	0.139	93.03
300	0.56	1.15	475	2.11	18.55	800	1.16	56.83	2000	0.119	93.97
305	0.59	1.35	480	2.10	19.31	810	1.12	57.64	2100	0.0945	94.74
310	0.66	1.57	485	1.98	20.06	820	1.08	58.43	2200	0.0764	95.34
315	0.73	1.83	490	1.96	20.74	830	1.06	59.20	2300	0.0644	95.86
320	0.75	2.10	495	2.00	21.47	840	1.02	59.95	2400	0.0575	96.29
325	0.89	2.37	500	1.96	22.18	850	0.966	60.67	2500	0.0532	96.66
330	1.04	2.74	510	1.97	23.60	860	0.961	61.36	3000†	0.0266	97.96
335	1.02	3.12	520	1.85	24.94	870	0.942	62.04	3500†	0.0139	98.67
340	1.00	3.47	530	1.92	26.31	880	0.936	62.72	4000†	0.0094	99.05
345	1.01	3.84	540	1.89	27.69	890	0.917	63.38	4500†	0.0061	99.32
350	1.04	4.19	550	1.88	29.05	900	0.893	64.03	5000†	0.0041	99.49
355	1.02	4.58	560	1.83	30.38	910	0.866	64.66	7000†	0.0011	99.81
360	0.98	4.93	570	1.85	31.70	920	0.842	65.28	10000†	0.0003	99.92
365	1.15	5.29	580	1.88	33.05	930	0.840	65.88	20000†	0.0002	99.98
370	1.15	5.75	590	1.83	34.38	940	0.818	66.48	40000†	0.0001	99.99

*Adjusted NRL data (Ref. 13)
†5800°K greybody

irradiance that have been smoothed over the detailed Fraunhofer structure. Such a listing is provided in Table III as a solar spectral irradiance listing proposed for engineering use.

The values of spectral irradiance in Table III corresponding to wavelengths shorter than 1000 nm have been integrated over a 10-nm interval centered at the respective wavelength. At longer wavelengths, the data have been integrated over the printout interval. Integration was performed numerically at 0.1-nm increments. A listing of the percentage P_λ of the total solar irradiance at wavelengths shorter than the printout wavelength is also provided.

In the 300–2500 nm wavelength region, the results are from the present experiment. Below 300 nm, the most recent NRL rocket spectrograph measurements, reported by Tousey,[13] are used. These data, obtained originally on a relative scale, have been normalized to the present experiment in the overlap region 300–400 nm. Beyond 2500 nm, a 5800-K greybody approximation is believed to be an adequate representation of the solar continuum.

The total irradiance, calculated from the integral of the spectral irradiance, is 1390 W/m² (1.99 cal/cm²-min). This number represents the total solar irradiance incident on a surface in space oriented normal to the sun at the earth's mean distance.

B. Uncertainty Limits of the Results

The measurements presented in this paper are based on the standard of spectral irradiance maintained by the National Bureau of Standards. The maximum uncertainty existing in the standard varies from approximately 5% at 300 nm to 3% in the visible and ir.[2] Total irradiance could possibly be more accurate since integration over a number of spectral data points tends to cancel the random component of error. The degree of systematic error is not known, although, as discussed later, results indicate that it probably does not exceed 2%.

The precision of the measurements is better than 1%. The absolute accuracy of the resultant extraterrestrial solar spectral irradiance can be determined from the individual accuracies of each factor affecting the measurement. The uncertainty in the measurement of a quantity $\xi(X)$ whose value is a function of n independent variables $X_1, X_2, \ldots, X_n$, each with an uncertainty $\Delta X_1, \Delta X_2, \ldots, \Delta X_n$, can be obtained by

$$\Delta\xi = \left[\left(\frac{\partial\xi}{\partial X_1}\Delta X_1\right)^2 + \left(\frac{\partial\xi}{\partial X_2}\Delta X_2\right)^2 + \ldots + \left(\frac{\partial\xi}{\partial X_n}\Delta X_n\right)^2\right]^{\frac{1}{2}} \quad (6)$$

Equations (1), (4), and (5) may be combined to express the extraterrestrial spectral irradiance $H_{\lambda,0}$ in terms of

Table IV. Uncertainty Limits

λ, nm	Standard of Spectral Irradiance, %	Spectroradiometer measurement, %	Zero air mass extrapolation, %	Mirror reflectance, %	Window transmittance, %	Total uncertainty, %
300	5.0	0.8	24.0	0.5	0.5	25.0
310	5.0	0.7	5.0	0.5	0.4	7.1
320	5.0	0.7	3.0	0.5	0.4	5.9
330	4.0	0.7	2.5	0.5	0.4	4.8
350	4.0	0.6	1.2	0.5	0.4	4.3
400	3.0	0.5	0.6	0.5	0.4	3.2
500	3.0	0.5	0.5	0.5	0.4	3.1
700	3.0	0.5	0.5	0.5	0.4	3.1
1000	3.0	0.5	0.3	0.5	0.4	3.1
1500	3.0	0.7	0.2	0.5	0.4	3.2
2000	3.0	0.8	0.2	0.5	0.4	3.2
2200	3.0	1.5	0.2	0.5	1.6	3.[illegible]
2500	3.0	2.0	0.2	0.5	0.9	3.[illegible]

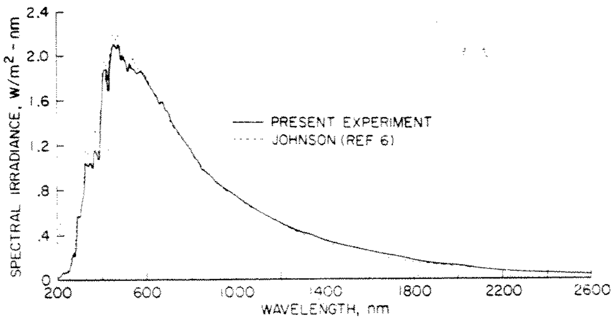

Fig. 10. Comparison of solar spectral irradiance, present experiment and Johnson.

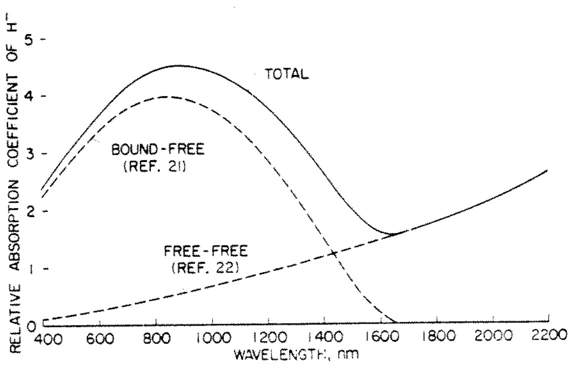

Fig. 11. Spectral variation of absorption coefficient of the negative hydrogen ion (H^-).

the measured spectral irradiance $H^*_{\lambda,m}$, atmospheric transmittance $\tau_{\lambda,m}$, distance from the sun a_0, mirror reflectance ρ_λ, and window transmittance τ_λ:

$$H_{\lambda,0} = \frac{a_0{}^2 H^*{}_{\lambda,m}}{\tau_{\lambda,m}\rho_\lambda\tau_\lambda}. \tag{7}$$

The fractional uncertainty in $H_{\lambda,0}$ can now be expressed in terms of the fractional uncertainties in the individual factors:

$$\frac{\Delta H_{\lambda,0}}{H_{\lambda,0}} = \left[\left(\frac{\Delta H^*{}_{\lambda,m}}{H^*{}_{\lambda,m}}\right)^2 + \left(\frac{\Delta\tau_{\lambda,m}}{\tau_{\lambda,m}}\right)^2 + \left(\frac{2\Delta a_0}{a_0}\right)^2 + \left(\frac{\Delta\rho_\lambda}{\rho_\lambda}\right)^2 + \left(\frac{\Delta\tau_\lambda}{\rho_\lambda}\right)^2\right]^{\frac{1}{2}}. \tag{8}$$

Table IV lists the individual uncertainties and the total uncertainty in $H_{\lambda,0}$ at various wavelengths from 300 nm to 2500 nm. The uncertainty associated with distance from the sun is small enough to be neglected with respect to the others and was not included in the table.

The largest total uncertainty occurs in the region of high ozone absorption below 320 nm. The uncertainty quickly decreases at longer wavelengths as the atmospheric transmittance increases and remains approximately 3% throughout the entire visible and ir. The primary uncertainty at wavelengths longer than 320 nm is due to uncertainty in the Standard of Spectral Irradiance.

V. Comparison With Previous Studies

A comparison between the values of spectral irradiance listed in Table III and Johnson's values[6] is shown in Fig. 10. In general, the results are relatively close considering the diverse data used by Johnson in his analysis. The primary region of discrepancy is in the uv where the results of the present experiment indicate a uniform 11% lower irradiance between 300 nm and 400 nm. There are regions of slight discrepancy in the visible and near ir and a broad region between 1300 nm and 1900 nm where the continuum is significantly higher than Johnson's level.

In the ir at wavelengths beyond 1250 nm, Johnson accepted the assumption that the sun radiated as a 6000-K greybody. This means that the spectral absorptance of the solar atmosphere is assumed to be independent of wavelength. This is not the case, and, in fact, as shown in Fig. 11, the absorptance of the solar atmosphere has a minimum in the same ir region as the results from the present experiment indicate higher irradiance.*

The lower intensity level in the spectral region below 600 nm is in good agreement with recently published

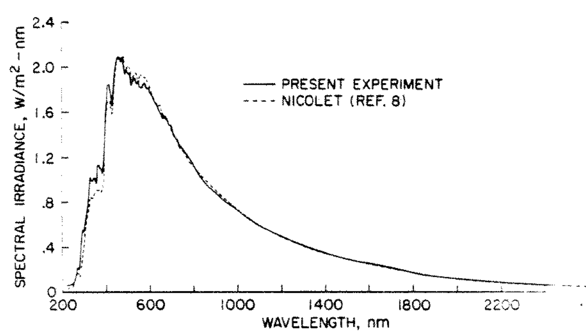

Fig. 12. Comparison of solar spectral irradiance, present experiment and Nicolet.

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* The data in Fig. 11 were obtained from Refs. 21 and 22 and represent known spectral variations in the opacity of the solar atmosphere. Most of the continuum absorption is due to the negative ion of hydrogen (H^-), which absorbs energy through either "bound-free" transitions or "free-free" transitions which are functions of wavelength. The minimum in the total absorption coefficient between 1300 nm and 1900 nm means that the radiation is emanating from a higher temperature region deeper within the solar atmosphere. Beyond 2500 nm, the free-free absorption coefficient continues to rise, with the result that the effective greybody temperature of the sun decreases at longer wavelengths. The exact relationship between the absorption coefficient and the effective solar temperature in the ir is not known, however, since the effect is small, the assumption is made in the present experiment that a 5800-K solar temperature is an adequate representation at wavelengths longer than 2500 nm.

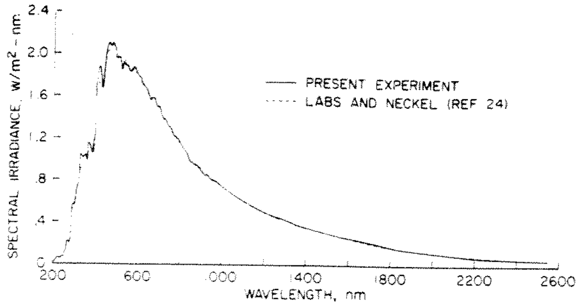

Fig. 13. Comparison of solar spectral irradiance, present experiment and Labs and Neckel.

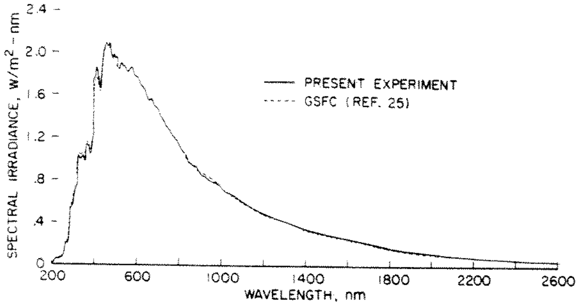

Fig. 14. Comparison of solar spectral irradiance, present experiment and Goddard Space Flight Center (GSFC).

results of measurements between 310 nm and 530 nm by Stair and Ellis obtained at the Mauna Loa Observatory, Hawaii.[23] Using Johnson's values of spectral irradiance at wavelengths longer than 530 nm, they concluded that the total irradiance is approximately 2% less than Johnson's value of 1395 W/m². However, the results of the present experiment indicate that the higher level of spectral irradiance in the ir would nearly compensate for the lower level in the uv and visible, with the result that the value of total irradiance should be virtually the same as Johnson's value.

The spectral irradiance values of Nicolet are compared with those of the present experiment in Fig. 12. There is general agreement in the visible and ir, except in the 500–600 nm region, where Nicolet's values appear to be an average of 3% higher than the present results. The primary region of discrepancy is in the uv. The difficulty of determining the true level of Fraunhofer absorption in this region, a necessary factor in Nicolet's method, is felt to be the probable cause of the discrepancy.

The results of Labs and Neckel,[24] obtained at the Jungfraujoch Scientific Station, Switzerland (altitude 3.6 km), are shown in Fig. 13. Their data are the results of measurements of the spectral radiance at the center of the solar disk in the 330–1250 nm wavelength region adjusted for center-limb variations and line blanketing to obtain mean spectral radiance. In the uv below 330 nm, they adjusted the data given by Tousey[13] and, in the ir, used the normalized continuum from solar models with corrections for the ratio of mean to central intensity and line blanketing. The agreement with results from the present experiment is very close except in the region below 500 nm where the results of Labs and Neckel average about 5% lower. Possible explanations for this discrepancy include inaccuracies in the evaluation of the higher degree of atmospheric attenuation experienced in their observations and inaccuracies in the determination of the center-limb variations and line blanketing coefficients. The value of total irradiance obtained by Labs and Neckel is 1366 W/m².

Researchers from the NASA Goddard Space Flight Center (GSFC), participating with independent instrumentation during seven of the CV-990 flights, have published values[25] of extraterrestrial solar spectral irradiance obtained from weighted averages of measurements from four instruments: (1) Perkin-Elmer model 112 monochromator; (2) modified Eppley filter radiometer; (3) Carl Leiss monochromator, and (4) Block model P-4 polarization interferometer. The measurements obtained with the latter two instruments were on a relative basis due to calibration difficulties. A comparison between the GSFC results and the results from the present experiment is presented in Fig. 14. The agreement is close, except in the spectral region between 500 nm and 800 nm, where the GSFC results indicate considerably lower spectral irradiance. The reason for this discrepancy is not clear at the present time, although, as shown in Ref. 25, the differences between the individual GSFC instruments in this spectral region are of this magnitude. The value of total irradiance obtained by GSFC is 1351 W/m².

The value of total irradiance obtained from the present experiment, 1390 W/m², can be compared to a recently published value of 1360 W/m² based on the International Pyrheliometric Scale. This value is the result of a total radiometer experiment by Jet Propulsion Laboratory and Eppley Laboratory aboard the X-15 aircraft.[26] The relatively close agreement between the two total irradiance values, which are based on completely different radiometric standards, indicates

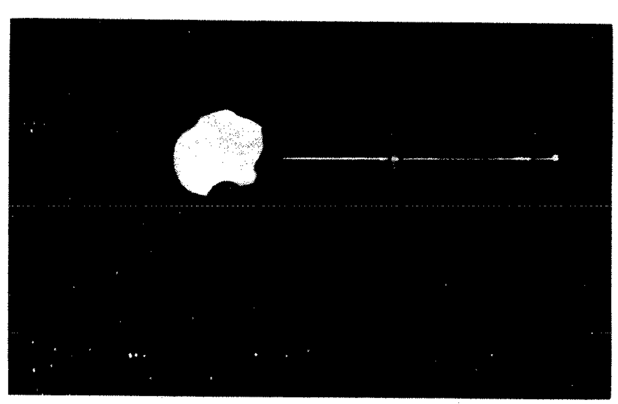

Fig. 15. Apparatus for measuring transmittance of fused silica windows.

Table V. Transmittance of 2.5-cm Fused Silica as a Function of Wavelength and Angle of Incidence (Unpolarized Radiation)

Wavelength, nm	Angle of incidence 0°	20°	30°	Wavelength, nm	Angle of incidence 0°	20°	30°
290	0.860	0.856	0.850	1410	0.873	0.869	0.859
295	0.864	0.860	0.855	1420	0.898	0.896	0.890
300	0.877	0.873	0.869	1430	0.916	0.915	0.912
320	0.910	0.909	0.906	1500	0.942	0.941	0.940
350	0.926	0.925	0.923	1600	0.943	0.943	0.943
400	0.937	0.937	0.937	1700	0.940	0.940	0.940
450	0.939	0.939	0.939	1800	0.936	0.936	0.935
500	0.939	0.939	0.939	1900	0.937	0.937	0.937
550	0.940	0.940	0.940	2000	0.937	0.937	0.937
600	0.941	0.941	0.941	2100	0.929	0.929	0.927
700	0.942	0.942	0.942	2140	0.898	0.895	0.889
800	0.942	0.942	0.942	2160	0.833	0.826	0.809
900	0.942	0.942	0.942	2180	0.753	0.744	0.715
1000	0.943	0.943	0.943	2200	0.398	0.362	0.275
1100	0.944	0.944	0.944	2220	0.292	0.249	0.145
1200	0.944	0.944	0.944	2250	0.423	0.389	0.306
1300	0.938	0.938	0.938	2270	0.535	0.508	0.443
1340	0.925	0.924	0.923	2300	0.710	0.695	0.658
1350	0.920	0.919	0.917	2350	0.827	0.820	0.802
1360	0.912	0.911	0.907	2400	0.828	0.821	0.803
1370	0.862	0.857	0.845	2420	0.781	0.771	0.745
1380	0.740	0.727	0.696	2450	0.714	0.699	0.663
1383	0.705	0.690	0.653	2470	0.680	0.663	0.621
1390	0.730	0.716	0.683	2480	0.593	0.570	0.514
1400	0.816	0.808	0.789	2500	0.514	0.486	0.417

that the systematic error in the values of extraterrestrial solar spectral irradiance is probably no greater than 2%.

The actual degree of systematic error in the measurements will be resolved when a measurement of total solar irradiance is performed in space by an absolute radiometer such as described in Ref. 27. This radiometer, the JPL Standard Total-Radiation Absolute Radiometer, is capable of better than 1.0% absolute accuracy. A direct total irradiance measurement obtained in space by such an instrument would justify a revision of the spectral irradiance data contained in this report if a significant discrepancy is found.

VI. Concluding Remarks

The NASA CV-990 aircraft afforded an excellent high-altitude platform from which to perform measurements of absolute solar spectral irradiance. Observational conditions such as stability of the aircraft and constancy of the atmosphere allowed measurements to be made with good resolution and high precision. At altitudes greater than 11.6 km, the aircraft is above 80% of the atmosphere and virtually all dust and water vapor. Therefore, the amount of atmospheric scattering was greatly reduced and the variability in atmospheric transmittance was virtually eliminated.

The primary purpose of the experiment was to reduce the uncertainties in the present knowledge of extraterrestrial solar spectral irradiance at the earth's mean distance from the sun. The measurements covered a spectral region encompassing over 95% of the total energy emitted by the sun, using a single instrument of high precision. The results of the measurements are directly traceable to the NBS Standard of Spectral Irradiance and possess an absolute accuracy, over most of the wavelength range, of approximately 3% and resolution to 0.1 nm. These measurements, integrated over relatively wide spectral intervals, form the basis for a solar spectral irradiance table (Table III) proposed for engineering use.

The solar spectral irradiance data in Table VII, covering the 300–2500 nm spectral interval with resolution to 0.1 nm, are available to any organization that has need for such information. The data may be obtained as a listing on either cards or tape from National Space Science Data Center, Code 601, Goddard Space Flight Center, Greenbelt, Maryland 20771.

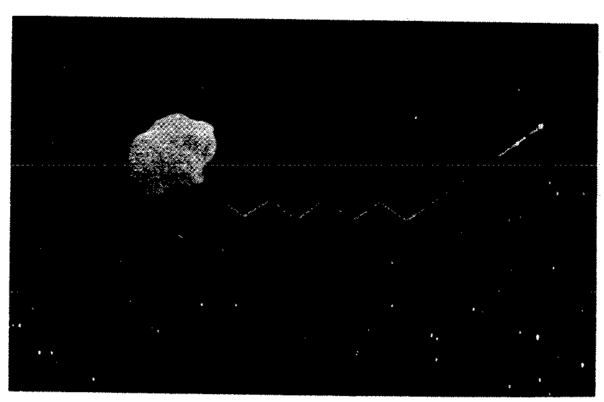

Fig. 16. Apparatus for measuring mirror reflectance.

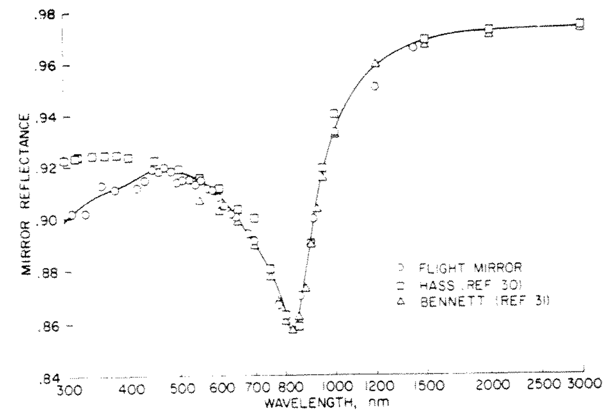

Fig. 17. Spectral reflectance of flight mirror.

Table VI. Reflectance of Front-Surface Aluminum Mirror as a Function of Wavelength and Angle of Incidence (Unpolarized Radiation)

Wavelength, nm	Angle of incidence 0°	35°	45°	55°
300	0.898	0.897	0.896	0.894
350	0.909	0.907	0.904	0.898
400	0.914	0.912	0.910	0.904
450	0.918	0.916	0.914	0.909
500	0.917	0.916	0.914	0.908
550	0.915	0.915	0.913	0.907
600	0.905	0.904	0.901	0.894
650	0.900	0.898	0.895	0.889
700	0.891	0.889	0.886	0.878
750	0.879	0.877	0.873	0.865
800	0.863	0.861	0.857	0.848
825	0.856	0.854	0.850	0.841
850	0.867	0.865	0.861	0.852
900	0.892	0.890	0.886	0.878
950	0.918	0.917	0.914	0.907
1000	0.933	0.932	0.930	0.926
1100	0.948	0.947	0.945	0.941
1200	0.957	0.956	0.954	0.950
1500	0.968	0.967	0.966	0.963
2000	0.972	0.971	0.970	0.967
2500	0.974	0.973	0.972	0.970

Appendix A. Determination of Transmittance of Windows and Reflectance of Mirror

An accurate determination of the transmittance of the fused silica windows and the reflectance of the mirror used in the measurements is highly important since an error in these values is a direct error in the measured value of solar spectral irradiance. Direct solar radiation at 11.6 km was found to be natural or unpolarized within detection limits of $\pm 0.2\%$. This determination was made by rotating a polarizer while the solar vector was at normal incidence to the upper aircraft window. At the maximum solar incidence angle of 31°, the degree of polarization of the solar radiation transmitted through the window was 2%, as expected by Fresnel reflection considerations. Reflectance from the aluminized turning mirror for unpolarized radiation would thus be in error only 0.15% at its maximum incidence angle of 55°. It is, therefore, sufficient to use transmittance and reflectance coefficients for unpolarized radiation in analysis of the data.

A. Measurement of Window Transmittance

The spectral transmittance of the fused silica window was determined by two independent procedures. The first utilized a Carl Leiss double-prism monochromator in conjunction with a 20-cm diam magnesium oxide integrating sphere and a Brower model 129 phase-lock amplifier. A collimated beam of light was directed through an aperture in the sphere (see Fig. 15) and measurements were made with the window in and out of the light beam at each wavelength setting of the monochromator. Since the entire beam always entered the sphere, it was not necessary to correct for the differences in optical path length with the window inserted or removed. The lamp exhibited a 12% polarization, which resulted in a negligible error (0.1% for 30° incidence) in the measured transmittance.

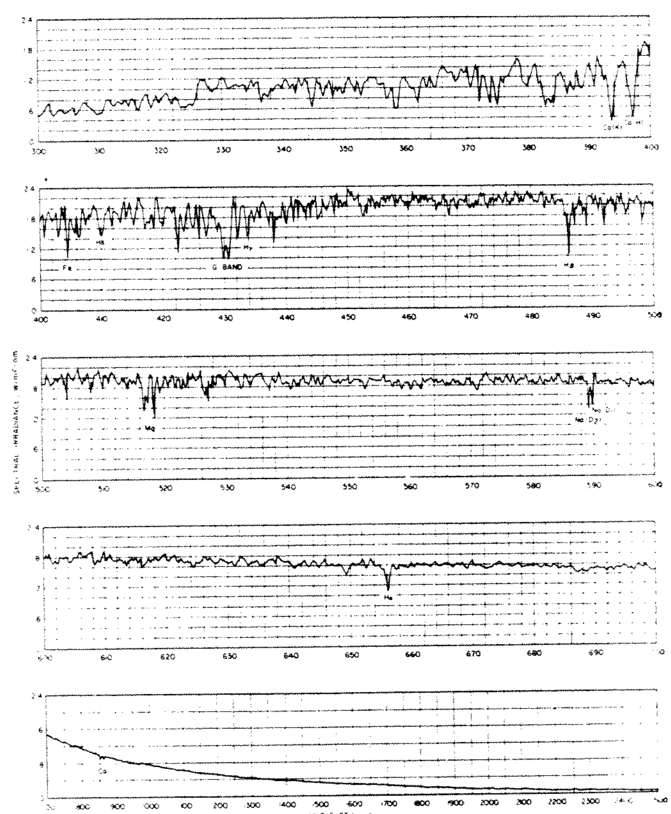

Fig. 18. Extraterrestrial solar spectral irradiance at the earth's mean distance from the sun (Table VII).

Table VII. Extraterrestrial Solar Spectral Irradiance at the Earth's Mean Distance from the Sun (300–2500 nm)

λ, nm	$H_λ$, W/m²·nm	$P_λ$, %
300.0	0.545	1.15
300.4	0.504	1.16
300.8	0.546	1.18
301.2	0.616	1.19
301.6	0.749	1.21
302.0	0.576	1.23
302.4	0.485	1.25
302.8	0.541	1.26
303.2	0.590	1.28
303.6	0.635	1.30
304.0	0.563	1.31
304.4	0.522	1.33
304.8	0.552	1.35
305.2	0.628	1.36
305.6	0.646	1.38
306.0	0.490	1.40
306.4	0.557	1.41
306.8	0.622	1.43
307.2	0.718	1.45
307.6	0.746	1.47
308.0	0.672	1.49
308.4	0.631	1.51
308.8	0.620	1.53
309.2	0.533	1.54
309.6	0.514	1.56
310.0	0.536	1.57
310.4	0.540	1.59
310.8	0.707	1.61
311.2	0.792	1.63
311.6	0.793	1.65
312.0	0.706	1.67
312.4	0.659	1.69
312.8	0.747	1.71
313.2	0.759	1.73
313.6	0.706	1.75
314.0	0.755	1.78
314.4	0.774	1.80
314.8	0.651	1.82
315.2	0.822	1.84
315.6	0.800	1.86
316.0	0.629	1.88
316.4	0.576	1.90
316.8	0.744	1.92
317.2	0.841	1.94
317.6	0.917	1.97
318.0	0.805	1.99
318.4	0.620	2.01
318.8	0.739	2.03
319.2	0.887	2.06
319.6	0.721	2.08
320.0	0.786	2.10
320.4	0.861	2.12
320.8	0.925	2.15
321.2	0.867	2.18
321.6	0.691	2.20
322.0	0.779	2.22
322.4	0.856	2.24
322.8	0.747	2.27
323.2	0.619	2.29
323.6	0.657	2.30
324.0	0.620	2.32
324.4	0.687	2.34
324.8	0.697	2.36
325.2	0.668	2.38
325.6	0.773	2.40
326.0	1.029	2.43
326.4	1.189	2.46
326.8	1.159	2.49
327.2	1.183	2.53
327.6	1.034	2.56
328.0	1.004	2.59
328.4	0.928	2.61
328.8	1.000	2.64
329.2	1.009	2.67
329.6	1.193	2.70
330.0	1.223	2.74
330.4	1.187	2.77
330.8	1.014	2.80
331.2	0.993	2.83
331.6	1.022	2.86
332.0	1.057	2.89
332.4	1.074	2.92
332.8	1.030	2.95
333.2	1.062	2.98
333.6	1.076	3.01
334.0	0.930	3.04
334.4	1.047	3.07
334.8	1.179	3.10
335.2	1.033	3.13
335.6	1.119	3.16
336.0	1.131	3.20
336.4	0.698	3.22
336.8	0.909	3.24
337.2	0.864	3.27
337.6	0.827	3.30
338.0	0.988	3.32
338.4	0.938	3.35
338.8	1.039	3.38
339.2	1.091	3.41
339.6	1.005	3.44

λ, nm	$H_λ$, W/m²·nm	$P_λ$, %
340.0	1.089	3.47
340.2	1.185	3.48
340.4	1.175	3.50
340.6	1.147	3.52
340.8	1.078	3.53
341.0	1.013	3.55
341.2	1.028	3.56
341.4	1.084	3.58
341.6	1.072	3.59
341.8	0.899	3.61
342.0	0.972	3.62
342.2	1.104	3.64
342.4	1.207	3.65
342.6	1.133	3.67
342.8	1.047	3.69
343.0	1.035	3.70
343.2	1.101	3.72
343.4	1.207	3.73
343.6	1.163	3.75
343.8	1.095	3.77
344.0	1.023	3.78
344.2	0.905	3.80
344.4	0.670	3.81
344.6	0.624	3.82
344.8	0.770	3.83
345.0	0.899	3.84
345.2	1.073	3.85
345.4	1.189	3.87
345.6	1.068	3.88
345.8	1.095	3.90
346.0	1.085	3.92
346.2	0.897	3.93
346.4	0.818	3.94
346.6	0.901	3.95
346.8	1.065	3.97
347.0	0.988	3.98
347.2	1.099	4.00
347.4	1.163	4.01
347.6	1.082	4.03
347.8	0.873	4.05
348.0	0.815	4.06
348.2	0.909	4.07
348.4	1.046	4.08
348.6	0.979	4.10
348.8	0.915	4.11
349.0	1.020	4.13
349.2	1.020	4.14
349.4	0.900	4.15
349.6	0.870	4.17
349.8	0.942	4.18
350.0	1.015	4.19
350.2	1.088	4.21
350.4	1.160	4.22
350.6	1.210	4.24
350.8	1.173	4.26
351.0	1.059	4.28
351.2	1.058	4.29
351.4	1.008	4.31
351.6	0.899	4.32
351.8	1.002	4.33
352.0	1.128	4.35
352.2	1.096	4.36
352.4	0.936	4.38
352.6	0.821	4.39
352.8	0.935	4.40
353.0	1.046	4.42
353.2	1.108	4.43
353.4	1.113	4.45
353.6	1.132	4.47
353.8	1.165	4.48
354.0	1.196	4.50
354.2	1.203	4.52
354.4	1.197	4.53
354.6	1.192	4.55
354.8	1.195	4.57
355.0	1.213	4.58
355.2	1.166	4.60
355.4	1.052	4.62
355.6	1.046	4.63
355.8	1.051	4.65
356.0	1.038	4.66
356.2	1.055	4.68
356.4	1.097	4.69
356.6	0.861	4.71
356.8	0.768	4.72
357.0	0.780	4.73
357.2	0.861	4.74
357.4	0.939	4.75
357.6	0.987	4.77
357.8	0.943	4.78
358.0	0.726	4.80
358.2	0.575	4.80
358.4	0.563	4.81
358.6	0.582	4.82
358.8	0.755	4.83
359.0	0.976	4.84
359.2	1.117	4.86
359.4	1.165	4.87
359.6	1.210	4.89
359.8	1.207	4.91

λ, nm	$H_λ$, W/m²·nm	$P_λ$, %
360.0	1.160	4.93
360.2	1.109	4.94
360.4	1.044	4.96
360.6	0.979	4.97
360.8	0.960	4.99
361.0	0.971	5.00
361.2	0.981	5.01
361.4	0.941	5.03
361.6	0.799	5.04
361.8	0.675	5.05
362.0	0.778	5.06
362.2	0.968	5.07
362.4	1.103	5.09
362.6	1.166	5.10
362.8	1.206	5.12
363.0	1.123	5.14
363.2	1.013	5.15
363.4	1.012	5.17
363.6	1.124	5.18
363.8	1.212	5.20
364.0	1.152	5.22
364.2	1.060	5.23
364.4	1.003	5.25
364.6	0.986	5.26
364.8	0.986	5.28
365.0	1.094	5.29
365.2	1.231	5.31
365.4	1.315	5.33
365.6	1.351	5.35
365.8	1.397	5.37
366.0	1.410	5.39
366.2	1.373	5.41
366.4	1.333	5.42
366.6	1.300	5.44
366.8	1.269	5.46
367.0	1.259	5.48
367.2	1.284	5.50
367.4	1.305	5.52
367.6	1.248	5.54
367.8	1.154	5.55
368.0	1.096	5.57
368.2	1.116	5.58
368.4	1.147	5.60
368.6	1.218	5.62
368.8	1.312	5.64
369.0	1.366	5.66
369.2	1.316	5.67
369.4	1.258	5.69
369.6	1.279	5.71
369.8	1.355	5.73
370.0	1.371	5.75
370.2	1.194	5.77
370.4	0.996	5.78
370.6	0.973	5.80
370.8	1.091	5.81
371.0	1.209	5.83
371.2	1.327	5.85
371.4	1.443	5.87
371.6	1.322	5.89
371.8	0.981	5.90
372.0	0.721	5.92
372.2	0.951	5.93
372.4	1.220	5.94
372.6	1.228	5.96
372.8	1.176	5.98
373.0	1.061	5.99
373.2	0.931	6.01
373.4	0.781	6.02
373.6	0.677	6.03
373.8	0.908	6.04
374.0	1.175	6.06
374.2	1.093	6.07
374.4	0.926	6.09
374.6	0.735	6.10
374.8	0.623	6.11
375.0	0.714	6.12
375.2	1.051	6.13
375.4	1.219	6.15
375.6	1.109	6.17
375.8	1.059	6.18
376.0	1.137	6.20
376.2	1.191	6.21
376.4	1.190	6.23
376.6	1.196	6.25
376.8	1.221	6.27
377.0	1.263	6.28
377.2	1.332	6.30
377.4	1.390	6.32
377.6	1.418	6.34
377.8	1.455	6.36
378.0	1.515	6.38
378.2	1.547	6.41
378.4	1.513	6.43
378.6	1.426	6.45
378.8	1.228	6.47
379.0	1.073	6.48
379.2	1.062	6.50
379.4	1.056	6.51
379.6	1.019	6.53
379.8	1.011	6.54

λ, nm	$H_λ$, W/m²·nm	$P_λ$, %
380.0	1.108	6.56
380.1	1.164	6.57
380.2	1.216	6.58
380.3	1.260	6.58
380.4	1.304	6.59
380.5	1.348	6.60
380.6	1.387	6.61
380.7	1.406	6.62
380.8	1.426	6.63
380.9	1.446	6.64
381.0	1.446	6.65
381.1	1.341	6.66
381.2	1.237	6.67
381.3	1.132	6.68
381.4	1.043	6.69
381.5	1.057	6.70
381.6	1.071	6.71
381.7	1.085	6.71
381.8	1.092	6.72
381.9	1.017	6.73
382.0	0.942	6.74
382.1	0.867	6.74
382.2	0.794	6.75
382.3	0.744	6.75
382.4	0.695	6.76
382.5	0.645	6.76
382.6	0.596	6.77
382.7	0.640	6.77
382.8	0.684	6.78
382.9	0.728	6.78
383.0	0.738	6.79
383.1	0.747	6.79
383.2	0.757	6.80
383.3	0.724	6.80
383.4	0.689	6.81
383.5	0.654	6.81
383.6	0.689	6.82
383.7	0.731	6.82
383.8	0.793	6.83
383.9	0.725	6.83
384.0	0.657	6.84
384.1	0.803	6.84
384.2	0.978	6.85
384.3	1.153	6.86
384.4	1.186	6.87
384.5	1.192	6.88
384.6	1.199	6.88
384.7	1.211	6.89
384.8	1.224	6.90
384.9	1.237	6.91
385.0	1.251	6.92
385.1	1.265	6.93
385.2	1.279	6.94
385.3	1.241	6.95
385.4	1.187	6.95
385.5	1.133	6.96
385.6	1.103	6.97
385.7	1.081	6.98
385.8	1.059	6.99
385.9	0.993	6.99
386.0	0.908	7.00
386.1	0.824	7.01
386.2	0.845	7.01
386.3	0.917	7.02
386.4	0.989	7.03
386.5	1.061	7.03
386.6	1.133	7.04
386.7	1.125	7.05
386.8	1.070	7.06
386.9	1.016	7.06
387.0	0.962	7.07
387.1	0.929	7.08
387.2	0.911	7.09
387.3	0.893	7.09
387.4	0.969	7.10
387.5	1.117	7.11
387.6	1.265	7.11
387.7	1.300	7.12
387.8	1.239	7.13
387.9	1.177	7.14
388.0	1.116	7.15
388.1	1.058	7.16
388.2	1.004	7.17
388.3	0.950	7.17
388.4	0.928	7.18
388.5	0.941	7.19
388.6	0.954	7.19
388.7	0.986	7.20
388.8	0.979	7.21
388.9	1.022	7.21
389.0	1.106	7.22
389.1	1.189	7.23
389.2	1.256	7.24
389.3	1.298	7.25
389.4	1.340	7.26
389.5	1.379	7.27
389.6	1.414	7.28
389.7	1.448	7.29
389.8	1.452	7.30
389.9	1.396	7.31

λ, nm	$H_λ$, W/m²·nm	$P_λ$, %
390.0	1.341	7.32
390.1	1.293	7.33
390.2	1.263	7.34
390.3	1.233	7.34
390.4	1.189	7.35
390.5	1.110	7.36
390.6	1.031	7.37
390.7	1.009	7.38
390.8	1.157	7.38
390.9	1.304	7.39
391.0	1.429	7.40
391.1	1.476	7.41
391.2	1.523	7.42
391.3	1.551	7.44
391.4	1.503	7.45
391.5	1.454	7.46
391.6	1.410	7.47
391.7	1.391	7.48
391.8	1.373	7.49
391.9	1.347	7.50
392.0	1.283	7.51
392.1	1.218	7.52
392.2	1.153	7.52
392.3	1.099	7.53
392.4	1.138	7.54
392.5	1.177	7.55
392.6	1.208	7.56
392.7	1.137	7.57
392.8	1.067	7.57
392.9	0.850	7.58
393.0	0.734	7.59
393.1	0.618	7.59
393.2	0.503	7.59
393.3	0.438	7.60
393.4	0.372	7.60
393.5	0.312	7.60
393.6	0.425	7.61
393.7	0.538	7.61
393.8	0.654	7.61
393.9	0.794	7.62
394.0	0.934	7.63
394.1	1.050	7.63
394.2	1.076	7.64
394.3	1.102	7.65
394.4	1.151	7.66
394.5	1.251	7.66
394.6	1.351	7.67
394.7	1.400	7.68
394.8	1.374	7.69
394.9	1.348	7.70
395.0	1.353	7.71
395.1	1.390	7.72
395.2	1.427	7.73
395.3	1.453	7.74
395.4	1.473	7.75
395.5	1.493	7.76
395.6	1.453	7.78
395.7	1.385	7.79
395.8	1.318	7.80
395.9	1.224	7.80
396.0	1.122	7.81
396.1	1.021	7.82
396.2	0.966	7.83
396.3	0.917	7.83
396.4	0.869	7.84
396.5	0.820	7.85
396.6	0.670	7.85
396.7	0.520	7.86
396.8	0.370	7.86
396.9	0.426	7.86
397.0	0.484	7.87
397.1	0.541	7.87
397.2	0.704	7.87
397.3	0.867	7.88
397.4	1.031	7.89
397.5	1.116	7.89
397.6	1.199	7.90
397.7	1.282	7.91
397.8	1.436	7.92
397.9	1.592	7.93
398.0	1.748	7.94
398.1	1.695	7.96
398.2	1.635	7.97
398.3	1.574	7.98
398.4	1.613	7.99
398.5	1.656	8.00
398.6	1.699	8.02
398.7	1.762	8.03
398.8	1.826	8.04
398.9	1.890	8.05
399.0	1.872	8.07
399.1	1.849	8.08
399.2	1.826	8.09
399.3	1.801	8.11
399.4	1.776	8.12
399.5	1.750	8.13
399.6	1.670	8.14
399.7	1.587	8.16
399.8	1.503	8.17
399.9	1.590	8.18

λ, nm	$H_λ$, W/m²·nm	$P_λ$, %
400.0	1.692	8.19
400.1	1.793	8.20
400.2	1.844	8.22
400.3	1.892	8.23
400.4	1.939	8.24
400.5	1.781	8.26
400.6	1.604	8.27
400.7	1.426	8.28
400.8	1.508	8.29
400.9	1.617	8.30
401.0	1.726	8.31
401.1	1.796	8.33
401.2	1.863	8.34
401.3	1.929	8.35
401.4	1.950	8.37
401.5	1.966	8.38
401.6	1.982	8.39
401.7	1.978	8.41
401.8	1.920	8.42
401.9	1.862	8.44
402.0	1.833	8.45
402.1	1.808	8.46
402.2	1.782	8.48
402.3	1.779	8.49
402.4	1.779	8.50
402.5	1.779	8.51
402.6	1.831	8.53
402.7	1.892	8.54
402.8	1.952	8.55
402.9	1.802	8.57
403.0	1.617	8.58
403.1	1.433	8.59
403.2	1.459	8.60
403.3	1.522	8.61
403.4	1.585	8.62
403.5	1.733	8.64
403.6	1.897	8.65
403.7	2.060	8.66
403.8	2.010	8.68
403.9	1.920	8.69
404.0	1.829	8.70
404.1	1.889	8.72
404.2	1.980	8.73
404.3	2.072	8.75
404.4	1.769	8.76
404.5	1.384	8.77
404.6	0.998	8.78
404.7	1.176	8.79
404.8	1.478	8.80
404.9	1.780	8.81
405.0	1.822	8.82
405.1	1.805	8.83
405.2	1.787	8.85
405.3	1.736	8.86
405.4	1.676	8.87
405.5	1.617	8.88
405.6	1.573	8.90
405.7	1.533	8.91
405.8	1.494	8.92
405.9	1.602	8.93
406.0	1.749	8.94
406.1	1.897	8.95
406.2	1.792	8.97
406.3	1.619	8.98
406.4	1.446	8.99
406.5	1.433	9.00
406.6	1.467	9.01
406.7	1.501	9.02
406.8	1.643	9.03
406.9	1.818	9.05
407.0	1.992	9.06
407.1	2.007	9.07
407.2	1.973	9.09
407.3	1.939	9.10
407.4	1.859	9.12
407.5	1.765	9.13
407.6	1.671	9.14
407.7	1.703	9.15
407.8	1.777	9.17
407.9	1.851	9.18
408.0	1.876	9.19
408.1	1.885	9.21
408.2	1.893	9.22
408.3	1.874	9.23
408.4	1.845	9.25
408.5	1.817	9.26
408.6	1.881	9.27
408.7	1.980	9.29
408.8	2.078	9.30
408.9	2.080	9.32
409.0	2.045	9.33
409.1	2.010	9.35
409.2	1.995	9.36
409.3	1.989	9.37
409.4	1.983	9.39
409.5	1.918	9.40
409.6	1.829	9.42
409.7	1.740	9.43
409.8	1.655	9.44
409.9	1.573	9.45

λ, nm	$H_λ$, W/m²·nm	$P_λ$, %
410.0	1.490	9.46
410.1	1.471	9.47
410.2	1.478	9.48
410.3	1.486	9.50
410.4	1.540	9.51
410.5	1.613	9.52
410.6	1.687	9.53
410.7	1.900	9.54
410.8	1.890	9.56
410.9	1.879	9.57
411.0	1.893	9.58
411.1	1.919	9.60
411.2	1.945	9.61
411.3	1.984	9.62
411.4	2.029	9.64
411.5	2.075	9.65
411.6	1.979	9.67
411.7	1.812	9.68
411.8	1.645	9.69
411.9	1.667	9.71
412.0	1.787	9.72
412.1	1.907	9.73
412.2	1.951	9.75
412.3	1.953	9.76
412.4	1.956	9.77
412.5	1.944	9.79
412.6	1.924	9.80
412.7	1.904	9.82
412.8	1.900	9.83
412.9	1.904	9.84
413.0	1.909	9.86
413.1	1.862	9.87
413.2	1.784	9.88
413.3	1.706	9.90
413.4	1.748	9.91
413.5	1.863	9.92
413.6	1.977	9.93
413.7	2.050	9.95
413.8	2.098	9.96
413.9	2.146	9.98
414.0	2.094	9.99
414.1	1.978	10.01
414.2	1.962	10.02
414.3	1.835	10.04
414.4	1.869	10.05
414.5	1.901	10.06
414.6	1.963	10.08
414.7	2.046	10.09
414.8	2.124	10.11
414.9	2.112	10.12
415.0	2.024	10.14
415.1	1.944	10.15
415.2	[illegible]	[illegible]
415.3	1.754	[illegible]
415.4	1.655	[illegible]
415.5	1.652	[illegible]
415.6	[illegible]	[illegible]
415.7	1.785	[illegible]
415.8	1.864	[illegible]
415.9	1.953	[illegible]
416.0	[illegible]	[illegible]
416.1	[illegible]	[illegible]
416.2	[illegible]	[illegible]
416.3	[illegible]	[illegible]
416.4	[illegible]	[illegible]
416.5	[illegible]	[illegible]
416.6	[illegible]	[illegible]
416.7	[illegible]	[illegible]
416.8	[illegible]	[illegible]
416.9	2.064	[illegible]
417.0	[illegible]	[illegible]
417.1	[illegible]	[illegible]
417.2	[illegible]	[illegible]
417.3	[illegible]	[illegible]
417.4	[illegible]	[illegible]
417.5	[illegible]	[illegible]
417.6	[illegible]	[illegible]
417.7	[illegible]	[illegible]
417.8	[illegible]	[illegible]
417.9	[illegible]	[illegible]
418.0	[illegible]	[illegible]
418.1	[illegible]	[illegible]
418.2	[illegible]	[illegible]
418.3	[illegible]	[illegible]
418.4	[illegible]	[illegible]
418.5	[illegible]	[illegible]
418.6	[illegible]	[illegible]
418.7	[illegible]	[illegible]
418.8	[illegible]	[illegible]
418.9	[illegible]	[illegible]
419.0	[illegible]	[illegible]
419.1	[illegible]	[illegible]
419.2	[illegible]	[illegible]
419.3	[illegible]	[illegible]
419.4	[illegible]	[illegible]
419.5	[illegible]	[illegible]
419.6	[illegible]	[illegible]
419.7	[illegible]	[illegible]
419.8	[illegible]	[illegible]
419.9	[illegible]	[illegible]

Table VII. (continued)

λ, nm	H_λ, W/m^2·nm	P_λ, %	λ, nm	H_λ, W/m^2·nm	P_λ, %	λ, nm	H_λ, W/m^2·nm	P_λ, %	λ, nm	H_λ, W/m^2·nm	P_λ, %	λ, nm	H_λ, W/m^2·nm	P_λ, %	λ, nm	H_λ, W/m^2·nm	P_λ, %	λ, nm	H_λ, W/m^2·nm	P_λ, %
420.0	1.725	10.82	430.0	1.080	12.08	440.0	1.735	13.34	450.0	2.023	14.79	460.0	1.946	16.30	470.0	2.002	17.80	480.0	2.115	19.31
420.1	1.690	10.83	430.1	1.127	12.09	440.1	1.714	13.35	450.1	2.074	14.80	460.1	1.936	16.31	470.1	1.959	17.81	480.1	2.106	19.32
420.2	1.656	10.84	430.2	1.173	12.10	440.2	1.693	13.37	450.2	2.149	14.82	460.2	2.008	16.33	470.2	1.939	17.82	480.2	2.147	19.34
420.3	1.687	10.85	430.3	1.215	12.11	440.3	1.675	13.38	450.3	2.244	14.83	460.3	2.079	16.34	470.3	1.962	17.84	480.3	2.173	19.36
420.4	1.793	10.87	430.4	1.256	12.12	440.4	1.770	13.39	450.4	2.345	14.85	460.4	2.086	16.36	470.4	1.992	17.85	480.4	2.101	19.37
420.5	1.899	10.88	430.5	1.262	12.13	440.5	1.865	13.40	450.5	2.330	14.86	460.5	2.046	16.37	470.5	2.038	17.87	480.5	2.040	19.39
420.6	1.969	10.89	430.6	1.156	12.14	440.6	1.958	13.42	450.6	2.286	14.88	460.6	2.084	16.39	470.6	2.041	17.88	480.6	2.061	19.40
420.7	1.998	10.91	430.7	1.049	12.14	440.7	1.982	13.43	450.7	2.251	14.90	460.7	2.182	16.40	470.7	1.964	17.90	480.7	2.079	19.42
420.8	2.027	10.92	430.8	0.989	12.15	440.8	2.005	13.45	450.8	2.219	14.91	460.8	2.280	16.42	470.8	1.937	17.91	480.8	2.077	19.43
420.9	2.039	10.94	430.9	1.079	12.16	440.9	2.029	13.46	450.9	2.253	14.93	460.9	2.248	16.43	470.9	2.005	17.92	480.9	2.073	19.45
421.0	2.030	10.95	431.0	1.169	12.17	441.0	2.099	13.47	451.0	2.305	14.95	461.0	2.114	16.45	471.0	2.063	17.94	481.0	2.052	19.46
421.1	2.020	10.97	431.1	1.273	12.18	441.1	2.168	13.49	451.1	2.254	14.96	461.1	2.077	16.46	471.1	2.100	17.95	481.1	2.033	19.47
421.2	2.017	10.98	431.2	1.424	12.19	441.2	2.237	13.51	451.2	2.174	14.98	461.2	2.117	16.48	471.2	2.098	17.97	481.2	2.036	19.49
421.3	2.022	10.99	431.3	1.574	12.20	441.3	1.969	13.52	451.3	2.132	14.99	461.3	2.157	16.50	471.3	2.018	17.98	481.3	2.047	19.50
421.4	2.027	11.01	431.4	1.732	12.21	441.4	1.701	13.53	451.4	2.102	15.01	461.4	2.197	16.51	471.4	1.988	18.00	481.4	2.113	19.52
421.5	2.005	11.02	431.5	1.919	12.22	441.5	1.840	13.55	451.5	2.124	15.02	461.5	2.175	16.53	471.5	2.061	18.01	481.5	2.176	19.53
421.6	1.951	11.04	431.6	2.106	12.24	441.6	1.981	13.56	451.6	2.163	15.04	461.6	2.101	16.54	471.6	2.131	18.03	481.6	2.220	19.55
421.7	1.897	11.05	431.7	2.234	12.25	441.7	2.078	13.58	451.7	2.169	15.06	461.7	2.056	16.56	471.7	2.194	18.04	481.7	2.256	19.57
421.8	1.899	11.06	431.8	2.143	12.27	441.8	2.176	13.59	451.8	2.165	15.07	461.8	2.034	16.57	471.8	2.233	18.06	481.8	2.225	19.58
421.9	1.975	11.08	431.9	2.052	12.28	441.9	2.138	13.61	451.9	2.195	15.09	461.9	2.078	16.59	471.9	2.220	18.08	481.9	2.193	19.60
422.0	2.051	11.09	432.0	1.938	12.30	442.0	2.099	13.62	452.0	2.237	15.10	462.0	2.179	16.60	472.0	2.207	18.09	482.0	2.160	19.61
422.1	2.050	11.11	432.1	1.735	12.31	442.1	1.979	13.64	452.1	2.159	15.12	462.1	2.189	16.62	472.1	2.189	18.11	482.1	2.119	19.63
422.2	1.946	11.12	432.2	1.533	12.32	442.2	1.858	13.65	452.2	2.044	15.13	462.2	2.122	16.63	472.2	2.172	18.12	482.2	2.005	19.64
422.3	1.842	11.14	432.3	1.384	12.33	442.3	1.994	13.66	452.3	2.036	15.15	462.3	2.120	16.65	472.3	2.176	18.14	482.3	1.912	19.66
422.4	1.670	11.15	432.4	1.445	12.34	442.4	2.135	13.68	452.4	2.064	15.16	462.4	2.175	16.66	472.4	2.225	18.15	482.4	2.045	19.67
422.5	1.405	11.16	432.5	1.506	12.35	442.5	2.102	13.69	452.5	1.974	15.18	462.5	2.200	16.68	472.5	2.224	18.17	482.5	2.167	19.69
422.6	1.141	11.17	432.6	1.584	12.36	442.6	2.064	13.71	452.6	1.845	15.19	462.6	2.200	16.69	472.6	2.107	18.19	482.6	2.162	19.70
422.7	1.117	11.18	432.7	1.737	12.38	442.7	2.066	13.72	452.7	1.812	15.20	462.7	2.169	16.71	472.7	2.027	18.20	482.7	2.146	19.72
422.8	1.430	11.19	432.8	1.889	12.39	442.8	2.068	13.74	452.8	1.811	15.22	462.8	2.110	16.73	472.8	2.032	18.22	482.8	2.082	19.73
422.9	1.743	11.20	432.9	2.015	12.40	442.9	1.987	13.75	452.9	1.821	15.23	462.9	2.127	16.74	472.9	2.012	18.23	482.9	2.024	19.75
423.0	1.911	11.21	433.0	2.025	12.42	443.0	1.902	13.77	453.0	1.835	15.24	463.0	2.214	16.76	473.0	1.933	18.24	483.0	2.035	19.76
423.1	1.869	11.22	433.1	2.036	12.43	443.1	1.960	13.78	453.1	1.936	15.26	463.1	2.192	16.77	473.1	1.913	18.26	483.1	2.044	19.78
423.2	1.827	11.24	433.2	2.044	12.45	443.2	2.023	13.79	453.2	2.068	15.27	463.2	2.069	16.79	473.2	2.037	18.27	483.2	2.024	19.79
423.3	1.758	11.25	433.3	2.043	12.46	443.3	1.874	13.81	453.3	2.002	15.29	463.3	2.048	16.80	473.3	2.132	18.29	483.3	2.011	19.81
423.4	1.652	11.26	433.4	2.043	12.48	443.4	1.715	13.82	453.4	1.863	15.30	463.4	2.124	16.82	473.4	2.151	18.30	483.4	2.106	19.82
423.5	1.545	11.27	433.5	2.007	12.49	443.5	1.859	13.83	453.5	1.966	15.31	463.5	2.151	16.83	473.5	2.147	18.32	483.5	2.195	19.84
423.6	1.525	11.29	433.6	1.805	12.50	443.6	2.018	13.85	453.6	2.158	15.33	463.6	2.131	16.85	473.6	2.032	18.33	483.6	2.199	19.85
423.7	1.639	11.30	433.7	1.603	12.52	443.7	2.057	13.86	453.7	2.177	15.34	463.7	2.120	16.86	473.7	2.103	18.35	483.7	2.197	19.87
423.8	1.752	11.31	433.8	1.438	12.53	443.8	2.090	13.88	453.8	2.130	15.36	463.8	2.117	16.88	473.8	2.146	18.36	483.8	2.093	19.88
423.9	1.834	11.32	433.9	1.458	12.54	443.9	2.073	13.89	453.9	2.085	15.37	463.9	2.133	16.89	473.9	2.116	18.38	483.9	1.995	19.90
424.0	1.866	11.33	434.0	1.477	12.55	444.0	2.054	13.91	454.0	2.042	15.39	464.0	2.169	16.91	474.0	2.388	18.39	484.0	1.992	19.91
424.1	1.898	11.35	434.1	1.511	12.56	444.1	1.937	13.92	454.1	2.094	15.40	464.1	2.157	16.92	474.1	2.064	18.41	484.1	1.991	19.93
424.2	1.949	11.36	434.2	1.621	12.57	444.2	1.815	13.94	454.2	2.185	15.42	464.2	2.094	16.94	474.2	2.059	18.42	484.2	2.030	19.94
424.3	2.032	11.38	434.3	1.730	12.58	444.3	1.977	13.95	454.3	2.176	15.44	464.3	2.079	16.96	474.3	2.105	18.44	484.3	2.068	19.96
424.4	2.114	11.39	434.4	1.829	12.59	444.4	2.159	13.96	454.4	2.127	15.45	464.4	2.115	16.97	474.4	2.126	18.45	484.4	2.083	19.97
424.5	2.107	11.41	434.5	1.876	12.61	444.5	2.111	13.98	454.5	2.100	15.47	464.5	2.086	16.99	474.5	2.074	18.47	484.5	2.098	19.99
424.6	1.951	11.42	434.6	1.922	12.62	444.6	2.047	13.99	454.6	2.081	15.48	464.6	1.895	17.00	474.6	2.058	18.48	484.6	2.087	20.00
424.7	1.796	11.43	434.7	1.948	12.64	444.7	2.068	14.01	454.7	2.024	15.50	464.7	1.911	17.01	474.7	2.147	18.50	484.7	2.076	20.02
424.8	1.686	11.45	434.8	1.856	12.65	444.8	2.096	14.02	454.8	1.951	15.51	464.8	1.954	17.03	474.8	2.206	18.51	484.8	2.058	20.03
424.9	1.655	11.46	434.9	1.764	12.66	444.9	2.124	14.04	454.9	1.988	15.52	464.9	2.027	17.04	474.9	2.175	18.53	484.9	2.042	20.05
425.0	1.624	11.47	435.0	1.694	12.67	445.0	2.159	14.05	455.0	2.075	15.54	465.0	2.070	17.06	475.0	2.149	18.55	485.0	2.076	20.06
425.1	1.610	11.48	435.1	1.759	12.69	445.1	2.196	14.07	455.1	2.099	15.55	465.1	2.080	17.07	475.1	2.140	18.56	485.1	2.109	20.08
425.2	1.628	11.49	435.2	1.825	12.70	445.2	1.988	14.08	455.2	2.095	15.57	465.2	2.062	17.09	475.2	2.124	18.58	485.2	2.086	20.09
425.3	1.645	11.51	435.3	1.887	12.71	445.3	1.758	14.10	455.3	2.040	15.58	465.3	2.013	17.10	475.3	2.089	18.59	485.3	2.060	20.11
425.4	1.718	11.52	435.4	1.929	12.73	445.4	1.765	14.11	455.4	1.961	15.60	465.4	1.999	17.11	475.4	2.057	18.61	485.4	1.914	20.12
425.5	1.892	11.53	435.5	1.970	12.74	445.5	1.796	14.12	455.5	1.985	15.61	465.5	2.026	17.13	475.5	2.036	18.62	485.5	1.770	20.13
425.6	2.066	11.54	435.6	1.998	12.75	445.6	1.816	14.14	455.6	2.056	15.63	465.6	2.086	17.14	475.6	2.029	18.64	485.6	1.802	20.15
425.7	2.079	11.56	435.7	1.929	12.77	445.7	1.835	14.15	455.7	2.183	15.64	465.7	2.185	17.16	475.7	2.069	18.65	485.7	1.832	20.16
425.8	1.793	11.57	435.8	1.861	12.78	445.8	1.866	14.16	455.8	2.181	15.66	465.8	2.231	17.18	475.8	2.121	18.66	485.8	1.685	20.17
425.9	1.506	11.59	435.9	1.810	12.80	445.9	1.898	14.18	455.9	2.141	15.67	465.9	2.214	17.19	475.9	2.213	18.68	485.9	1.537	20.18
426.0	1.402	11.60	436.0	1.884	12.81	446.0	1.981	14.19	456.0	2.121	15.69	466.0	2.170	17.21	476.0	2.268	18.70	486.0	1.282	20.19
426.1	1.650	11.61	436.1	1.959	12.82	446.1	2.068	14.21	456.1	2.149	15.70	466.1	2.092	17.22	476.1	2.199	18.71	486.1	1.028	20.20
426.2	1.897	11.62	436.2	2.030	12.84	446.2	2.156	14.22	456.2	2.200	15.72	466.2	2.072	17.24	476.2	2.131	18.73	486.2	1.353	20.21
426.3	2.055	11.63	436.3	2.067	12.85	446.3	2.105	14.24	456.3	2.155	15.73	466.3	2.121	17.25	476.3	2.077	18.74	486.3	1.679	20.22
426.4	2.035	11.65	436.4	2.105	12.87	446.4	2.036	14.25	456.4	2.061	15.75	466.4	2.094	17.27	476.4	2.075	18.76	486.4	1.728	20.23
426.5	2.014	11.66	436.5	2.135	12.88	446.5	2.019	14.27	456.5	2.069	15.76	466.5	1.970	17.28	476.5	2.063	18.77	486.5	1.777	20.25
426.6	1.974	11.68	436.6	2.100	12.90	446.6	2.009	14.28	456.6	2.128	15.78	466.6	1.867	17.30	476.6	2.008	18.79	486.6	1.821	20.26
426.7	1.893	11.69	436.7	2.065	12.91	446.7	1.957	14.29	456.7	2.169	15.80	466.7	1.789	17.31	476.7	1.982	18.80	486.7	1.865	20.27
426.8	1.812	11.70	436.8	2.029	12.93	446.8	1.921	14.31	456.8	2.201	15.81	466.8	1.829	17.32	476.8	2.066	18.82	486.8	1.965	20.29
426.9	1.718	11.72	436.9	1.988	12.94	446.9	1.957	14.32	456.9	2.169	15.83	466.9	2.021	17.34	476.9	2.128	18.83	486.9	2.066	20.30
427.0	1.597	11.73	437.0	1.947	12.96	447.0	2.003	14.34	457.0	2.103	15.84	467.0	2.120	17.35	477.0	2.108	18.85	487.0	1.825	20.31
427.1	1.475	11.74	437.1	1.901	12.97	447.1	2.036	14.35	457.1	2.112	15.86	467.1	2.092	17.37	477.1	2.086	18.86	487.1	1.585	20.33
427.2	1.419	11.75	437.2	1.806	12.98	447.2	2.067	14.37	457.2	2.163	15.87	467.2	2.084	17.38	477.2	2.058	18.88	487.2	1.768	20.34
427.3	1.507	11.76	437.3	1.711	13.00	447.3	2.125	14.38	457.3	2.196	15.89	467.3	2.105	17.40	477.3	2.062	18.89	487.3	1.950	20.35
427.4	1.595	11.77	437.4	1.631	13.01	447.4	2.187	14.40	457.4	2.220	15.90	467.4	2.126	17.41	477.4	2.195	18.91	487.4	1.929	20.37
427.5	1.695	11.78	437.5	1.705	13.02	447.5	2.208	14.41	457.5	2.232	15.92	467.5	2.149	17.43	477.5	2.293	18.92	487.5	1.908	20.38
427.6	1.823	11.80	437.6	1.926	13.03	447.6	2.222	14.43	457.6	2.238	15.94	467.6	2.131	17.44	477.6	2.242	18.94	487.6	1.955	20.39
427.7	1.951	11.81	437.7	1.922	13.05	447.7	2.205	14.44	457.7	2.200	15.95	467.7	2.053	17.46	477.7	2.197	18.96	487.7	2.002	20.41
427.8	2.015	11.82	437.8	1.919	13.06	447.8	2.183	14.46	457.8	2.137	15.97	467.8	1.987	17.47	477.8	2.175	18.97	487.8	2.068	20.42
427.9	1.931	11.84	437.9	1.898	13.07	447.9	2.034	14.47	457.9	2.072	15.98	467.9	1.936	17.49	477.9	2.164	18.99	487.9	2.134	20.44
428.0	1.847	11.85	438.0	1.679	13.09	448.0	1.863	14.49	458.0	2.005	16.00	468.0	1.912	17.50	478.0	2.198	19.00	488.0	2.053	20.45
428.1	1.794	11.87	438.1	1.459	13.10	448.1	1.913	14.50	458.1	2.045	16.01	468.1	1.929	17.51	478.1	2.208	19.02	488.1	1.971	20.47
428.2	1.818	11.88	438.2	1.268	13.11	448.2	2.001	14.52	458.2	2.149	16.03	468.2	1.976	17.53	478.2	2.102	19.03	488.2	2.022	20.48
428.3	1.841	11.89	438.3	1.460	13.12	448.3	2.092	14.53	458.3	2.139	16.04	468.3	2.070	17.54	478.3	2.029	19.05	488.3	2.074	20.50
428.4	1.854	11.90	438.4	1.653	13.13	448.4	2.184	14.55	458.4	2.059	16.06	468.4	2.124	17.56	478.4	2.109	19.06	488.4	1.941	20.51
428.5	1.841	11.92	438.5	1.832	13.14	448.5	2.238	14.56	458.5	2.057	16.07	468.5	2.116	17.57	478.5	2.164	19.08	488.5	1.807	20.52
428.6	1.828	11.93	438.6	1.804	13.15	448.6	2.285	14.58	458.6	2.105	16.09	468.6	2.116	17.59	478.6	2.099	19.09	488.6	1.879	20.54
428.7	1.761	11.94	438.7	1.777	13.17	448.7	2.142	14.59	458.7	2.162	16.10	468.7	2.128	17.60	478.7	2.045	19.11	488.7	1.951	20.55
428.8	1.665	11.96	438.8	1.752	13.18	448.8	1.962	14.61	458.8	2.224	16.12	468.8	2.125	17.62	478.8	2.047	19.12	488.8	1.932	20.56
428.9	1.568	11.97	438.9	1.778	13.19	448.9	2.016	14.62	458.9	2.223	16.13	468.9	2.097	17.63	478.9	2.057	19.14	488.9	1.914	20.58
429.0	1.520	11.98	439.0	1.805	13.21	449.0	2.115	14.64	459.0	2.182	16.15	469.0	2.086	17.65	479.0	2.108	19.15	489.0	1.719	20.59
429.1	1.602	11.99	439.1	1.830	13.22	449.1	2.139	14.65	459.1	2.138	16.17	469.1	2.102	17.66	479.1	2.153	19.17	489.1	1.525	20.60
429.2	1.683	12.00	439.2	1.814	13.23	449.2	2.147	14.67	459.2	2.091	16.18	469.2	2.091	17.68	479.2	2.169	19.18	489.2	1.831	20.62
429.3	1.729	12.01	439.3	1.798	13.24	449.3	2.069	14.68	459.3	2.083	16.20	469.3	2.033	17.69	479.3	2.189	19.20	489.3	2.138	20.63
429.4	1.676	12.03	439.4	1.788	13.26	449.4	1.974	14.70	459.4	2.099	16.21	469.4	2.050	17.71	479.4	2.232	19.22	489.4	2.150	20.64
429.5	1.624	12.04	439.5	1.907	13.27	449.5	1.991	14.71	459.5	2.074	16.23	469.5	2.189	17.72	479.5	2.265	19.23	489.5	2.162	20.66
429.6	1.536	12.05	439.6	2.026	13.28	449.6	2.032	14.73	459.6	2.019	16.24	469.6	2.219	17.74	479.6	2.233	19.25	489.6	2.167	[illegible]
429.7	1.348	12.06	439.7	2.136	13.30	449.7	2.068	14.74	459.7	2.038	16.25	469.7	2.061	17.75	479.7	2.200	19.26	489.7	2.173	[illegible]
429.8	1.160	12.07	439.8	2.001	13.31	449.8	2.103	14.76	459.8	2.109	16.27	469.8	1.971	17.77	479.8	2.164	19.28	489.8	2.151	[illegible]
429.9	1.032	12.08	439.9	1.866	13.33	449.9	2.071	14.77	459.9	2.067	16.28	469.9	1.999	17.78	479.9	2.131	19.29	489.9	2.128	[illegible]

continued

Table VII. (continued)

λ, nm	H_{λ}, $W/m^2 \cdot nm$	P_{λ}, %	λ, nm	H_{λ}, $W/m^2 \cdot nm$	P_{λ}, %	λ, nm	H_{λ}, $W/m^2 \cdot nm$	P_{λ}, %	λ, nm	H_{λ}, $W/m^2 \cdot nm$	P_{λ}, %	λ, nm	H_{λ}, $W/m^2 \cdot nm$	P_{λ}, %	λ, nm	H_{λ}, $W/m^2 \cdot nm$	P_{λ}, %	λ, nm	H_{λ}, $W/m^2 \cdot nm$	P_{λ}, %
490.0	2.155	20.74	500.0	1.927	22.18	510.0	1.927	23.60	520.0	1.994	24.94	530.0	1.993	26.31	540.0	1.852	27.69	550.0	1.849	29.05
490.1	2.182	20.75	500.1	1.910	22.20	510.1	2.042	23.61	520.1	2.012	24.95	530.1	2.013	26.32	540.1	1.851	27.71	550.1	1.834	29.06
490.2	2.090	20.77	500.2	1.893	22.21	510.2	2.031	23.63	520.2	2.030	24.97	530.2	2.034	26.34	540.2	1.850	27.72	550.2	1.819	29.07
490.3	1.998	20.78	500.3	1.893	22.23	510.3	2.021	23.64	520.3	1.976	24.98	530.3	2.051	26.35	540.3	1.785	27.73	550.3	1.829	29.09
490.4	2.051	20.80	500.4	1.894	22.24	510.4	2.040	23.65	520.4	1.922	25.00	530.4	2.068	26.36	540.4	1.719	27.75	550.4	1.840	29.10
490.5	2.105	20.81	500.5	1.895	22.25	510.5	2.060	23.67	520.5	1.848	25.01	530.5	2.094	26.38	540.5	1.731	27.76	550.5	1.849	29.11
490.6	2.150	20.83	500.6	1.895	22.27	510.6	2.012	23.68	520.6	1.775	25.02	530.6	2.120	26.39	540.6	1.743	27.77	550.6	1.858	29.13
490.7	2.194	20.84	500.7	1.896	22.28	510.7	1.964	23.70	520.7	1.860	25.04	530.7	2.097	26.41	540.7	1.819	27.78	550.7	1.889	29.14
490.8	2.108	20.86	500.8	1.992	22.29	510.8	1.915	23.71	520.8	1.946	25.05	530.8	2.075	26.42	540.8	1.895	27.80	550.8	1.921	29.15
490.9	2.023	20.87	500.9	2.088	22.31	510.9	1.867	23.73	520.9	1.924	25.06	530.9	2.076	26.44	540.9	1.912	27.81	550.9	1.905	29.17
491.0	1.931	20.89	501.0	2.037	22.32	511.0	1.973	23.74	521.0	1.902	25.08	531.0	2.076	26.45	541.0	1.928	27.82	551.0	1.888	29.18
491.1	1.840	20.90	501.1	1.985	22.34	511.1	2.078	23.75	521.1	1.978	25.09	531.1	2.052	26.47	541.1	1.907	27.84	551.1	1.888	29.19
491.2	1.983	20.92	501.2	1.933	22.35	511.2	2.069	23.77	521.2	2.054	25.11	531.2	2.027	26.48	541.2	1.886	27.85	551.2	1.888	29.21
491.3	2.126	20.93	501.3	1.882	22.37	511.3	2.059	23.78	521.3	2.044	25.12	531.3	1.993	26.50	541.3	1.832	27.87	551.3	1.903	29.22
491.4	2.127	20.95	501.4	1.830	22.38	511.4	2.086	23.80	521.4	2.021	25.14	531.4	1.959	26.51	541.4	1.778	27.88	551.4	1.919	29.24
491.5	2.127	20.96	501.5	1.857	22.39	511.5	2.112	23.81	521.5	1.912	25.15	531.5	1.927	26.53	541.5	1.815	27.89	551.5	1.917	29.25
491.6	2.128	20.98	501.6	1.885	22.41	511.6	2.086	23.83	521.6	1.804	25.16	531.6	1.896	26.54	541.6	1.851	27.90	551.6	1.916	29.26
491.7	1.955	20.99	501.7	1.894	22.42	511.7	2.059	23.84	521.7	1.812	25.18	531.7	1.947	26.55	541.7	1.830	27.92	551.7	1.881	29.28
491.8	1.782	21.00	501.8	1.904	22.43	511.8	2.033	23.86	521.8	1.821	25.19	531.8	1.999	26.57	541.8	1.809	27.93	551.8	1.846	29.29
491.9	1.675	21.02	501.9	1.913	22.45	511.9	2.006	23.87	521.9	1.916	25.20	531.9	2.020	26.58	541.9	1.840	27.94	551.9	1.863	29.30
492.0	1.567	21.03	502.0	1.922	22.46	512.0	1.980	23.89	522.0	2.011	25.22	532.0	2.042	26.60	542.0	1.871	27.96	552.0	1.880	29.32
492.1	1.747	21.04	502.1	1.931	22.47	512.1	1.954	23.90	522.1	1.978	25.23	532.1	1.952	26.61	542.1	1.896	27.97	552.1	1.878	29.33
492.2	1.926	21.05	502.2	1.940	22.49	512.2	1.927	23.92	522.2	1.945	25.24	532.2	1.863	26.63	542.2	1.920	27.98	552.2	1.877	29.34
492.3	1.931	21.07	502.3	1.979	22.50	512.3	1.901	23.93	522.3	1.962	25.26	532.3	1.798	26.64	542.3	1.930	28.00	552.3	1.856	29.36
492.4	1.935	21.08	502.4	2.018	22.52	512.4	1.874	23.94	522.4	1.979	25.27	532.4	1.742	26.65	542.4	1.939	28.01	552.4	1.836	29.37
492.5	2.023	21.10	502.5	1.967	22.53	512.5	1.848	23.96	522.5	1.874	25.29	532.5	1.754	26.66	542.5	1.966	28.03	552.5	1.768	29.38
492.6	2.110	21.11	502.6	1.916	22.54	512.6	1.866	23.97	522.6	1.769	25.30	532.6	1.767	26.68	542.6	1.994	28.04	552.6	1.700	29.40
492.7	2.064	21.12	502.7	1.955	22.56	512.7	1.883	23.98	522.7	1.759	25.31	532.7	1.773	26.69	542.7	1.919	28.05	552.7	1.704	29.41
492.8	2.018	21.14	502.8	1.995	22.57	512.8	1.901	24.00	522.8	1.748	25.32	532.8	1.779	26.70	542.8	1.845	28.07	552.8	1.708	29.42
492.9	2.035	21.15	502.9	2.012	22.59	512.9	1.919	24.01	522.9	1.856	25.34	532.9	1.918	26.72	542.9	1.850	28.08	552.9	1.758	29.43
493.0	2.051	21.17	503.0	2.030	22.60	513.0	1.953	24.02	523.0	1.963	25.35	533.0	2.056	26.73	543.0	1.854	28.09	553.0	1.808	29.45
493.1	2.112	21.18	503.1	2.048	22.62	513.1	1.987	24.04	523.1	1.914	25.37	533.1	2.034	26.74	543.1	1.856	28.11	553.1	1.834	29.46
493.2	2.173	21.20	503.2	2.075	22.63	513.2	1.946	24.05	523.2	1.865	25.38	533.2	2.012	26.76	543.2	1.858	28.12	553.2	1.860	29.47
493.3	2.077	21.21	503.3	2.103	22.65	513.3	1.905	24.07	523.3	1.826	25.39	533.3	2.010	26.77	543.3	1.819	28.13	553.3	1.912	29.49
493.4	1.981	21.23	503.4	1.983	22.66	513.4	1.959	24.08	523.4	1.786	25.41	533.4	2.008	26.79	543.4	1.781	28.15	553.4	1.963	29.50
493.5	2.036	21.24	503.5	1.864	22.67	513.5	2.013	24.09	523.5	1.815	25.42	533.5	1.970	26.80	543.5	1.827	28.16	553.5	1.931	29.51
493.6	2.090	21.26	503.6	1.906	22.69	513.6	1.953	24.11	523.6	1.843	25.43	533.6	1.933	26.82	543.6	1.873	28.17	553.6	1.899	29.53
493.7	1.946	21.27	503.7	1.948	22.70	513.7	1.892	24.12	523.7	1.966	25.45	533.7	1.882	26.83	543.7	1.937	28.19	553.7	1.906	29.54
493.8	1.801	21.29	503.8	1.815	22.71	513.8	1.802	24.14	523.8	2.088	25.46	533.8	1.831	26.84	543.8	2.002	28.20	553.8	1.914	29.55
493.9	1.917	21.30	503.9	1.682	22.73	513.9	1.773	24.15	523.9	2.018	25.47	533.9	1.802	26.86	543.9	2.002	28.22	553.9	1.904	29.57
494.0	2.033	21.31	504.0	1.668	22.74	514.0	1.772	24.16	524.0	1.947	25.49	534.0	1.774	26.87	544.0	2.002	28.23	554.0	1.895	29.58
494.1	2.098	21.33	504.1	1.654	22.75	514.1	1.771	24.17	524.1	1.943	25.50	534.1	1.825	26.88	544.1	1.994	28.24	554.1	1.898	29.60
494.2	2.164	21.34	504.2	1.887	22.76	514.2	1.836	24.19	524.2	1.938	25.52	534.2	1.876	26.89	544.2	1.985	28.26	554.2	1.902	29.61
494.3	2.161	21.36	504.3	2.119	22.78	514.3	1.902	24.20	524.3	1.945	25.53	534.3	1.901	26.91	544.3	1.929	28.27	554.3	1.891	29.62
494.4	2.159	21.37	504.4	2.096	22.79	514.4	1.936	24.21	524.4	1.952	25.54	534.4	1.927	26.92	544.4	1.873	28.29	554.4	1.880	29.64
494.5	2.085	21.39	504.5	2.073	22.81	514.5	1.971	24.23	524.5	2.008	25.56	534.5	1.946	26.94	544.5	1.835	28.30	554.5	1.868	29.65
494.6	2.010	21.40	504.6	2.050	22.82	514.6	1.914	24.24	524.6	2.064	25.57	534.6	1.965	26.95	544.6	1.797	28.31	554.6	1.856	29.66
494.7	2.118	21.42	504.7	2.027	22.84	514.7	1.857	24.26	524.7	2.002	25.59	534.7	1.978	26.96	544.7	1.873	28.33	554.7	1.875	29.68
494.8	2.227	21.44	504.8	2.005	22.85	514.8	1.891	24.27	524.8	1.941	25.60	534.8	1.990	26.98	544.8	1.950	28.34	554.8	1.895	29.69
494.9	2.144	21.45	504.9	1.982	22.87	514.9	1.926	24.28	524.9	1.925	25.62	534.9	2.001	26.99	544.9	1.953	28.35	554.9	1.893	29.70
495.0	2.061	21.47	505.0	1.959	22.88	515.0	1.931	24.30	525.0	1.910	25.63	535.0	2.012	27.01	545.0	1.956	28.37	555.0	1.892	29.72
495.1	2.037	21.48	505.1	1.936	22.90	515.1	1.936	24.31	525.1	1.923	25.64	535.1	2.024	27.02	545.1	1.894	28.38	555.1	1.876	29.73
495.2	2.013	21.50	505.2	1.975	22.91	515.2	1.892	24.32	525.2	1.937	25.66	535.2	2.036	27.04	545.2	1.833	28.39	555.2	1.860	29.74
495.3	2.002	21.51	505.3	2.015	22.92	515.3	1.847	24.34	525.3	1.947	25.67	535.3	2.033	27.05	545.3	1.810	28.41	555.3	1.886	29.76
495.4	1.990	21.52	505.4	2.039	22.94	515.4	1.878	24.35	525.4	1.958	25.69	535.4	2.029	27.07	545.4	1.787	28.42	555.4	1.912	29.77
495.5	1.895	21.54	505.5	2.063	22.95	515.5	1.908	24.36	525.5	1.962	25.70	535.5	2.040	27.08	545.5	1.830	28.43	555.5	1.942	29.78
495.6	1.800	21.55	505.6	2.087	22.97	515.6	2.007	24.38	525.6	1.966	25.71	535.6	2.050	27.09	545.6	1.872	28.45	555.6	1.973	29.80
495.7	1.837	21.56	505.7	2.111	22.98	515.7	2.107	24.39	525.7	2.041	25.73	535.7	2.049	27.11	545.7	1.885	28.46	555.7	1.962	29.81
495.8	1.874	21.58	505.8	2.141	23.00	515.8	2.034	24.41	525.8	2.116	25.74	535.8	2.048	27.12	545.8	1.899	28.47	555.8	1.951	29.83
495.9	1.934	21.59	505.9	2.171	23.01	515.9	1.962	24.42	525.9	2.055	25.76	535.9	2.006	27.14	545.9	1.922	28.49	555.9	1.911	29.84
496.0	1.994	21.61	506.0	2.128	23.03	516.0	1.961	24.44	526.0	1.995	25.77	536.0	1.964	27.15	546.0	1.946	28.50	556.0	1.871	29.85
496.1	2.054	21.62	506.1	2.086	23.04	516.1	1.960	24.45	526.1	1.903	25.79	536.1	1.929	27.17	546.1	1.937	28.52	556.1	1.863	29.87
496.2	2.114	21.63	506.2	2.043	23.06	516.2	1.918	24.46	526.2	1.812	25.80	536.2	1.893	27.18	546.2	1.927	28.53	556.2	1.855	29.88
496.3	2.085	21.65	506.3	2.000	23.07	516.3	1.876	24.48	526.3	1.720	25.81	536.3	1.891	27.19	546.3	1.967	28.54	556.3	1.852	29.89
496.4	2.056	21.66	506.4	1.936	23.09	516.4	1.747	24.49	526.4	1.672	25.82	536.4	1.859	27.21	546.4	2.007	28.56	556.4	1.849	29.91
496.5	2.055	21.68	506.5	1.873	23.10	516.5	1.618	24.50	526.5	1.629	25.84	536.5	1.850	27.22	546.5	1.991	28.57	556.5	1.864	29.92
496.6	2.054	21.69	506.6	1.889	23.11	516.6	1.475	24.51	526.6	1.586	25.85	536.6	1.841	27.23	546.6	1.975	28.59	556.6	1.878	29.93
496.7	2.053	21.71	506.7	1.906	23.13	516.7	1.331	24.52	526.7	1.689	25.86	536.7	1.826	27.25	546.7	1.971	28.60	556.7	1.879	29.95
496.8	2.052	21.72	506.8	1.969	23.14	516.8	1.475	24.53	526.8	1.792	25.87	536.8	1.810	27.26	546.8	1.966	28.61	556.8	1.880	29.96
496.9	2.039	21.74	506.9	2.033	23.16	516.9	1.638	24.55	526.9	1.642	25.88	536.9	1.749	27.27	546.9	1.960	28.63	556.9	1.843	29.97
497.0	2.027	21.75	507.0	1.980	23.17	517.0	1.625	24.56	527.0	1.491	25.90	537.0	1.689	27.29	547.0	1.953	28.64	557.0	1.805	29.99
497.1	2.064	21.77	507.1	1.927	23.19	517.1	1.576	24.57	527.1	1.701	25.91	537.1	1.760	27.30	547.1	1.912	28.66	557.1	1.774	30.00
497.2	2.102	21.78	507.2	1.989	23.20	517.2	1.526	24.58	527.2	1.910	25.92	537.2	1.832	27.31	547.2	1.872	28.67	557.2	1.743	30.01
497.3	2.141	21.80	507.3	2.051	23.21	517.3	1.476	24.59	527.3	1.827	25.93	537.3	1.879	27.32	547.3	1.872	28.68	557.3	1.792	30.03
497.4	2.180	21.81	507.4	2.078	23.23	517.4	1.596	24.60	527.4	1.827	25.95	537.4	1.927	27.34	547.4	1.872	28.70	557.4	1.841	30.04
497.5	2.139	21.83	507.5	2.106	23.24	517.5	1.833	24.61	527.5	1.796	25.96	537.5	1.951	27.35	547.5	1.853	28.71	557.5	1.839	30.05
497.6	2.098	21.84	507.6	2.021	23.26	517.6	1.985	24.63	527.6	1.765	25.97	537.6	1.975	27.37	547.6	1.834	28.72	557.6	1.836	30.07
497.7	2.084	21.86	507.7	1.937	23.27	517.7	2.042	24.64	527.7	1.895	25.99	537.7	1.925	27.38	547.7	1.853	28.74	557.7	1.839	30.08
497.8	2.070	21.87	507.8	1.824	23.29	517.8	2.059	24.66	527.8	2.025	26.00	537.8	1.875	27.39	547.8	1.871	28.75	557.8	1.843	30.09
497.9	2.002	21.89	507.9	1.712	23.30	517.9	2.004	24.67	527.9	1.975	26.01	537.9	1.863	27.41	547.9	1.835	28.76	557.9	1.839	30.11
498.0	1.935	21.90	508.0	1.814	23.31	518.0	1.925	24.69	528.0	1.925	26.03	538.0	1.851	27.42	548.0	1.799	28.78	558.0	1.835	30.12
498.1	1.801	21.92	508.1	1.915	23.32	518.1	1.767	24.70	528.1	1.880	26.04	538.1	1.850	27.43	548.1	1.853	28.79	558.1	1.868	30.13
498.2	1.668	21.93	508.2	1.867	23.34	518.2	1.602	24.71	528.2	1.834	26.06	538.2	1.849	27.45	548.2	1.908	28.80	558.2	1.901	30.15
498.3	1.755	21.94	508.3	1.818	23.35	518.3	1.391	24.72	528.3	1.828	26.07	538.3	1.913	27.46	548.3	1.906	28.82	558.3	1.862	30.16
498.4	1.843	21.95	508.4	1.922	23.36	518.4	1.180	24.73	528.4	1.823	26.08	538.4	1.976	27.47	548.4	1.905	28.83	558.4	1.823	30.17
498.5	1.931	21.97	508.5	2.026	23.38	518.5	1.477	24.74	528.5	1.926	26.09	538.5	2.037	27.49	548.5	1.861	28.84	558.5	1.758	30.18
498.6	1.996	21.98	508.6	2.046	23.39	518.6	1.773	24.75	528.6	2.029	26.11	538.6	2.098	27.50	548.6	1.816	28.86	558.6	1.693	30.20
498.7	2.061	22.00	508.7	2.065	23.41	518.7	1.866	24.77	528.7	2.029	26.12	538.7	2.051	27.52	548.7	1.822	28.87	558.7	1.715	30.21
498.8	2.043	22.01	508.8	2.059	23.42	518.8	1.959	24.78	528.8	2.029	26.14	538.8	2.003	27.53	548.8	1.827	28.88	558.8	1.738	30.22
498.9	2.024	22.03	508.9	2.053	23.44	518.9	1.978	24.79	528.9	1.998	26.15	538.9	1.934	27.55	548.9	1.864	28.90	558.9	1.785	30.23
499.0	2.006	22.04	509.0	2.062	23.45	519.0	1.997	24.81	529.0	1.967	26.17	539.0	1.864	27.56	549.0	1.901	28.91	559.0	1.832	30.25
499.1	2.014	22.05	509.1	2.072	23.47	519.1	1.830	24.82	529.1	2.003	26.18	539.1	1.847	27.57	549.1	1.893	28.92	559.1	1.844	30.26
499.2	2.023	22.07	509.2	2.117	23.48	519.2	1.664	24.83	529.2	2.039	26.20	539.2	1.830	27.59	549.2	1.885	28.94	559.2	1.856	30.27
499.3	2.032	22.08	509.3	2.161	23.50	519.3	1.727	24.85	529.3	1.983	26.21	539.3	1.833	27.60	549.3	1.885	28.95	559.3	1.843	30.29
499.4	2.030	22.10	509.4	2.103	23.51	519.4	1.791	24.86	529.4	1.926	26.22	539.4	1.835	27.61	549.4	1.884	28.96	559.4	1.831	30.30
499.5	2.028	22.11	509.5	2.046	23.53	519.5	1.801	24.87	529.5	1.938	26.24	539.5	1.846	27.63	549.5	1.890	28.98	559.5	1.839	30.31
499.6	2.027	22.13	509.6	1.968	23.54	519.6	1.810	24.88	529.6	1.950	26.25	539.6	1.857	27.64	549.6	1.895	28.99	559.6	1.847	30.33
499.7	1.999	22.14	509.7	1.891	23.56	519.7	1.857	24.90	529.7	1.880	26.27	539.7	1.864	27.65	549.7	1.917	29.01	559.7	1.822	30.34
499.8	1.972	22.16	509.8	1.852	23.57	519.8	1.904	24.91	529.8	1.811	26.28	539.8	1.870	27.67	549.8	1.940	29.02	559.8	1.797	30.35
499.9	1.945	22.17	509.9	1.813	23.58	519.9	1.949	24.93	529.9	1.902	26.29	539.9	1.861	27.68	549.9	1.945	29.03	559.9	1.755	30.37

continued

Table VII. (continued)

λ, nm	H_λ, $W/m^2\cdot nm$	P_λ, %	λ, nm	H_λ, $W/m^2\cdot nm$	P_λ, %	λ, nm	H_λ, $W/m^2\cdot nm$	P_λ, %	λ, nm	H_λ, $W/m^2\cdot nm$	P_λ, %	λ, nm	H_λ, $W/m^2\cdot nm$	P_λ, %	λ, nm	H_λ, $W/m^2\cdot nm$	P_λ, %	λ, nm	H_λ, $W/m^2\cdot nm$	P_λ, %
560.0	1.712	30.38	570.0	1.822	31.70	580.0	1.886	33.05	590.0	1.900	34.38	600.0	1.816	35.69	610.0	1.915	36.98	620.0	1.794	38.23
560.1	1.717	30.39	570.1	1.840	31.71	580.1	1.844	33.06	590.1	1.961	34.39	600.1	1.814	35.71	610.1	1.830	37.00	620.2	1.734	38.26
560.2	1.723	30.40	570.2	1.858	31.73	580.2	1.803	33.08	590.2	2.023	34.40	600.2	1.813	35.72	610.2	1.745	37.01	620.4	1.707	38.28
560.3	1.796	30.42	570.3	1.815	31.74	580.3	1.803	33.09	590.3	1.930	34.42	600.3	1.836	35.73	610.3	1.735	37.02	620.6	1.736	38.31
560.4	1.870	30.43	570.4	1.772	31.75	580.4	1.803	33.10	590.4	1.837	34.43	600.4	1.860	35.75	610.4	1.758	37.03	620.8	1.783	38.33
560.5	1.876	30.44	570.5	1.758	31.77	580.5	1.819	33.12	590.5	1.816	34.44	600.5	1.846	35.76	610.5	1.771	37.05	621.0	1.792	38.36
560.6	1.883	30.46	570.6	1.745	31.78	580.6	1.836	33.13	590.6	1.796	34.46	600.6	1.832	35.77	610.6	1.784	37.06	621.2	1.802	38.39
560.7	1.881	30.47	570.7	1.713	31.79	580.7	1.846	33.14	590.7	1.805	34.47	600.7	1.815	35.79	610.7	1.797	37.07	621.4	1.852	38.41
560.8	1.880	30.48	570.8	1.680	31.80	580.8	1.855	33.16	590.8	1.815	34.48	600.8	1.799	35.80	610.8	1.811	37.09	621.6	1.751	38.44
560.9	1.850	30.50	570.9	1.678	31.82	580.9	1.887	33.17	590.9	1.831	34.50	600.9	1.846	35.81	610.9	1.842	37.10	621.8	1.699	38.46
561.0	1.820	30.51	571.0	1.675	31.83	581.0	1.919	33.18	591.0	1.846	34.51	601.0	1.893	35.83	611.0	1.873	37.11	622.0	1.687	38.49
561.1	1.808	30.52	571.1	1.729	31.84	581.1	1.943	33.20	591.1	1.860	34.52	601.1	1.833	35.84	611.1	1.811	37.13	622.2	1.714	38.51
561.2	1.795	30.54	571.2	1.782	31.85	581.2	1.967	33.21	591.2	1.874	34.54	601.2	1.774	35.85	611.2	1.750	37.14	622.4	1.772	38.54
561.3	1.779	30.55	571.3	1.840	31.87	581.3	1.928	33.23	591.3	1.848	34.55	601.3	1.738	35.86	611.3	1.731	37.15	622.6	1.741	38.56
561.4	1.762	30.56	571.4	1.897	31.88	581.4	1.889	33.24	591.4	1.822	34.56	601.4	1.702	35.88	611.4	1.726	37.16	622.8	1.695	38.59
561.5	1.734	30.57	571.5	1.889	31.89	581.5	1.839	33.25	591.5	1.839	34.58	601.5	1.691	35.89	611.5	1.724	37.18	623.0	1.671	38.61
561.6	1.705	30.59	571.6	1.881	31.91	581.6	1.788	33.27	591.6	1.855	34.59	601.6	1.679	35.90	611.6	1.722	37.19	623.2	1.697	38.63
561.7	1.768	30.60	571.7	1.899	31.92	581.7	1.802	33.28	591.7	1.857	34.60	601.7	1.711	35.91	611.7	1.722	37.20	623.4	1.713	38.66
561.8	1.830	30.61	571.8	1.917	31.93	581.8	1.816	33.29	591.8	1.859	34.62	601.8	1.743	35.93	611.8	1.723	37.21	623.6	1.679	38.68
561.9	1.877	30.62	571.9	1.939	31.95	581.9	1.850	33.30	591.9	1.850	34.63	601.9	1.744	35.94	611.9	1.720	37.22	623.8	1.692	38.71
562.0	1.925	30.64	572.0	1.961	31.96	582.0	1.883	33.32	592.0	1.842	34.64	602.0	1.746	35.95	612.0	1.716	37.24	624.0	1.690	38.73
562.1	1.896	30.65	572.1	1.981	31.98	582.1	1.880	33.33	592.1	1.841	34.66	602.1	1.725	35.96	612.1	1.722	37.25	624.2	1.627	38.76
562.2	1.868	30.67	572.2	2.000	31.99	582.2	1.877	33.35	592.2	1.840	34.67	602.2	1.704	35.98	612.2	1.729	37.26	624.4	1.590	38.78
562.3	1.846	30.68	572.3	2.021	32.00	582.3	1.851	33.36	592.3	1.869	34.68	602.3	1.696	35.99	612.3	1.738	37.27	624.6	1.594	38.80
562.4	1.824	30.69	572.4	2.042	32.02	582.4	1.824	33.37	592.4	1.899	34.70	602.4	1.688	36.00	612.4	1.778	37.29	624.8	1.689	38.83
562.5	1.859	30.71	572.5	2.009	32.03	582.5	1.831	33.38	592.5	1.856	34.71	602.5	1.758	36.01	612.5	1.761	37.30	625.0	1.691	38.85
562.6	1.894	30.72	572.6	1.977	32.05	582.6	1.838	33.40	592.6	1.813	34.72	602.6	1.829	36.02	612.6	1.745	37.31	625.2	1.675	38.87
562.7	1.886	30.73	572.7	1.943	32.06	582.7	1.849	33.41	592.7	1.836	34.74	602.7	1.823	36.04	612.7	1.749	37.32	625.4	1.674	38.90
562.8	1.878	30.75	572.8	1.909	32.08	582.8	1.860	33.42	592.8	1.860	34.75	602.8	1.818	36.05	612.8	1.752	37.34	625.6	1.675	38.92
562.9	1.891	30.76	572.9	1.886	32.09	582.9	1.910	33.44	592.9	1.813	34.76	602.9	1.802	36.06	612.9	1.729	37.35	625.8	1.723	38.95
563.0	1.905	30.77	573.0	1.863	32.10	583.0	1.960	33.45	593.0	1.766	34.78	603.0	1.787	36.08	613.0	1.706	37.36	626.0	1.776	38.97
563.1	1.916	30.79	573.1	1.877	32.12	583.1	1.902	33.47	593.1	1.781	34.79	603.1	1.787	36.09	613.1	1.690	37.37	626.2	1.792	39.00
563.2	1.926	30.80	573.2	1.891	32.13	583.2	1.844	33.48	593.2	1.797	34.80	603.2	1.787	36.10	613.2	1.674	37.39	626.4	1.793	39.02
563.3	1.928	30.81	573.3	1.868	32.14	583.3	1.835	33.49	593.3	1.790	34.81	603.3	1.786	36.12	613.3	1.710	37.40	626.6	1.780	39.05
563.4	1.929	30.83	573.4	1.845	32.16	583.4	1.827	33.51	593.4	1.783	34.83	603.4	1.784	36.13	613.4	1.745	37.41	626.8	1.731	39.07
563.5	1.899	30.84	573.5	1.833	32.17	583.5	1.862	33.52	593.5	1.826	34.84	603.5	1.806	36.14	613.5	1.679	37.42	627.0	1.754	39.10
563.6	1.869	30.86	573.6	1.821	32.18	583.6	1.896	33.53	593.6	1.870	34.85	603.6	1.829	36.15	613.6	1.612	37.44	627.2	1.766	39.12
563.7	1.847	30.87	573.7	1.879	32.20	583.7	1.907	33.55	593.7	1.874	34.87	603.7	1.829	36.17	613.7	1.659	37.45	627.4	1.715	39.15
563.8	1.825	30.88	573.8	1.937	32.21	583.8	1.919	33.56	593.8	1.879	34.88	603.8	1.829	36.18	613.8	1.706	37.46	627.6	1.695	39.17
563.9	1.837	30.89	573.9	1.941	32.22	583.9	1.934	33.57	593.9	1.877	34.89	603.9	1.787	36.19	613.9	1.722	37.47	627.8	1.669	39.20
564.0	1.849	30.91	574.0	1.945	32.24	584.0	1.949	33.59	594.0	1.876	34.91	604.0	1.745	36.21	614.0	1.738	37.48	628.0	1.670	39.22
564.1	1.880	30.92	574.1	1.915	32.25	584.1	1.974	33.60	594.1	1.862	34.92	604.1	1.727	36.22	614.1	1.731	37.50	628.2	1.654	39.25
564.2	1.912	30.94	574.2	1.886	32.27	584.2	1.999	33.62	594.2	1.848	34.93	604.2	1.709	36.23	614.2	1.723	37.51	628.4	1.663	39.27
564.3	1.867	30.95	574.3	1.878	32.28	584.3	1.970	33.63	594.3	1.879	34.95	604.3	1.706	36.24	614.3	1.757	37.52	628.6	1.705	39.29
564.4	1.822	30.96	574.4	1.870	32.29	584.4	1.941	33.64	594.4	1.910	34.96	604.4	1.704	36.26	614.4	1.792	37.53	628.8	1.755	39.32
564.5	1.834	30.98	574.5	1.902	32.31	584.5	1.893	33.66	594.5	1.894	34.97	604.5	1.712	36.27	614.5	1.763	37.55	629.0	1.743	39.34
564.6	1.846	30.99	574.6	1.933	32.32	584.6	1.846	33.67	594.6	1.877	34.99	604.6	1.720	36.28	614.6	1.734	37.56	629.2	1.711	39.37
564.7	1.840	31.00	574.7	1.893	32.33	584.7	1.850	33.68	594.7	1.852	35.00	604.7	1.738	36.29	614.7	1.738	37.57	629.4	1.731	39.39
564.8	1.835	31.01	574.8	1.852	32.35	584.8	1.854	33.70	594.8	1.827	35.01	604.8	1.756	36.30	614.8	1.741	37.58	629.6	1.694	39.42
564.9	1.851	31.03	574.9	1.833	32.36	584.9	1.836	33.71	594.9	1.841	35.03	604.9	1.785	36.32	614.9	1.764	37.60	629.8	1.693	39.44
565.0	1.867	31.04	575.0	1.814	32.37	585.0	1.818	33.72	595.0	1.855	35.04	605.0	1.814	36.33	615.0	1.788	37.61	630.0	1.651	39.47
565.1	1.885	31.05	575.1	1.814	32.39	585.1	1.832	33.74	595.1	1.840	35.05	605.1	1.817	36.34	615.1	1.782	37.62	630.2	1.649	39.49
565.2	1.903	31.07	575.2	1.815	32.40	585.2	1.846	33.75	595.2	1.824	35.07	605.2	1.820	36.36	615.2	1.776	37.64	630.4	1.663	39.51
565.3	1.865	31.08	575.3	1.853	32.41	585.3	1.857	33.76	595.3	1.816	35.08	605.3	1.807	36.37	615.3	1.727	37.65	630.6	1.688	39.54
565.4	1.827	31.10	575.4	1.890	32.43	585.4	1.868	33.78	595.4	1.807	35.09	605.4	1.795	36.38	615.4	1.678	37.66	630.8	1.699	39.56
565.5	1.815	31.11	575.5	1.929	32.44	585.5	1.828	33.79	595.5	1.772	35.11	605.5	1.795	36.40	615.5	1.686	37.67	631.0	1.649	39.59
565.6	1.803	31.12	575.6	1.968	32.45	585.6	1.787	33.80	595.6	1.737	35.12	605.6	1.795	36.41	615.6	1.695	37.68	631.2	1.621	39.61
565.7	1.778	31.13	575.7	1.969	32.47	585.7	1.814	33.82	595.7	1.728	35.13	605.7	1.860	36.42	615.7	1.733	37.70	631.4	1.620	39.63
565.8	1.754	31.15	575.8	1.969	32.48	585.8	1.840	33.83	595.8	1.720	35.14	605.8	1.925	36.44	615.8	1.771	37.71	631.6	1.678	39.66
565.9	1.797	31.16	575.9	1.951	32.50	585.9	1.898	33.84	595.9	1.803	35.16	605.9	1.900	36.45	615.9	1.702	37.72	631.8	1.711	39.68
566.0	1.841	31.17	576.0	1.932	32.51	586.0	1.957	33.86	596.0	1.886	35.17	606.0	1.875	36.46	616.0	1.634	37.73	632.0	1.798	39.71
566.1	1.814	31.19	576.1	1.883	32.52	586.1	1.944	33.87	596.1	1.911	35.18	606.1	1.887	36.48	616.1	1.618	37.75	632.2	1.771	39.73
566.2	1.787	31.20	576.2	1.834	32.54	586.2	1.932	33.88	596.2	1.936	35.20	606.2	1.900	36.49	616.2	1.603	37.76	632.4	1.756	39.76
566.3	1.787	31.21	576.3	1.824	32.55	586.3	1.879	33.90	596.3	1.883	35.21	606.3	1.850	36.50	616.3	1.627	37.77	632.6	1.750	39.78
566.4	1.825	31.22	576.4	1.855	32.56	586.4	1.826	33.91	596.4	1.852	35.22	606.4	1.808	36.52	616.4	1.651	37.78	632.8	1.746	39.81
566.5	1.820	31.24	576.5	1.906	32.58	586.5	1.814	33.92	596.5	1.859	35.24	606.5	1.819	36.53	616.5	1.651	37.79	633.0	1.716	39.83
566.6	1.814	31.25	576.6	1.958	32.59	586.6	1.801	33.94	596.6	1.865	35.25	606.6	1.831	36.54	616.6	1.651	37.80	633.2	1.649	39.86
566.7	1.852	31.26	576.7	1.968	32.60	586.7	1.848	33.95	596.7	1.851	35.26	606.7	1.832	36.56	616.7	1.665	37.82	633.4	1.617	39.88
566.8	1.890	31.28	576.8	1.978	32.62	586.8	1.895	33.96	596.8	1.837	35.28	606.8	1.833	36.57	616.8	1.679	37.83	633.6	1.647	39.90
566.9	1.903	31.29	576.9	1.926	32.63	586.9	1.914	33.98	596.9	1.837	35.29	606.9	1.814	36.58	616.9	1.724	37.84	633.8	1.694	39.93
567.0	1.915	31.30	577.0	1.875	32.65	587.0	1.932	33.99	597.0	1.837	35.30	607.0	1.794	36.59	617.0	1.768	37.85	634.0	1.682	39.95
567.1	1.878	31.32	577.1	1.841	32.66	587.1	1.911	34.01	597.1	1.870	35.32	607.1	1.835	36.61	617.1	1.785	37.87	634.2	1.674	39.98
567.2	1.842	31.33	577.2	1.807	32.67	587.2	1.890	34.02	597.2	1.903	35.33	607.2	1.875	36.62	617.2	1.801	37.88	634.4	1.683	40.00
567.3	1.793	31.34	577.3	1.821	32.69	587.3	1.874	34.03	597.3	1.857	35.34	607.3	1.876	36.63	617.3	1.764	37.89	634.6	1.698	40.02
567.4	1.812	31.36	577.4	1.824	32.70	587.4	1.859	34.05	597.4	1.811	35.36	607.4	1.877	36.65	617.4	1.726	37.90	634.8	1.714	40.05
567.5	1.843	31.37	577.5	1.861	32.71	587.5	1.945	34.06	597.5	1.776	35.37	607.5	1.873	36.66	617.5	1.703	37.92	635.0	1.692	40.07
567.6	1.875	31.38	577.6	1.897	32.73	587.6	1.942	34.07	597.6	1.741	35.38	607.6	1.869	36.67	617.6	1.679	37.93	635.2	1.627	40.10
567.7	1.868	31.40	577.7	1.884	32.74	587.7	1.859	34.09	597.7	1.767	35.40	607.7	1.891	36.69	617.7	1.717	37.94	635.4	1.620	40.12
567.8	1.861	31.41	577.8	1.871	32.75	587.8	1.829	34.10	597.8	1.793	35.41	607.8	1.913	36.70	617.8	1.754	37.95	635.6	1.641	40.14
567.9	1.837	31.42	577.9	1.896	32.77	587.9	1.890	34.11	597.9	1.825	35.42	607.9	1.897	36.72	617.9	1.746	37.97	635.8	1.639	40.17
568.0	1.813	31.44	578.0	1.922	32.78	588.0	1.887	34.13	598.0	1.857	35.43	608.0	1.880	36.73	618.0	1.738	37.98	636.0	1.638	40.19
568.1	1.817	31.45	578.1	1.906	32.79	588.1	1.945	34.14	598.1	1.830	35.45	608.1	1.826	36.74	618.1	1.764	37.99	636.2	1.675	40.21
568.2	1.821	31.46	578.2	1.890	32.81	588.2	1.890	34.16	598.2	1.803	35.46	608.2	1.772	36.76	618.2	1.790	38.00	636.4	1.681	40.24
568.3	1.813	31.48	578.3	1.907	32.82	588.3	1.853	34.17	598.3	1.784	35.47	608.3	1.697	36.77	618.3	1.797	38.02	636.6	1.709	40.26
568.4	1.786	31.49	578.4	1.891	32.83	588.4	1.839	34.18	598.4	1.764	35.49	608.4	1.645	36.78	618.4	1.803	38.03	636.8	1.739	40.29
568.5	1.782	31.50	578.5	1.900	32.85	588.5	1.838	34.20	598.5	1.784	35.50	608.5	1.674	36.79	618.5	1.770	38.04	637.0	1.731	40.31
568.6	1.778	31.51	578.6	1.909	32.86	588.6	1.837	34.21	598.6	1.805	35.51	608.6	1.703	36.80	618.6	1.737	38.05	637.2	1.719	40.34
568.7	1.782	31.53	578.7	1.956	32.88	588.7	1.846	34.22	598.7	1.817	35.52	608.7	1.732	36.82	618.7	1.726	38.07	637.4	1.745	40.36
568.8	1.786	31.54	578.8	2.004	32.89	588.8	1.856	34.23	598.8	1.830	35.54	608.8	1.761	36.83	618.8	1.715	38.08	637.6	1.717	40.39
568.9	1.817	31.55	578.9	1.971	32.90	588.9	1.568	34.25	598.9	1.836	35.55	608.9	1.748	36.84	618.9	1.732	38.09	637.8	1.658	40.41
569.0	1.849	31.57	579.0	1.939	32.92	589.0	1.281	34.26	599.0	1.843	35.56	609.0	1.736	36.85	619.0	1.748	38.10	638.0	1.702	40.44
569.1	1.892	31.58	579.1	1.881	32.93	589.1	1.488	34.27	599.1	1.862	35.58	609.1	1.719	36.87	619.1	1.771	38.12	638.2	1.803	40.46
569.2	1.936	31.59	579.2	1.823	32.95	589.2	1.695	34.28	599.2	1.881	35.59	609.2	1.703	36.88	619.2	1.795	38.13	638.4	1.797	40.49
569.3	1.916	31.61	579.3	1.827	32.96	589.3	1.725	34.29	599.3	1.835	35.60	609.3	1.709	36.89	619.3	1.799	38.14	638.6	1.753	40.51
569.4	1.895	31.62	579.4	1.830	32.97	589.4	1.756	34.30	599.4	1.789	35.62	609.4	1.716	36.90	619.4	1.814	38.16	638.8	1.703	40.54
569.5	1.910	31.63	579.5	1.850	32.98	589.5	1.581	34.32	599.5	1.771	35.63	609.5	1.774	36.92	619.5	1.833	38.17	639.0	1.707	40.56
569.6	1.925	31.65	579.6	1.870	33.00	589.6	1.406	34.33	599.6	1.753	35.64	609.6	1.833	36.93	619.6	1.852	38.18	639.2	1.676	40.59
569.7	1.868	31.66	579.7	1.847	33.01	589.7	1.602	34.34	599.7	1.761	35.66	609.7	1.873	36.94	619.7	1.860	38.19	639.4	1.677	40.61
569.8	1.811	31.68	579.8	1.824	33.02	589.8	1.797	34.35	599.8	1.769	35.67	609.8	1.913	36.96	619.8	1.868	38.21	639.6	1.676	40.63
569.9	1.817	31.69	579.9	1.855	33.04	589.9	1.849	34.36	599.9	1.752	35.68	609.9	1.914	36.97	619.9	1.831	38.22	639.8	1.698	40.66

continued

Table VII. (concluded)

λ, nm	H_λ, W/m²·nm	P_λ, %
640.0	1.685	40.68
640.2	1.686	40.71
640.4	1.634	40.73
640.6	1.570	40.75
640.8	1.557	40.78
641.0	1.581	40.80
641.2	1.620	40.82
641.4	1.642	40.84
641.6	1.650	40.87
641.8	1.643	40.89
642.0	1.642	40.92
642.2	1.670	40.94
642.4	1.727	40.96
642.6	1.714	40.99
642.8	1.634	41.01
643.0	1.609	41.04
643.2	1.581	41.06
643.4	1.597	41.08
643.6	1.652	41.10
643.8	1.699	41.13
644.0	1.714	41.15
644.2	1.698	41.18
644.4	1.669	41.20
644.6	1.597	41.23
644.8	1.564	41.25
645.0	1.599	41.27
645.2	1.671	41.29
645.4	1.660	41.32
645.6	1.708	41.34
645.8	1.746	41.37
646.0	1.697	41.39
646.2	1.616	41.42
646.4	1.615	41.44
646.6	1.608	41.46
646.8	1.636	41.49
647.0	1.656	41.51
647.2	1.626	41.53
647.4	1.595	41.56
647.6	1.599	41.58
647.8	1.621	41.60
648.0	1.615	41.63
648.2	1.629	41.65
648.4	1.625	41.67
648.6	1.591	41.69
648.8	1.542	41.72
649.0	1.518	41.74
649.2	1.443	41.76
649.4	1.420	41.78
649.6	1.509	41.80
649.8	1.556	41.82
650.0	1.577	41.85
650.2	1.615	41.87
650.4	1.654	41.89
650.6	1.640	41.92
650.8	1.606	41.94
651.0	1.600	41.96
651.2	1.636	41.99
651.4	1.633	42.01
651.6	1.626	42.03
651.8	1.688	42.06
652.0	1.744	42.08
652.2	1.727	42.11
652.4	1.614	42.13
652.6	1.553	42.15
652.8	1.541	42.18
653.0	1.598	42.20
653.2	1.678	42.22
653.4	1.756	42.25
653.6	1.719	42.27
653.8	1.643	42.30
654.0	1.599	42.32
654.2	1.585	42.34
654.4	1.598	42.36
654.6	1.604	42.39
654.8	1.613	42.41
655.0	1.570	42.43
655.2	1.526	42.46
655.4	1.514	42.48
655.6	1.539	42.50
655.8	1.414	42.52
656.0	1.209	42.54
656.2	1.116	42.56
656.4	1.293	42.57
656.6	1.461	42.59
656.8	1.598	42.61
657.0	1.627	42.64
657.2	1.589	42.66
657.4	1.533	42.68
657.6	1.520	42.71
657.8	1.542	42.73
658.0	1.599	42.75
658.2	1.608	42.77
658.4	1.608	42.80
658.6	1.591	42.82
658.8	1.575	42.84
659.0	1.596	42.86
659.2	1.573	42.89
659.4	1.540	42.91
659.6	1.571	42.93
659.8	1.611	42.95

λ, nm	H_λ, W/m²·nm	P_λ, %
660.0	1.680	42.98
660.4	1.557	43.03
660.8	1.635	43.07
661.2	1.613	43.12
661.6	1.599	43.16
662.0	1.623	43.21
662.4	1.604	43.26
662.8	1.593	43.30
663.2	1.561	43.35
663.6	1.653	43.39
664.0	1.654	43.44
664.4	1.570	43.49
664.8	1.580	43.53
665.2	1.627	43.58
665.6	1.640	43.63
666.0	1.636	43.67
666.4	1.589	43.72
666.8	1.542	43.76
667.2	1.619	43.81
667.6	1.628	43.86
668.0	1.598	43.90
668.4	1.650	43.95
668.8	1.534	44.00
669.2	1.525	44.04
669.6	1.640	44.08
670.0	1.692	44.13
670.4	1.561	44.18
670.8	1.589	44.22
671.2	1.585	44.27
671.6	1.550	44.31
672.0	1.528	44.36
672.4	1.520	44.40
672.8	1.538	44.45
673.2	1.554	44.49
673.6	1.598	44.54
674.0	1.602	44.58
674.4	1.664	44.63
674.8	1.633	44.68
675.2	1.577	44.72
675.6	1.605	44.77
676.0	1.578	44.81
676.4	1.558	44.86
676.8	1.566	44.90
677.2	1.604	44.95
677.6	1.634	45.00
678.0	1.537	45.04
678.4	1.559	45.09
678.8	1.564	45.13
679.2	1.573	45.18
679.6	1.574	45.22
680.0	1.578	45.27
680.4	1.605	45.31
680.8	1.554	45.36
681.2	1.527	45.40
681.6	1.581	45.45
682.0	1.578	45.49
682.4	1.556	45.54
682.8	1.518	45.58
683.2	1.598	45.63
683.6	1.570	45.67
684.0	1.504	45.72
684.4	1.525	45.76
684.8	1.565	45.80
685.2	1.517	45.85
685.6	1.532	45.89
686.0	1.566	45.94
686.4	1.520	45.98
686.8	1.447	46.02
687.2	1.441	46.06
687.6	1.454	46.11
688.0	1.495	46.15
688.4	1.443	46.19
688.8	1.454	46.23
689.2	1.498	46.27
689.6	1.512	46.32
690.0	1.504	46.36
690.4	1.548	46.40
690.8	1.508	46.45
691.2	1.508	46.49
691.6	1.513	46.54
692.0	1.438	46.58
692.4	1.513	46.62
692.8	1.531	46.66
693.2	1.456	46.71
693.6	1.539	46.75
694.0	1.534	46.79
694.4	1.520	46.84
694.8	1.574	46.88
695.2	1.558	46.93
695.6	1.492	46.97
696.0	1.526	47.01
696.4	1.466	47.06
696.8	1.536	47.10
697.2	1.585	47.15
697.6	1.550	47.19
698.0	1.514	47.23
698.4	1.575	47.28
698.8	1.518	47.32
699.2	1.456	47.37
699.6	1.461	47.41

λ, nm	H_λ, W/m²·nm	P_λ, %
700.0	1.495	47.45
702.0	1.471	47.66
704.0	1.476	47.87
706.0	1.450	48.08
708.0	1.427	48.29
710.0	1.455	48.50
712.0	1.439	48.71
714.0	1.421	48.91
716.0	1.406	49.11
718.0	1.393	49.32
720.0	1.367	49.51
722.0	1.396	49.71
724.0	1.406	49.91
726.0	1.392	50.11
728.0	1.366	50.31
730.0	1.367	50.51
732.0	1.362	50.70
734.0	1.359	50.90
736.0	1.363	51.10
738.0	1.332	51.29
740.0	1.316	51.48
742.0	1.302	51.67
744.0	1.306	51.85
746.0	1.308	52.04
748.0	1.314	52.23
750.0	1.308	52.42
752.0	1.297	52.61
754.0	1.297	52.79
756.0	1.292	52.98
758.0	1.283	53.16
760.0	1.269	53.35
762.0	1.272	53.53
764.0	1.255	53.71
766.0	1.251	53.89
768.0	1.235	54.07
770.0	1.226	54.25
772.0	1.217	54.42
774.0	1.216	54.60
776.0	1.197	54.77
778.0	1.218	54.94
780.0	1.223	55.12
782.0	1.217	55.29
784.0	1.218	55.47
786.0	1.213	55.64
788.0	1.202	55.82
790.0	1.185	55.99
792.0	1.160	56.15
794.0	1.177	56.32
796.0	1.172	56.49
798.0	1.163	56.66
800.0	1.154	56.83
802.0	1.150	56.99
804.0	1.148	57.16
806.0	1.141	57.32
808.0	1.120	57.48
810.0	1.105	57.64
812.0	1.101	57.80
814.0	1.120	57.96
816.0	1.090	58.12
818.0	1.086	58.28
820.0	1.079	58.43
822.0	1.063	58.58
824.0	1.082	58.74
826.0	1.078	58.89
828.0	1.070	59.05
830.0	1.043	59.20
832.0	1.057	59.35
834.0	1.038	59.50
836.0	1.029	59.65
838.0	1.048	59.80
840.0	1.027	59.95
842.0	1.030	60.10
844.0	1.000	60.24
846.0	1.010	60.38
848.0	1.012	60.53
850.0	0.976	60.67
852.0	0.966	60.81
854.0	0.876	60.94
856.0	0.948	61.08
858.0	0.994	61.21
860.0	0.968	61.36
862.0	0.985	61.50
864.0	0.921	61.64
866.0	0.887	61.76
868.0	0.962	61.89
870.0	0.960	62.04
872.0	0.953	62.17
874.0	0.956	62.31
876.0	0.958	62.45
878.0	0.934	62.58
880.0	0.935	62.72
882.0	0.923	62.85
884.0	0.937	62.98
886.0	0.922	63.12
888.0	0.924	63.25
890.0	0.920	63.38
892.0	0.911	63.51
894.0	0.914	63.64
896.0	0.919	63.78
898.0	0.894	63.91

λ, nm	H_λ, W/m²·nm	P_λ, %
900.0	0.889	64.03
902.0	0.891	64.16
904.0	0.881	64.29
906.0	0.881	64.42
908.0	0.854	64.54
910.0	0.865	64.66
912.0	0.873	64.79
914.0	0.865	64.91
916.0	0.860	65.04
918.0	0.861	65.16
920.0	0.835	65.28
922.0	0.828	65.40
924.0	0.834	65.52
926.0	0.839	65.64
928.0	0.845	65.76
930.0	0.840	65.88
932.0	0.848	66.00
934.0	0.835	66.13
936.0	0.820	66.24
938.0	0.828	66.36
940.0	0.821	66.48
942.0	0.806	66.60
944.0	0.822	66.71
946.0	0.817	66.83
948.0	0.801	66.95
950.0	0.803	67.06
952.0	0.796	67.18
954.0	0.785	67.29
956.0	0.799	67.41
958.0	0.796	67.52
960.0	0.792	67.63
962.0	0.791	67.75
964.0	0.788	67.86
966.0	0.780	67.97
968.0	0.798	68.09
970.0	0.783	68.20
972.0	0.783	68.31
974.0	0.767	68.43
976.0	0.783	68.54
978.0	0.781	68.65
980.0	0.772	68.76
982.0	0.774	68.87
984.0	0.776	68.98
986.0	0.758	69.09
988.0	0.767	69.20
990.0	0.763	69.31
992.0	0.754	69.42
994.0	0.756	69.53
996.0	0.743	69.64
998.0	0.743	69.74
1000.0	0.741	69.85
1005.0	0.725	70.11
1010.0	0.723	70.37
1015.0	0.722	70.63
1020.0	0.716	70.89
1025.0	0.725	71.15
1030.0	0.700	71.41
1035.0	0.695	71.65
1040.0	0.679	71.90
1045.0	0.686	72.15
1050.0	0.668	72.39
1055.0	0.659	72.63
1060.0	0.650	72.86
1065.0	0.648	73.10
1070.0	0.640	73.33
1075.0	0.631	73.55
1080.0	0.621	73.78
1085.0	0.614	74.00
1090.0	0.612	74.22
1095.0	0.599	74.44
1100.0	0.608	74.66
1105.0	0.601	74.87
1110.0	0.602	75.09
1115.0	0.588	75.30
1120.0	0.578	75.51
1125.0	0.568	75.72
1130.0	0.565	75.92
1135.0	0.562	76.12
1140.0	0.556	76.32
1145.0	0.554	76.52
1150.0	0.543	76.72
1155.0	0.552	76.92
1160.0	0.538	77.11
1165.0	0.528	77.30
1170.0	0.531	77.50
1175.0	0.523	77.68
1180.0	0.512	77.87
1185.0	0.509	78.05
1190.0	0.508	78.23
1195.0	0.498	78.42
1200.0	0.492	78.59
1205.0	0.489	78.77
1210.0	0.484	78.95
1215.0	0.494	79.12
1220.0	0.475	79.29
1225.0	0.474	79.47
1230.0	0.476	79.64
1235.0	0.468	79.80
1240.0	0.466	79.97
1245.0	0.453	80.14

λ, nm	H_λ, W/m²·nm	P_λ, %
1250.0	0.461	80.30
1255.0	0.451	80.47
1260.0	0.432	80.62
1265.0	0.426	80.78
1270.0	0.427	80.93
1275.0	0.441	81.09
1280.0	0.424	81.25
1285.0	0.426	81.39
1290.0	0.431	81.55
1295.0	0.427	81.70
1300.0	0.427	81.86
1305.0	0.418	82.01
1310.0	0.409	82.16
1315.0	0.406	82.30
1320.0	0.407	82.45
1325.0	0.402	82.60
1330.0	0.396	82.74
1335.0	0.392	82.88
1340.0	0.390	83.02
1345.0	0.387	83.16
1350.0	0.380	83.30
1355.0	0.375	83.43
1360.0	0.372	83.57
1365.0	0.364	83.70
1370.0	0.363	83.83
1375.0	0.363	83.96
1380.0	0.359	84.09
1385.0	0.359	84.22
1390.0	0.354	84.35
1395.0	0.353	84.47
1400.0	0.349	84.60
1405.0	0.346	84.72
1410.0	0.343	84.85
1415.0	0.341	84.97
1420.0	0.340	85.09
1425.0	0.345	85.22
1430.0	0.335	85.34
1435.0	0.329	85.46
1440.0	0.325	85.57
1445.0	0.317	85.69
1450.0	0.322	85.81
1455.0	0.306	85.92
1460.0	0.316	86.03
1465.0	0.311	86.14
1470.0	0.311	86.25
1475.0	0.307	86.37
1480.0	0.303	86.47
1485.0	0.299	86.58
1490.0	0.304	86.69
1495.0	0.301	86.80
1500.0	0.297	86.91
1505.0	0.296	87.01
1510.0	0.292	87.12
1515.0	0.292	87.22
1520.0	0.288	87.33
1525.0	0.292	87.43
1530.0	0.284	87.54
1535.0	0.277	87.64
1540.0	0.278	87.73
1545.0	0.277	87.84
1550.0	0.276	87.93
1555.0	0.275	88.03
1560.0	0.273	88.13
1565.0	0.267	88.23
1570.0	0.264	88.32
1575.0	0.263	88.42
1580.0	0.259	88.51
1585.0	0.256	88.61
1590.0	0.250	88.70
1595.0	0.251	88.79
1600.0	0.252	88.88
1605.0	0.247	88.97
1610.0	0.249	89.05
1615.0	0.248	89.14
1620.0	0.245	89.23
1625.0	0.249	89.32
1630.0	0.246	89.41
1635.0	0.242	89.50
1640.0	0.238	89.58
1645.0	0.239	89.67
1650.0	0.238	89.75
1655.0	0.238	89.84
1660.0	0.237	89.93
1665.0	0.233	90.01
1670.0	0.232	90.09
1675.0	0.224	90.18
1680.0	0.225	90.26
1685.0	0.223	90.34
1690.0	0.223	90.42
1695.0	0.218	90.50
1700.0	0.221	90.57
1705.0	0.216	90.65
1710.0	0.207	90.73
1715.0	0.216	90.80
1720.0	0.209	90.88
1725.0	0.200	90.95
1730.0	0.194	91.03
1735.0	0.193	91.09
1740.0	0.195	91.16
1745.0	0.189	91.23

λ, nm	H_λ, W/m²·nm	P_λ, %
1750.0	0.191	91.30
1755.0	0.193	91.37
1760.0	0.188	91.44
1765.0	0.186	91.51
1770.0	0.180	91.57
1775.0	0.176	91.64
1780.0	0.174	91.70
1785.0	0.173	91.76
1790.0	0.172	91.82
1795.0	0.176	91.88
1800.0	0.172	91.95
1805.0	0.171	92.01
1810.0	0.163	92.07
1815.0	0.163	92.13
1820.0	0.162	92.19
1825.0	0.159	92.24
1830.0	0.159	92.30
1835.0	0.153	92.36
1840.0	0.156	92.41
1845.0	0.154	92.47
1850.0	0.151	92.52
1855.0	0.148	92.58
1860.0	0.146	92.63
1865.0	0.146	92.68
1870.0	0.138	92.73
1875.0	0.138	92.78
1880.0	0.143	92.83
1885.0	0.141	92.88
1890.0	0.140	92.93
1895.0	0.141	92.98
1900.0	0.136	93.03
1905.0	0.139	93.08
1910.0	0.141	93.13
1915.0	0.139	93.18
1920.0	0.137	93.23
1925.0	0.135	93.28
1930.0	0.135	93.33
1935.0	0.134	93.38
1940.0	0.132	93.43
1945.0	0.130	93.47
1950.0	0.129	93.52
1955.0	0.124	93.57
1960.0	0.128	93.61
1965.0	0.128	93.66
1970.0	0.127	93.70
1975.0	0.132	93.75
1980.0	0.127	93.80
1985.0	0.125	93.84
1990.0	0.123	93.89
1995.0	0.125	93.93
2000.0	0.118	93.97
2005.0	0.112	94.01
2010.0	0.116	94.06
2015.0	0.114	94.10
2020.0	0.115	94.14
2025.0	0.115	94.18
2030.0	0.112	94.22
2035.0	0.109	94.26
2040.0	0.109	94.30
2045.0	0.110	94.34
2050.0	0.106	94.38
2055.0	0.104	94.41
2060.0	0.102	94.45
2065.0	0.097	94.49
2070.0	0.101	94.52
2075.0	0.103	94.56
2080.0	0.099	94.60
2085.0	0.098	94.63
2090.0	0.100	94.67
2095.0	0.093	94.70
2100.0	0.095	94.74
2105.0	0.095	94.77
2110.0	0.089	94.80
2115.0	0.092	94.83
2120.0	0.089	94.87
2125.0	0.089	94.90
2130.0	0.089	94.93
2135.0	0.087	94.96
2140.0	0.092	95.00
2145.0	0.084	95.03
2150.0	0.083	95.06
2155.0	0.081	95.09
2160.0	0.084	95.12
2165.0	0.082	95.15
2170.0	0.084	95.18
2175.0	0.079	95.21
2180.0	0.077	95.23
2185.0	0.069	95.26
2190.0	0.074	95.28
2195.0	0.075	95.31
2200.0	0.084	95.34
2205.0	0.077	95.37
2210.0	0.077	95.40
2215.0	0.074	95.42
2220.0	0.079	95.45
2225.0	0.077	95.48
2230.0	0.077	95.51
2235.0	0.066	95.53
2240.0	0.061	95.55
2245.0	0.073	95.58

λ, nm	H_λ, W/m²·nm	P_λ, %
2250.0	0.077	95.61
2255.0	0.077	95.64
2260.0	0.072	95.66
2265.0	0.073	95.69
2270.0	0.066	95.71
2275.0	0.065	95.73
2280.0	0.070	95.76
2285.0	0.067	95.78
2290.0	0.067	95.81
2295.0	0.066	95.83
2300.0	0.067	95.86
2305.0	0.064	95.88
2310.0	0.063	95.90
2315.0	0.059	95.92
2320.0	0.054	95.94
2325.0	0.056	95.96
2330.0	0.056	95.98
2335.0	0.060	96.01
2340.0	0.059	96.03
2345.0	0.061	96.05
2350.0	0.062	96.07
2356.0	0.064	96.09
2360.0	0.066	96.12
2365.0	0.062	96.14
2370.0	0.062	96.16
2375.0	0.058	96.18
2380.0	0.056	96.20
2385.0	0.061	96.22
2390.0	0.060	96.25
2395.0	0.059	96.27
2400.0	0.055	96.29
2405.0	0.056	96.31
2410.0	0.057	96.33
2415.0	0.054	96.35
2420.0	0.058	96.37
2425.0	0.055	96.39
2430.0	0.059	96.41
2435.0	0.055	96.43
2440.0	0.052	96.45
2445.0	0.050	96.47
2450.0	0.051	96.48
2455.0	0.052	96.50
2460.0	0.049	96.52
2465.0	0.054	96.54
2470.0	0.049	96.56
2475.0	0.054	96.58
2480.0	0.051	96.59
2485.0	0.048	96.61
2490.0	0.055	96.63
2495.0	0.047	96.65

The second procedure utilized the Cary spectroradiometer (see Fig. 6). An uncollimated high-intensity tungsten lamp was installed in the sample side 50 cm from the limiting aperture. Polarization of radiation from this lamp was less than 2%. The window was placed into and out of the sample light path and the ratio of signals noted. Measurements were performed at selected wavelengths for incidence angles of 0°, 20°, and 30°. After correction was made for the difference in optical path lengths for air and fused silica, the average disagreement in transmittance between the two sets of measurements made with different equipment was ±0.006. After a smooth curve was fit through each set of data, the disagreement averaged ±0.004. There was no measurable difference in spectral transmittance between either of the windows used during the solar measurements. The tabulation of transmittance as a function of wavelength and incidence angle is given in Table V.

B. Measurement of Mirror Reflectance

The spectral reflectance of the mirror was determined by a multiple reflection technique to obtain the highest degree of accuracy. The method used is somewhat similar to the techniques of Strong[28] or Bennett and Koehler,[29] which enable measurements to be made to a precision of ±0.1%.

During solar measurements, the incidence angle on the turning mirror ranged from 25° to 55°, depending on the solar zenith angle. The mirror reflectance exhibits at most a 2% variation in reflectance for unpolarized radiation over this range. Because of this small variation with incidence angle, measurements were performed only at the angle most commonly encountered during the measurements (35°), and Fresnel's equations for an aluminum–air interface were used to obtain the variation with angle.

The apparatus used in the reflectance measurements is shown in Fig. 16. Essentially the same instrumentation was used as for the window transmittance measurements described previously. Two mirrors, prepared under identical conditions, were placed opposite each other at a separation distance of 6 cm. Collimated radiation from a xenon-arc source was directed horizontally into the integrating sphere to obtain the reference signal level, V_R, and then directed onto the lower mirror at an angle of incidence of 35°. At this angle of incidence, the light beam undergoes seven reflections between the two mirrors before entering the integrating sphere, which was rotated downward to accept the beam, as shown in Fig. 16. The intensity of the radiation entering the integrating sphere is indicated by the sample signal level, V_s. The reflectance R of the mirror is obtained by the seventh root of the signal ratio:

$$R = (V_s/V_R)^{1/7}. \tag{A1}$$

Measurements were performed at each wavelength with the beam polarized both parallel (R_p) and normal (R_n) to the plane of incidence through the use of a Nicol prism. The spectral reflectance ρ_λ for natural or unpolarized radiation was calculated from the arithmetic mean of the two component reflectances

$$\rho_\lambda = (R_p + R_n)/2. \tag{A2}$$

The results of the measurements are shown in Fig. 17 for 0° incidence and are listed in Table VI for incidence angles 0°, 35°, 45°, and 55°.

In preparing the mirror, the aluminum was deposited at a rate of 50 nm/sec at a pressure of 5×10^{-5} Torr. The total thickness was approximately 500 nm. Also shown in Fig. 17 are the data of Hass[30] for a fresh aluminum surface evaporated at an extremely high evaporation rate (100 nm/sec) in good vacuum (1×10^{-5} Torr) and the data of Bennett *et al.*[31] for an aluminum surface deposited at a slower rate and approximately the same pressure level. In general, the present measurements are very close to the previously published data. The 2% decrease in the uv near 300 nm is felt to be due to the lower rate of deposition and higher pressure during evaporation than used by Hass. The data of Hass and Bennett were used beyond 1200 nm since the low output of the xenon-arc source at longer wavelengths resulted in a low signal level. The mirror reflectance indicated by the solid curve in Fig. 17 and the listing in Table VI are felt to be within ±0.5% of the true reflectance.

Appendix B. Extraterrestrial Spectral Irradiance from 300 nm to 2500 nm

The data presented in this section are representative of the degree of resolution attained in the experimental results over the 300–2500 nm spectral range. All values are on an absolute spectral irradiance scale based on the Standard of Spectral Irradiance and can be used to calculate total or average irradiance within arbitrary spectral bands.

A view of the Fraunhofer absorption in the solar atmosphere is shown in Fig. 18. The spectral region from 300 nm to 700 nm has considerably greater structure than the 700–2500 nm region and is shown in higher detail. The identities of selected major absorption lines are indicated in the spectra.

A tabular listing of the data is given in Table VII. The values of extraterrestrial spectral irradiance, $H_{\lambda 0}$, are averaged over the printout interval. A listing of the percentage P_λ of the total solar irradiance at wavelengths shorter than the respective wavelength is also shown.

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November 13, 1969

EXTRATERRESTIAL SOLAR SPECTRAL IRRADIANCES

TABLE OF CONTENTS

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From Ames – C
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Moffett Field, California 94035
October 23, 1969

From Ames - Code STP
To Goddard Space Flight Center
Code 601
National Space Science Data Center

Subject: Data on extraterrestrial solar spectral irradiance

Reference: Arvesen, John C.; Griffin, Roy N., Jr.; and Pearson, B. Douglas, Jr.: "Determination of Extraterrestrial Solar Spectral Irradiance from a Research Aircraft," Applied Optics, 8, 11, 1969

1. The magnetic tape, which is being sent under separate cover, contains the extraterrestrial solar spectral irradiance listing reported in the referenced paper (copy enclosed). The computer output of a program which reads the tape and prints the listing is also enclosed. The program is written in Fortran IV and was run on the IBM 7040/7094 DCS.

2. If you require any further information, please feel free to contact us.

John C. Arvesen

John C. Arvesen
Aerospace Engineer

Encs.
1. Referenced paper(1)
2. Computer output (1)
3. Magnetic tape (under separate cover)

EXTRATERRESTRIAL SOLAR SPECTRAL IRRADIANCE

AT

EARTHS MEAN SOLAR DISTANCE

(300 - 2500NM)

* *

REFERENCE***** ARVESEN, JOHN C. GRIFFIN, ROY N. JR. AND PEARSON, B DOUGLAS, JR. --DETERMINATION OF EXTRA-TERRESTRIAL SOLAR SPECTRAL IRRADIANCE FROM A RESEARCH AIRCRAFT--. APPLIED OPTICS, VOL 8, NO 11, 1969.

WAVELENGTH, NANOMETER	EXTRATERRESTRIAL SPECTRAL IRRADIANCE, WATT/SQMETER-NANOMETER	PERCENTAGE OF TOTAL IRRADIANCE AT SHORTER WAVELENGTH
300.0	0.543	1.15
300.4	0.504	1.16
300.8	0.546	1.18
301.2	0.616	1.19
301.6	0.749	1.21
302.0	0.576	1.23
302.4	0.485	1.25
302.8	0.541	1.26
303.2	0.590	1.28
303.6	0.635	1.30
304.0	0.563	1.31
304.4	0.522	1.33
304.8	0.552	1.35

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		0001	REC	1. LENGTH	84
		0002	REC	2. LENGTH	84
		0003	REC	3. LENGTH	84
OLAR SPECTRAL IRRADIANCE		0004	REC	4. LENGTH	84
AT		0005	REC	5. LENGTH	84
N SOLAR DISTANCE		0006	REC	6. LENGTH	84
- 2500NM)		0007	REC	7. LENGTH	84
* * * * * * * * * * * * * * * * * *		0008	REC	8. LENGTH	84
		0009	REC	9. LENGTH	84
		0010	REC	10. LENGTH	84
N C. GRIFFIN, ROY N. JR. AND		0011	REC	11. LENGTH	84
--DETERMINATION OF EXTRA-		0012	REC	12. LENGTH	84
TRAL IRRADIANCE FROM A RESEARCH		0013	REC	13. LENGTH	84
TICS, VOL 8, NO 11, 1969.		0014	REC	14. LENGTH	84
		0015	REC	15. LENGTH	84
TRIAL	PERCENTAGE OF TOTAL	0016	REC	16. LENGTH	84
DIANCE,	IRRADIANCE AT	0017	REC	17. LENGTH	84
NOMETER	SHORTER WAVELENGTH	0018	REC	18. LENGTH	84
* * * *	* * * * * * * * * *	0019	REC	19. LENGTH	84
	1.15	0020	REC	20. LENGTH	84
	1.16	0021	REC	21. LENGTH	84
	1.18	0022	REC	22. LENGTH	84
	1.19	0023	REC	23. LENGTH	84
	1.21	0024	REC	24. LENGTH	84
	1.23	0025	REC	25. LENGTH	84
	1.25	0026	REC	26. LENGTH	84
	1.26	0027	REC	27. LENGTH	84
	1.28	0028	REC	28. LENGTH	84
	1.30	0029	REC	29. LENGTH	84
	1.31	0030	REC	30. LENGTH	84
	1.33	0031	REC	31. LENGTH	84
	1.35	0032	REC	32. LENGTH	84

305.2	0.628	1.36	0033
305.6	0.646	1.38	0034
306.0	0.490	1.40	0035
306.4	0.557	1.41	0036
306.8	0.622	1.43	0037
307.2	0.718	1.45	0038
307.6	0.746	1.47	0039
308.0	0.672	1.49	0040
308.4	0.631	1.51	0041
308.8	0.620	1.53	0042
309.2	0.533	1.54	0043
309.6	0.514	1.56	0044
310.0	0.536	1.57	0045
310.4	0.540	1.59	0046
310.8	0.707	1.61	0047
311.2	0.792	1.63	0048
311.6	0.793	1.65	0049
312.0	0.706	1.67	0050
312.4	0.659	1.69	0051
312.8	0.747	1.71	0052
313.2	0.759	1.73	0053
313.6	0.706	1.75	0054
314.0	0.755	1.78	0055
314.4	0.774	1.80	0056
314.8	0.651	1.82	0057
315.2	0.822	1.84	0058
315.6	0.800	1.86	0059
316.0	0.629	1.88	0060
316.4	0.576	1.90	0061
316.8	0.744	1.92	0062
317.2	0.841	1.94	0063
317.6	0.917	1.97	0064

1.36	0033	REC	33. LENGTH	84
1.38	0034	REC	34. LENGTH	84
1.40	0035	REC	35. LENGTH	84
1.41	0036	REC	36. LENGTH	84
1.43	0037	REC	37. LENGTH	84
1.45	0038	REC	38. LENGTH	84
1.47	0039	REC	39. LENGTH	84
1.49	0040	REC	40. LENGTH	84
1.51	0041	REC	41. LENGTH	84
1.53	0042	REC	42. LENGTH	84
1.54	0043	REC	43. LENGTH	84
1.56	0044	REC	44. LENGTH	84
1.57	0045	REC	45. LENGTH	84
1.59	0046	REC	46. LENGTH	84
1.61	0047	REC	47. LENGTH	84
1.63	0048	REC	48. LENGTH	84
1.65	0049	REC	49. LENGTH	84
1.67	0050	REC	50. LENGTH	84
1.69	0051	REC	51. LENGTH	84
1.71	0052	REC	52. LENGTH	84
1.73	0053	REC	53. LENGTH	84
1.75	0054	REC	54. LENGTH	84
1.78	0055	REC	55. LENGTH	84
1.80	0056	REC	56. LENGTH	84
1.82	0057	REC	57. LENGTH	84
1.84	0058	REC	58. LENGTH	84
1.86	0059	REC	59. LENGTH	84
1.88	0060	REC	60. LENGTH	84
1.90	0061	REC	61. LENGTH	84
1.92	0062	REC	62. LENGTH	84
1.94	0063	REC	63. LENGTH	84
1.97	0064	REC	64. LENGTH	84

96.29	3450	REC	1.	LENGTH	84
96.31	3451	REC	2.	LENGTH	84
96.33	3452	REC	3.	LENGTH	84
96.35	3453	REC	4.	LENGTH	84
96.37	3454	REC	5.	LENGTH	84
96.39	3455	REC	6.	LENGTH	84
96.41	3456	REC	7.	LENGTH	84
96.43	3457	REC	8.	LENGTH	84
96.45	3458	REC	9.	LENGTH	84
96.47	3459	REC	10.	LENGTH	84
96.48	3460	REC	11.	LENGTH	84
96.50	3461	REC	12.	LENGTH	84
96.52	3462	REC	13.	LENGTH	84
96.54	3463	REC	14.	LENGTH	84
96.56	3464	REC	15.	LENGTH	84
96.58	3465	REC	16.	LENGTH	84
96.59	3466	REC	17.	LENGTH	84
96.61	3467	REC	18.	LENGTH	84
96.63	3468	REC	19.	LENGTH	84
96.65	3469	REC	20.	LENGTH	84

2400.0	0.055	96.29	3450
2405.0	0.056	96.31	3451
2410.0	0.057	96.33	3452
2415.0	0.054	96.35	3453
2420.0	0.058	96.37	3454
2425.0	0.055	96.39	3455
2430.0	0.059	96.41	3456
2435.0	0.055	96.43	3457
2440.0	0.052	96.45	3458
2445.0	0.050	96.47	3459
2450.0	0.051	96.48	3460
2455.0	0.052	96.50	3461
2460.0	0.049	96.52	3462
2465.0	0.054	96.54	3463
2470.0	0.049	96.56	3464
2475.0	0.054	96.58	3465
2480.0	0.051	96.59	3466
2485.0	0.048	96.61	3467
2490.0	0.055	96.63	3468
2495.0	0.047	96.65	3469

EXTRATERRESTRIAL SOLAR SPECTRAL IRRADIANCE
AT
EARTHS MEAN SOLAR DISTANCE
(300 - 2500NM)

* *

REFERENCE***** ARVESEN, JOHN C, GRIFFIN, ROY N, JR, AND PEARSON, B DOUGLAS, JR, --DETERMINATION OF EXTRA-TERRESTRIAL SOLAR SPECTRAL IRRADIANCE FROM A RESEARCH AIRCRAFT--, APPLIED OPTICS, VOL 8, NO 11, 1969.

WAVELENGTH, NANOMETER	EXTRATERRESTRIAL SPECTRAL IRRADIANCE, WATT/SQMETER-NANOMETER	PERCENTAGE OF TOTAL IRRADIANCE AT SHORTER WAVELENGTH
* * * * * *	* * * * * * * * * * * *	* * * * * * * * * *
300.0	0.545	1.15
300.4	0.504	1.16
300.8	0.546	1.18
301.2	0.616	1.19
301.6	0.749	1.21
302.0	0.576	1.23
302.4	0.485	1.25
302.8	0.541	1.26
303.2	0.590	1.28
303.6	0.635	1.30
304.0	0.563	1.31
304.4	0.522	1.33
304.8	0.552	1.35
305.2	0.628	1.36
305.6	0.646	1.38
306.0	0.490	1.40
306.4	0.557	1.41
306.8	0.622	1.43
307.2	0.718	1.45
307.6	0.746	1.47
308.0	0.672	1.49
308.4	0.631	1.51
308.8	0.620	1.53
309.2	0.533	1.54
309.6	0.514	1.56
310.0	0.536	1.57
310.4	0.540	1.59
310.8	0.707	1.61
311.2	0.792	1.63
311.6	0.793	1.65
312.0	0.706	1.67
312.4	0.659	1.69
312.8	0.747	1.71
313.2	0.759	1.73
313.6	0.706	1.75
314.0	0.755	1.79
314.4	0.774	1.80
314.8	0.651	1.82
315.2	0.822	1.84

59	315.6	0.800	1.85	0059
60	316.0	0.629	1.88	0060
61	316.4	0.576	1.90	0061
62	316.8	0.744	1.92	0062
63	317.2	0.841	1.94	0063
64	317.6	0.917	1.97	0064
65	318.0	0.805	1.99	0065
66	318.4	0.620	2.01	0066
67	318.8	0.739	2.03	0067
68	319.2	0.887	2.06	0068
69	319.6	0.721	2.08	0069
70	320.0	0.786	2.10	0070
71	320.4	0.861	2.12	0071
72	320.8	0.925	2.15	0072
73	321.2	0.867	2.18	0073
74	321.6	0.691	2.20	0074
75	322.0	0.779	2.22	0075
76	322.4	0.856	2.24	0076
77	322.8	0.747	2.27	0077
78	323.2	0.619	2.29	0078
79	323.6	0.657	2.30	0079
80	324.0	0.620	2.32	0080
81	324.4	0.687	2.34	0081
82	324.8	0.697	2.36	0082
83	325.2	0.668	2.38	0083
84	325.6	0.773	2.40	0084
85	326.0	1.029	2.43	0085
86	326.4	1.189	2.46	0086
87	326.8	1.159	2.49	0087
88	327.2	1.183	2.53	0088
89	327.6	1.034	2.56	0089
90	328.0	1.004	2.59	0090
91	328.4	0.928	2.61	0091
92	328.8	1.000	2.64	0092
93	329.2	1.009	2.67	0093
94	329.6	1.193	2.70	0094
95	330.0	1.223	2.74	0095
96	330.4	1.187	2.77	0096
97	330.8	1.014	2.80	0097
98	331.2	0.993	2.83	0098
99	331.6	1.022	2.86	0099
100	332.0	1.057	2.89	0100
101	332.4	1.074	2.92	0101
102	332.8	1.030	2.95	0102
103	333.2	1.062	2.98	0103
104	333.6	1.076	3.01	0104
105	334.0	0.930	3.04	0105
106	334.4	1.047	3.07	0106
107	334.8	1.179	3.10	0107
108	335.2	1.033	3.13	0108
109	335.6	1.119	3.16	0109
110	336.0	1.131	3.20	0110
111	336.4	0.698	3.22	0111
112	336.8	0.909	3.24	0112
113	337.2	0.864	3.27	0113
114	337.6	0.827	3.30	0114
115	338.0	0.988	3.32	0115
116	338.4	0.938	3.35	0116

117	338.8	1.039	3.38	0117
118	339.2	1.091	3.41	0118
119	339.6	1.005	3.44	0119
120	340.0	1.089	3.47	0120
121	340.2	1.185	3.49	0121
122	340.4	1.175	3.50	0122
123	340.6	1.147	3.52	0123
124	340.8	1.078	3.53	0124
125	341.0	1.013	3.55	0125
126	341.2	1.028	3.56	0126
127	341.4	1.084	3.58	0127
128	341.6	1.072	3.59	0128
129	341.8	0.899	3.61	0129
130	342.0	0.972	3.62	0130
131	342.2	1.104	3.64	0131
132	342.4	1.207	3.65	0132
133	342.6	1.133	3.67	0133
134	342.8	1.047	3.69	0134
135	343.0	1.035	3.70	0135
136	343.2	1.101	3.72	0136
137	343.4	1.207	3.73	0137
138	343.6	1.163	3.75	0138
139	343.8	1.095	3.77	0139
140	344.0	1.023	3.78	0140
141	344.2	0.905	3.80	0141
142	344.4	0.670	3.81	0142
143	344.6	0.624	3.82	0143
144	344.8	0.770	3.83	0144
145	345.0	0.899	3.84	0145
146	345.2	1.073	3.85	0146
147	345.4	1.189	3.87	0147
148	345.6	1.068	3.88	0148
149	345.8	1.095	3.90	0149
150	346.0	1.085	3.92	0150
151	346.2	0.897	3.93	0151
152	346.4	0.818	3.94	0152
153	346.6	0.901	3.95	0153
154	346.8	1.065	3.97	0154
155	347.0	0.988	3.98	0155
156	347.2	1.099	4.00	0156
157	347.4	1.163	4.01	0157
158	347.6	1.082	4.03	0158
159	347.8	0.873	4.05	0159
160	348.0	0.815	4.06	0160
161	348.2	0.909	4.07	0161
162	348.4	1.046	4.08	0162
163	348.6	0.979	4.10	0163
164	348.8	0.915	4.11	0164
165	349.0	1.020	4.13	0165
166	349.2	1.020	4.14	0166
167	349.4	0.900	4.15	0167
168	349.6	0.870	4.17	0168
169	349.8	0.942	4.18	0169
170	350.0	1.015	4.19	0170
171	350.2	1.088	4.21	0171
172	350.4	1.160	4.22	0172
173	350.6	1.210	4.24	0173
174	350.8	1.173	4.26	0174

175	351.0	1.059	4.28	0175
176	351.2	1.058	4.29	0176
177	351.4	1.008	4.31	0177
178	351.6	0.899	4.32	0178
179	351.8	1.002	4.33	0179
180	352.0	1.128	4.35	0180
181	352.2	1.096	4.36	0181
182	352.4	0.936	4.38	0182
183	352.6	0.821	4.39	0183
184	352.8	0.935	4.40	0184
185	353.0	1.046	4.42	0185
186	353.2	1.108	4.43	0186
187	353.4	1.113	4.45	0187
188	353.6	1.132	4.47	0188
189	353.8	1.165	4.48	0189
190	354.0	1.196	4.50	0190
191	354.2	1.203	4.52	0191
192	354.4	1.197	4.53	0192
193	354.6	1.192	4.55	0193
194	354.8	1.195	4.57	0194
195	355.0	1.213	4.58	0195
196	355.2	1.166	4.60	0196
197	355.4	1.052	4.62	0197
198	355.6	1.046	4.63	0198
199	355.8	1.051	4.65	0199
200	356.0	1.038	4.66	0200
201	356.2	1.055	4.68	0201
202	356.4	1.097	4.69	0202
203	356.6	0.861	4.71	0203
204	356.8	0.768	4.72	0204
205	357.0	0.780	4.73	0205
206	357.2	0.861	4.74	0206
207	357.4	0.939	4.75	0207
208	357.6	0.987	4.77	0208
209	357.8	0.943	4.78	0209
210	358.0	0.726	4.80	0210
211	358.2	0.575	4.80	0211
212	358.4	0.563	4.81	0212
213	358.6	0.582	4.82	0213
214	358.8	0.755	4.83	0214
215	359.0	0.976	4.84	0215
216	359.2	1.117	4.86	0216
217	359.4	1.165	4.87	0217
218	359.6	1.210	4.89	0218
219	359.8	1.207	4.91	0219
220	360.0	1.160	4.93	0220
221	360.2	1.109	4.94	0221
222	360.4	1.044	4.96	0222
223	360.6	0.979	4.97	0223
224	360.8	0.960	4.99	0224
225	361.0	0.971	5.00	0225
226	361.2	0.981	5.01	0226
227	361.4	0.941	5.03	0227
228	361.6	0.799	5.04	0228
229	361.8	0.675	5.05	0229
230	362.0	0.778	5.06	0230
231	362.2	0.968	5.07	0231
232	362.4	1.103	5.09	0232

233	362.6	1.166	5.10	0233
234	362.8	1.206	5.12	0234
235	363.0	1.123	5.14	0235
236	363.2	1.013	5.15	0236
237	363.4	1.012	5.17	0237
238	363.6	1.124	5.18	0238
239	363.8	1.212	5.20	0239
240	364.0	1.152	5.22	0240
241	364.2	1.060	5.23	0241
242	364.4	1.003	5.25	0242
243	364.6	0.986	5.26	0243
244	364.8	0.986	5.28	0244
245	365.0	1.094	5.29	0245
246	365.2	1.231	5.31	0246
247	365.4	1.315	5.33	0247
248	365.6	1.351	5.35	0248
249	365.8	1.397	5.37	0249
250	366.0	1.410	5.39	0250
251	366.2	1.373	5.41	0251
252	366.4	1.333	5.42	0252
253	366.6	1.300	5.44	0253
254	366.8	1.269	5.46	0254
255	367.0	1.259	5.48	0255
256	367.2	1.284	5.50	0256
257	367.4	1.305	5.52	0257
258	367.6	1.248	5.54	0258
259	367.8	1.154	5.55	0259
260	368.0	1.096	5.57	0260
261	368.2	1.116	5.58	0261
262	368.4	1.147	5.60	0262
263	368.6	1.218	5.62	0263
264	368.8	1.312	5.64	0264
265	369.0	1.366	5.66	0265
266	369.2	1.316	5.67	0266
267	369.4	1.258	5.69	0267
268	369.6	1.279	5.71	0268
269	369.8	1.355	5.73	0269
270	370.0	1.371	5.75	0270
271	370.2	1.194	5.77	0271
272	370.4	0.996	5.78	0272
273	370.6	0.973	5.80	0273
274	370.8	1.091	5.81	0274
275	371.0	1.209	5.83	0275
276	371.2	1.327	5.85	0276
277	371.4	1.443	5.87	0277
278	371.6	1.322	5.89	0278
279	371.8	0.981	5.90	0279
280	372.0	0.721	5.92	0280
281	372.2	0.951	5.93	0281
282	372.4	1.220	5.94	0282
283	372.6	1.228	5.96	0283
284	372.8	1.176	5.98	0284
285	373.0	1.061	5.99	0285
286	373.2	0.931	6.01	0286
287	373.4	0.781	6.02	0287
288	373.6	0.677	6.03	0288
289	373.8	0.908	6.04	0289
290	374.0	1.175	6.06	0290

291	374.2	1.093	6.07	0291
292	374.4	0.926	6.09	0292
293	374.6	0.735	6.10	0293
294	374.8	0.623	6.11	0294
295	375.0	0.714	6.12	0295
296	375.2	1.051	6.13	0296
297	375.4	1.219	6.15	0297
298	375.6	1.109	6.17	0298
299	375.8	1.059	6.19	0299
300	376.0	1.137	6.20	0300
301	376.2	1.191	6.21	0301
302	376.4	1.190	6.23	0302
303	376.6	1.196	6.25	0303
304	376.8	1.221	6.27	0304
305	377.0	1.263	6.28	0305
306	377.2	1.332	6.30	0306
307	377.4	1.390	6.32	0307
308	377.6	1.418	6.34	0308
309	377.8	1.455	6.36	0309
310	378.0	1.515	6.38	0310
311	378.2	1.547	6.41	0311
312	378.4	1.513	6.43	0312
313	378.6	1.426	6.45	0313
314	378.8	1.228	6.47	0314
315	379.0	1.073	6.48	0315
316	379.2	1.062	6.50	0316
317	379.4	1.056	6.51	0317
318	379.6	1.019	6.53	0318
319	379.8	1.011	6.54	0319
320	380.0	1.108	6.56	0320
321	380.1	1.164	6.57	0321
322	380.2	1.216	6.58	0322
323	380.3	1.260	6.58	0323
324	380.4	1.304	6.59	0324
325	380.5	1.348	6.60	0325
326	380.6	1.387	6.61	0326
327	380.7	1.406	6.62	0327
328	380.8	1.426	6.63	0328
329	380.9	1.446	6.64	0329
330	381.0	1.446	6.65	0330
331	381.1	1.341	6.66	0331
332	381.2	1.237	6.67	0332
333	381.3	1.132	6.68	0333
334	381.4	1.043	6.69	0334
335	381.5	1.057	6.70	0335
336	381.6	1.071	6.71	0336
337	381.7	1.085	6.71	0337
338	381.8	1.092	6.72	0338
339	381.9	1.017	6.73	0339
340	382.0	0.942	6.74	0340
341	382.1	0.867	6.74	0341
342	382.2	0.794	6.75	0342
343	382.3	0.744	6.75	0343
344	382.4	0.695	6.76	0344
345	382.5	0.645	6.76	0345
346	382.6	0.596	6.77	0346
347	382.7	0.640	6.77	0347
348	382.8	0.684	6.78	0348

952.0	0.796	67.18	3146
954.0	0.785	67.29	3147
956.0	0.799	67.41	3148
958.0	0.796	67.52	3149
960.0	0.792	67.63	3150
962.0	0.791	67.75	3151
964.0	0.788	67.86	3152
966.0	0.780	67.97	3153
968.0	0.798	68.09	3154
970.0	0.783	68.20	3155
972.0	0.783	68.31	3156
974.0	0.767	68.43	3157
976.0	0.783	68.54	3158
978.0	0.781	68.65	3159
980.0	0.772	68.76	3160
982.0	0.774	68.87	3161
984.0	0.776	68.98	3162
986.0	0.758	69.09	3163
988.0	0.767	69.20	3164
990.0	0.763	69.31	3165
992.0	0.754	69.42	3166
994.0	0.756	69.53	3167
996.0	0.743	69.64	3168
998.0	0.743	69.74	3169
1000.0	0.741	69.85	3170
1005.0	0.725	70.11	3171
1010.0	0.723	70.37	3172
1015.0	0.722	70.63	3173
1020.0	0.716	70.89	3174
1025.0	0.725	71.15	3175
1030.0	0.700	71.41	3176
1035.0	0.695	71.65	3177
1040.0	0.679	71.90	3178
1045.0	0.686	72.15	3179
1050.0	0.668	72.39	3180
1055.0	0.659	72.63	3181
1060.0	0.650	72.86	3182
1065.0	0.648	73.10	3183
1070.0	0.640	73.33	3184
1075.0	0.631	73.55	3185
1080.0	0.621	73.78	3186
1085.0	0.614	74.00	3187
1090.0	0.612	74.22	3188
1095.0	0.599	74.44	3189
1100.0	0.608	74.66	3190
1105.0	0.601	74.87	3191
1110.0	0.602	75.09	3192
1115.0	0.588	75.30	3193
1120.0	0.578	75.51	3194
1125.0	0.568	75.72	3195
1130.0	0.565	75.92	3196
1135.0	0.562	76.12	3197
1140.0	0.556	76.32	3198
1145.0	0.554	76.52	3199
1150.0	0.543	76.72	3200
1155.0	0.552	76.92	3201
1160.0	0.538	77.11	3202
1165.0	0.528	77.30	3203

59	1170.0	0.531	77.50	3204
60	1175.0	0.523	77.68	3205
61	1180.0	0.512	77.87	3206
62	1185.0	0.509	78.05	3207
63	1190.0	0.508	78.23	3208
64	1195.0	0.498	78.42	3209
65	1200.0	0.492	78.59	3210
66	1205.0	0.489	78.77	3211
67	1210.0	0.484	78.95	3212
68	1215.0	0.494	79.12	3213
69	1220.0	0.475	79.29	3214
70	1225.0	0.474	79.47	3215
71	1230.0	0.476	79.64	3216
72	1235.0	0.468	79.80	3217
73	1240.0	0.466	79.97	3218
74	1245.0	0.453	80.14	3219
75	1250.0	0.461	80.30	3220
76	1255.0	0.451	80.47	3221
77	1260.0	0.432	80.62	3222
78	1265.0	0.426	80.78	3223
79	1270.0	0.427	80.93	3224
80	1275.0	0.441	81.09	3225
81	1280.0	0.424	81.25	3226
82	1285.0	0.426	81.39	3227
83	1290.0	0.431	81.55	3228
84	1295.0	0.427	81.70	3229
85	1300.0	0.427	81.85	3230
86	1305.0	0.418	82.01	3231
87	1310.0	0.409	82.16	3232
88	1315.0	0.406	82.30	3233
89	1320.0	0.407	82.45	3234
90	1325.0	0.402	82.60	3235
91	1330.0	0.396	82.74	3236
92	1335.0	0.392	82.88	3237
93	1340.0	0.390	83.02	3238
94	1345.0	0.387	83.16	3239
95	1350.0	0.380	83.30	3240
96	1355.0	0.375	83.43	3241
97	1360.0	0.372	83.57	3242
98	1365.0	0.364	83.70	3243
99	1370.0	0.363	83.83	3244
100	1375.0	0.363	83.96	3245
101	1380.0	0.359	84.09	3246
102	1385.0	0.359	84.22	3247
103	1390.0	0.354	84.35	3248
104	1395.0	0.353	84.47	3249
105	1400.0	0.349	84.60	3250
106	1405.0	0.346	84.72	3251
107	1410.0	0.343	84.85	3252
108	1415.0	0.341	84.97	3253
109	1420.0	0.340	85.09	3254
110	1425.0	0.345	85.22	3255
111	1430.0	0.335	85.34	3256
112	1435.0	0.329	85.46	3257
113	1440.0	0.325	85.57	3258
114	1445.0	0.317	85.69	3259
115	1450.0	0.322	85.81	3260
116	1455.0	0.306	85.92	3261

117	1460.0	0.316	86.03	3262
118	1465.0	0.311	86.14	3263
119	1470.0	0.311	86.25	3264
120	1475.0	0.307	86.37	3265
121	1480.0	0.303	86.47	3266
122	1485.0	0.299	86.58	3267
123	1490.0	0.304	86.69	3268
124	1495.0	0.301	86.80	3269
125	1500.0	0.297	86.91	3270
126	1505.0	0.296	87.01	3271
127	1510.0	0.292	87.12	3272
128	1515.0	0.292	87.22	3273
129	1520.0	0.288	87.33	3274
130	1525.0	0.292	87.43	3275
131	1530.0	0.284	87.54	3276
132	1535.0	0.277	87.64	3277
133	1540.0	0.278	87.73	3278
134	1545.0	0.277	87.84	3279
135	1550.0	0.276	87.93	3280
136	1555.0	0.275	88.03	3281
137	1560.0	0.273	88.13	3282
138	1565.0	0.267	88.23	3283
139	1570.0	0.264	88.32	3284
140	1575.0	0.263	88.42	3285
141	1580.0	0.259	88.51	3286
142	1585.0	0.256	88.61	3287
143	1590.0	0.250	88.70	3288
144	1595.0	0.251	88.79	3289
145	1600.0	0.252	88.88	3290
146	1605.0	0.247	88.97	3291
147	1610.0	0.249	89.05	3292
148	1615.0	0.248	89.14	3293
149	1620.0	0.245	89.23	3294
150	1625.0	0.249	89.32	3295
151	1630.0	0.246	89.41	3296
152	1635.0	0.242	89.50	3297
153	1640.0	0.238	89.58	3298
154	1645.0	0.239	89.67	3299
155	1650.0	0.238	89.75	3300
156	1655.0	0.238	89.84	3301
157	1660.0	0.237	89.93	3302
158	1665.0	0.233	90.01	3303
159	1670.0	0.232	90.09	3304
160	1675.0	0.224	90.18	3305
161	1680.0	0.225	90.26	3306
162	1685.0	0.223	90.34	3307
163	1690.0	0.223	90.42	3308
164	1695.0	0.218	90.50	3309
165	1700.0	0.221	90.57	3310
166	1705.0	0.216	90.65	3311
167	1710.0	0.207	90.73	3312
168	1715.0	0.216	90.80	3313
169	1720.0	0.209	90.88	3314
170	1725.0	0.200	90.95	3315
171	1730.0	0.194	91.03	3316
172	1735.0	0.193	91.09	3317
173	1740.0	0.195	91.16	3318
174	1745.0	0.189	91.27	3319

175	1750.0	0.191	91.30	3320
176	1755.0	0.193	91.37	3321
177	1760.0	0.188	91.44	3322
178	1765.0	0.186	91.51	3323
179	1770.0	0.180	91.57	3324
180	1775.0	0.176	91.64	3325
181	1780.0	0.174	91.70	3326
182	1785.0	0.173	91.76	3327
183	1790.0	0.172	91.82	3328
184	1795.0	0.176	91.88	3329
185	1800.0	0.172	91.95	3330
186	1805.0	0.171	92.01	3331
187	1810.0	0.163	92.07	3332
188	1815.0	0.163	92.13	3333
189	1820.0	0.162	92.19	3334
190	1825.0	0.159	92.24	3335
191	1830.0	0.159	92.30	3336
192	1835.0	0.153	92.35	3337
193	1840.0	0.156	92.41	3338
194	1845.0	0.154	92.47	3339
195	1850.0	0.151	92.52	3340
196	1855.0	0.148	92.58	3341
197	1860.0	0.146	92.63	3342
198	1865.0	0.146	92.68	3343
199	1870.0	0.138	92.73	3344
200	1875.0	0.138	92.78	3345
201	1880.0	0.143	92.83	3346
202	1885.0	0.141	92.88	3347
203	1890.0	0.140	92.93	3348
204	1895.0	0.141	92.98	3349
205	1900.0	0.136	93.03	3350
206	1905.0	0.139	93.08	3351
207	1910.0	0.141	93.13	3352
208	1915.0	0.139	93.18	3353
209	1920.0	0.137	93.23	3354
210	1925.0	0.135	93.28	3355
211	1930.0	0.135	93.33	3356
212	1935.0	0.134	93.38	3357
213	1940.0	0.132	93.43	3358
214	1945.0	0.130	93.47	3359
215	1950.0	0.129	93.52	3360
216	1955.0	0.124	93.57	3361
217	1960.0	0.128	93.61	3362
218	1965.0	0.128	93.66	3363
219	1970.0	0.127	93.70	3364
220	1975.0	0.132	93.75	3365
221	1980.0	0.127	93.80	3366
222	1985.0	0.125	93.84	3367
223	1990.0	0.123	93.89	3368
224	1995.0	0.125	93.93	3369
225	2000.0	0.118	93.97	3370
226	2005.0	0.112	94.01	3371
227	2010.0	0.116	94.06	3372
228	2015.0	0.114	94.10	3373
229	2020.0	0.115	94.14	3374
230	2025.0	0.115	94.18	3375
231	2030.0	0.112	94.22	3376
232	2035.0	0.109	94.26	3377

233	2040.0	0.109	94.30	3378
234	2045.0	0.110	94.34	3379
235	2050.0	0.106	94.38	3380
236	2055.0	0.104	94.41	3381
237	2060.0	0.102	94.45	3382
238	2065.0	0.097	94.49	3383
239	2070.0	0.101	94.52	3384
240	2075.0	0.103	94.56	3385
241	2080.0	0.099	94.60	3386
242	2085.0	0.098	94.63	3387
243	2090.0	0.100	94.67	3388
244	2095.0	0.093	94.70	3389
245	2100.0	0.095	94.74	3390
246	2105.0	0.095	94.77	3391
247	2110.0	0.089	94.80	3392
248	2115.0	0.092	94.83	3393
249	2120.0	0.089	94.87	3394
250	2125.0	0.089	94.90	3395
251	2130.0	0.089	94.93	3396
252	2135.0	0.087	94.96	3397
253	2140.0	0.092	95.00	3398
254	2145.0	0.084	95.03	3399
255	2150.0	0.083	95.06	3400
256	2155.0	0.081	95.09	3401
257	2160.0	0.084	95.12	3402
258	2165.0	0.082	95.15	3403
259	2170.0	0.084	95.18	3404
260	2175.0	0.079	95.21	3405
261	2180.0	0.077	95.23	3406
262	2185.0	0.069	95.26	3407
263	2190.0	0.074	95.28	3408
264	2195.0	0.075	95.31	3409
265	2200.0	0.084	95.34	3410
266	2205.0	0.077	95.37	3411
267	2210.0	0.077	95.40	3412
268	2215.0	0.074	95.43	3413
269	2220.0	0.079	95.45	3414
270	2225.0	0.077	95.48	3415
271	2230.0	0.077	95.51	3416
272	2235.0	0.066	95.53	3417
273	2240.0	0.061	95.55	3418
274	2245.0	0.073	95.58	3419
275	2250.0	0.077	95.61	3420
276	2255.0	0.077	95.64	3421
277	2260.0	0.072	95.66	3422
278	2265.0	0.073	95.69	3423
279	2270.0	0.066	95.71	3424
280	2275.0	0.065	95.73	3425
281	2280.0	0.070	95.76	3426
282	2285.0	0.067	95.78	3427
283	2290.0	0.067	95.81	3428
284	2295.0	0.066	95.83	3429
285	2300.0	0.067	95.86	3430
286	2305.0	0.064	95.88	3431
287	2310.0	0.063	95.90	3432
288	2315.0	0.059	95.92	3433
289	2320.0	0.054	95.94	3434
290	2325.0	0.056	95.96	3435

2330.0	0.056	95.98	3436
2335.0	0.060	96.01	3437
2340.0	0.059	96.03	3438
2345.0	0.061	96.05	3439
2350.0	0.062	96.07	3440
2355.0	0.064	96.09	3441
2360.0	0.066	96.12	3442
2365.0	0.062	96.14	3443
2370.0	0.062	96.16	3444
2375.0	0.058	96.18	3445
2380.0	0.056	96.20	3446
2385.0	0.061	96.22	3447
2390.0	0.060	96.25	3448
2395.0	0.059	96.27	3449
2400.0	0.055	96.29	3450
2405.0	0.056	96.31	3451
2410.0	0.057	96.33	3452
2415.0	0.054	96.35	3453
2420.0	0.058	96.37	3454
2425.0	0.055	96.39	3455
2430.0	0.059	96.41	3456
2435.0	0.055	96.43	3457
2440.0	0.052	96.45	3458
2445.0	0.050	96.47	3459
2450.0	0.051	96.48	3460
2455.0	0.052	96.50	3461
2460.0	0.049	96.52	3462
2465.0	0.054	96.54	3463
2470.0	0.049	96.56	3464
2475.0	0.054	96.58	3465
2480.0	0.051	96.59	3466
2485.0	0.048	96.61	3467
2490.0	0.055	96.63	3468
2495.0	0.047	96.65	3469

```
EXI
$WEO LPS
```

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$$
$REW LO
```