ASTRONOMY & ASTROPHYSICS
SUPPLEMENT SERIES

MAY 1988, PAGE 195

Astron. Astrophys. Suppl. Ser. **73,** 195-208 (1988)

Atlas of the wavelength dependence of ultraviolet extinction in the galaxy (*)

S. Aiello (1), B. Barsella (2), G. Chlewicki (3,4), J. M. Greenberg (4), P. Patriarchi (5) and M. Perinotto (6)

(1) Dipartimento di Fisica, University of Florence, via L. Pancaldo, 3/45, 50127 Firenze, Italy
(2) Istituto di Astronomia, University of Pisa, Italy
(3) Laboratory Astrophysics, University of Leiden, The Netherlands
(4) Laboratory for Space Research and Kapteyn Astronomical Institute, University of Groningen, The Netherlands
(5) Osservatorio Astrofisico di Arcetri, Florence, Italy
(6) Istituto di Astronomia, University of Florence, Italy

Received January 5, accepted May 18, 1987

Summary. — The paper presents a collection of 115 extinction curves derived from low dispersion IUE spectra. The spectra have been reduced with the use of techniques designed to reduce the effects of random noise and the influence of residual spectral features due to classification mismatch. The magnitudes of other instrumental and interpretational uncertainties are estimated. The extinction curves are presented with normalization to $E_{B\text{-}V} = 1$ and the far ultraviolet portion ($\lambda < 1700$ Å) is also shown for $E_{13\text{-}17} = 1$. The atlas includes examples of extinction originating in the diffuse medium and several major nebulae and dense clouds.

Key words : interstellar medium : extinction.

1. Introduction.

Systematic analysis of ultraviolet extinction provides one of the main sources of observational constraints on the composition of interstellar grain populations. Since its launch in 1978, the International Ultraviolet Explorer (IUE) has provided a large amount of data on interstellar extinction, which led to an improved picture of grain properties in various regions of the interstellar medium. However, most of this material has been presented in a very non-uniform way, which has often hampered the astrophysical interpretation of the data. In order to fill this gap in the existing literature, we have prepared a large set of uniformly reduced UV extinction curves, which should enable easy comparison between various region of the interstellar medium. The final data base was obtained by merging two samples collected independently in Florence and in Leiden, as a result of earlier work on UV extinction by the individual participants of the project (e.g., Aiello *et al.*, 1982 ; Barsella *et al.*, 1982 ; Greenberg and Chlewicki, 1983). The atlas contained in this paper (see microfiche), includes most of the previously known patterns of UV extinction and presents several new types of extinction curves.

The analysis of errors and uncertainties in the measurements of UV extinction obtained from IUE data has received detailed attention in the preparation of the atlas and its salient points are discussed in the following two sections. The relevant data for the stars included in the catalogue are tabulated in section 4, which is followed by the pictorial part of the atlas containing 115 extinction curves. A discussion of the implications of the data for the modelling of grains is contained in separate publications (Chlewicki, 1985 ; Chlewicki and Greenberg, 1986 ; Patriarchi *et al.*, 1988).

2. Selection of objects and derivation of extinction curves.

2.1 SELECTION CRITERIA. — The sample selected for the present study included most early-type spectra available in the IUE data bank before the end of 1984. The collection of IUE data was restricted to low resolution images, for which relatively reliable photometric calibration can be obtained ; the programme also included several OAO-2 spectra for some of the brightest comparison stars. We attempted to cover a variety of different areas, including well-known dense clouds (the Great

(*) Based on observations by the *International Ultraviolet Explorer,* retrieved from the Data Bank of the Villafranca Satellite Tracking Station of the European Space Agency.
Send offprint requests to : S. Aiello.

Carina Nebula, the Orion complex and the ρ Oph cloud), although most of the objects were expected to represent the properties of diffuse medium material. The sample was also intended to provide a good coverage of the galactic plane, including the local spiral arm and the adjacent inner and outer arms along with several stars located in more distant spiral features (Fig. 1). The spectral types were limited to those earlier than B9, with most stars (~ 95 %) having spectral classifications in the more restricted range O3-B3. Although almost all sample stars presumably belong to OB associations, specific assignments could be found in the literature only for ~ 70 % of the objects. The values of visual extinction for the sample span a wide range from $E_{B-V} \sim 0^{m}.25$ to $E_{B-V} \sim 1^{m}.30$. The essential parameters for all sample stars are listed in table IV in section 4. The instrumental quality of the spectra was used as one of the strongest selection criteria and resulted in reducing the number of extinction curves from more than 200 in the initial sample to 115 curves presented in this catalogue.

From the point of view of the astrophysical environment, the extinction curves presented in this atlas can be divided into two samples : those which represent « diffuse medium » extinction and those towards « dense cloud » objects. The « diffuse medium » sample includes objects in the direction of which no dense material is observed, and covers most of the studied lines of sight. The « diffuse medium » average curve is very close to the mean interstellar extinction curve compiled by Savage and Mathis (1979). The « dense cloud » sample includes

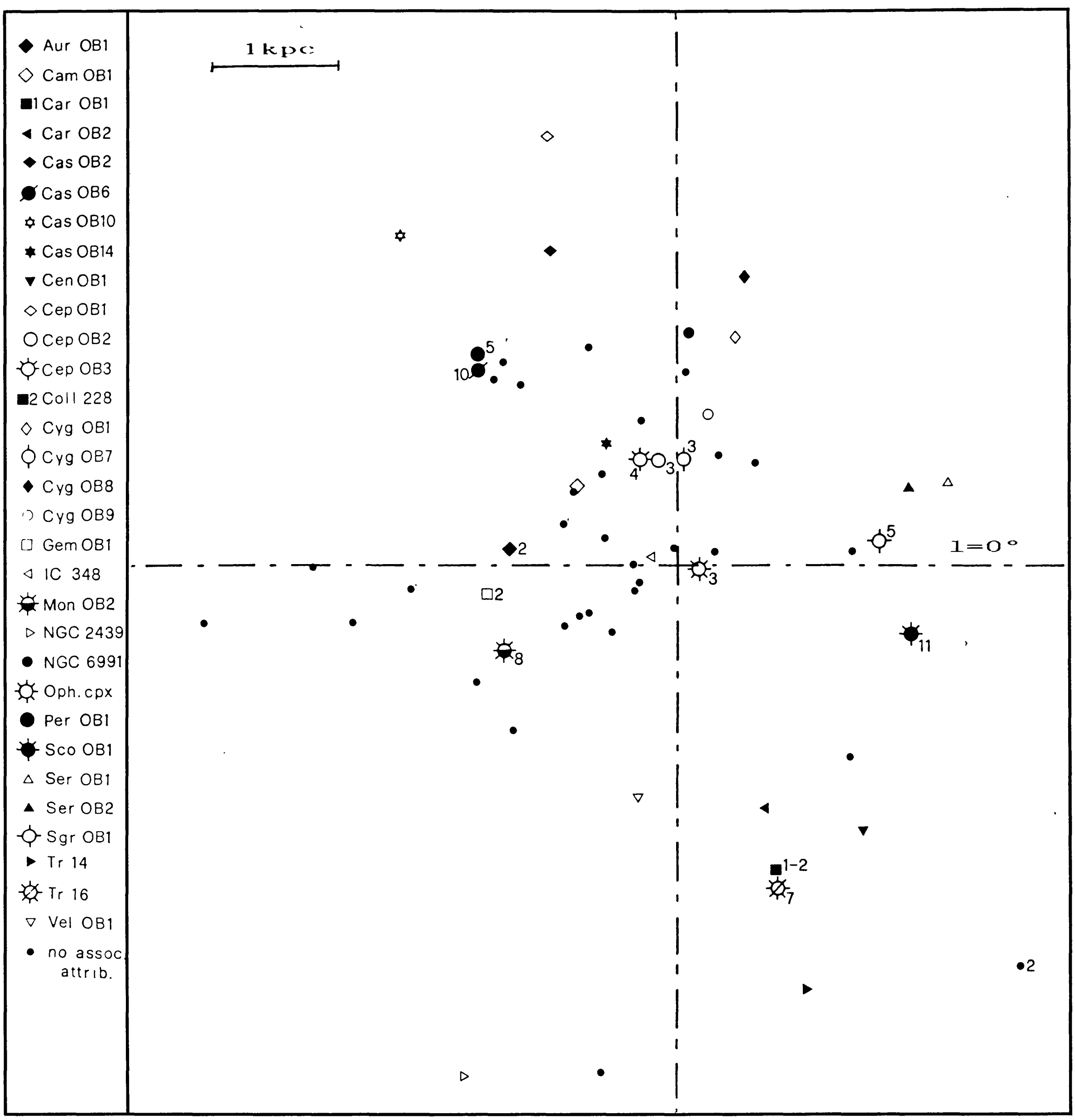

FIGURE 1. — Galactic distribution of the whole sample. Symbols indicate different associations. Numbers next to the symbols indicate the number of stars belonging to the given association.

TABLE I. — *Number of stars observed per* Sp/L.

L Class	03-04	05-09.5	B0-B3	B4-B9.5
I	1	7	12	6
II		1	1	
II-III	1	1	1	
III		13	7	
III-IV		1	1	
IV		4	4	
IV-V		1	1	
V	8	25	15	4
Total	10	53	42	10

the regions in which observational data (CO and other molecular emissions, IR and submillimetre emission) reveal the presence of dense interstellar matter and where the interstellar medium is strongly disturbed by the effects of recent and ongoing star formation.

2.2 DATA REDUCTION. — Each of the spectra from which the extinction curves presented in the catalogue were derived consists of at least two separate images, one for the shorter and one for the longer wavelengths, taken with one of the following IUE cameras: short wavelength prime (SWP, $1150 < \lambda < 2000$ Å), long wavelength redundant (LWR, $1800 < \lambda < 3300$ Å), and long wavelength prime (LWP, $1800 < \lambda < 3300$ Å). Since absolute calibration can only be obtained for spectra taken with the large IUE aperture, these images were selected in preference to small aperture data. For most heavily reddened stars in the sample ($E_{B-V} > 0^{\mathrm{m}}.4$), two long wavelength exposures were required to provide a sufficient dynamic range for the 2200 Å hump. For all such stars, at least one long wavelength image was taken with the large aperture, and the relative calibration, should the second image be with the small aperture, was obtained by comparing average fluxes in an interval of 50-200 Å which was usually selected in the range 2300-2600 Å. In general, the accuracy of the fluxes obtained by merging several spectra was comparable to the photometric accuracy of the calibration (see the discussion of calibration errors in Sect. 3); several objects in which low signal to noise (S/N) ratio resulted in less reliable fluxes have been individually indicated in table IV. The absolute calibration of the spectra preceded their merging into a single composite image and was based on the results of Bohlin and Holm (1981) and those of Cassatella and Harris (1983).

Although most of the reduction was carried out on extracted spectra, spatially resolved line-by-line data were also processed for spectra affected by the faulty intensity transfer function (Holm, 1979), for which the corrective algorithm of Cassatella *et al.* (1980) was applied.

The set of stars observed by IUE in low dispersion suitable to be used as standard stars turned out to be incomplete for purpose of this study, especially for high luminosity classes and was supplemented with spectra of six stars from the OAO-2 catalogue of Code and Meade (1979). All IUE images were reduced to a form directly compatible with the OAO data by convolution with a Gaussian of 20 Å width and transformation to a uniform 20 Å-spaced wavelength grid. The relative calibration for the two instruments is discussed in section 3.

The existence of strong lines in UV spectra of early-type stars, which are at best matched only approximately by comparison objects, leaves residual features in the extinction curves which for the earliest types may significantly distort the extinction curves (CIV at λ 1548 Å and SiIV at λ 1400 Å). The effects of such features were reduced in our sample of extinction curves by applying a smoothing algorithm which included a median filter and a double-pass running average. The FWHM of the filter was ~ 50 Å for $\lambda < 2000$ Å and ~ 85 Å at longer wavelengths (the difference in width accounts for the variation in the sampling frequency of IUE spectra). Several artefacts in the spectra, such as particles spikes and the permanent blemish in the LWR camera at λ 2200 Å were removed by interpolation.

2.3 DERIVATION OF EXTINCTION CURVES. — For an unreddened comparison star, the normalized extinction may be expressed as:

$$A(\lambda\,;\lambda_1,\lambda_2)=\frac{\Delta m_*(\lambda,\lambda_1)-\Delta m_0(\lambda,\lambda_1)}{\Delta m_*(\lambda_2,\lambda_1)-\Delta m_0(\lambda_2,\lambda_1)} \tag{1}$$

$$A(\lambda_1\,;\lambda_1,\lambda_2)=0\,; \tag{1'}$$

$$A(\lambda_2\,;\lambda_1,\lambda_2)=1\,; \tag{1''}$$

where the colour index, m is defined as $\Delta m(\lambda,\lambda_1) = -2.5 \log [F(\lambda)/F(\lambda_1)]$; λ_1 and λ_2 represent normalization wavelengths; asterisks denote quantities referring to a programme star, and 0 indicates the energy distribution of an unreddened standard.

Stars used as comparison objects can be reddened by as much as $E_{B-V} \sim 0^{\mathrm{m}}.1$, the extinction obtained by subtracting such spectra is therefore different from the value defined by equation (1):

$$A'(\lambda\,;\lambda_1,\lambda_2)=\frac{\Delta m_*(\lambda,\lambda_1)-\Delta m_c(\lambda,\lambda_1)}{\Delta m_*(\lambda_2,\lambda_1)-\Delta m_c(\lambda_2,\lambda_1)} \tag{2}$$

where subscript c refers to a lightly reddened comparison star and distinguishes its parameters from those of the unreddened stellar continuum.

A simple rearrangement of terms in equation (1), leads to the following relation between the two values of extinction:

$$A(\lambda\,;\lambda_1,\lambda_2)=A'(\lambda\,;\lambda_1,\lambda_2)+\\ +[A_c(\lambda\,;\lambda_1,\lambda_2)-A'(\lambda\,;\lambda_1,\lambda_2)]\times\\ \times\frac{E_c(\lambda_1,\lambda_2)}{E_*(\lambda_1,\lambda_2)}\,. \tag{3}$$

The colour excess, E, is defined by $E(\lambda_1,\lambda_2)=\Delta m(\lambda_2,\lambda_1)-\Delta m_0(\lambda_2,\lambda_1)$; A_c represents the extinction for the line of sight towards the comparison star. A_c cannot be determined observationaly and is in practice replaced by the average extinction curve for the sample.

Spectral classification determines the ultimate accuracy of the extinction curves and was therefore given particular in the preparation of this catalogue. Most classifications were derived from a critical collation of the data available in the literature (see Tab. II). All stars were also classified independently using the UV scheme developed by Heck *et al.* (1984). The UV classification appears to be more reliable for early spectral types and was therefore given precedence in cases when there was significant disagreement with optical determinations of spectral type. The ultimate accuracy of classifications listed in table I appears to be within 1 subclass in spectral type. The luminosity classification appears to provide a reliable distinction between supergiants, giants and dwarfs. Somewhat more accurate classification (within 0.5 subclass) was attempted for early B-type stars, whose UV continua are particularly strongly dependent on the spectral type.

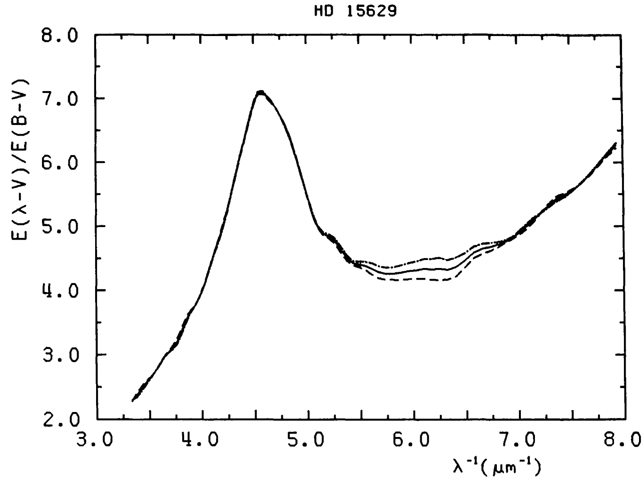

FIGURE 2. — The effects of changes in the comparison spectrum on the extinction curve derived for O-type star. All curves are for HD 15629 (Cas OB6, $Sp/L =$ O5 V, $E_{B-V} = 0.75$). Solid line : comparison spectrum interpolated as described in the text ; dashed line : 15 Mon (O7 V) used for comparison ; dash-dot : ζ Pup (O41 f) as a comparison star.

TABLE II. — *Errors in ultraviolet fluxes (magnitudes) due to a spectral mismatch of 1 subclass.*

Sp/L	λ = 1300 A	λ = 1700 A	λ = 2200 A	λ = 2500 A
Sp < O8	0.20	0.20	0.15	0.15
B1V	0.55	0.45	0.40	0.40
B1I	0.35	0.20	0.15	0.10
B5V	0.50	0.35	0.35	0.25
B5I	0.40	0.25	0.25	0.20
B8V	1.15	0.75	0.60	0.55
B8I	0.40	0.30	0.30	0.25

The derivation of extinction curves for early O-type stars required a different procedure as a result of the scarcity of lightly reddened comparison stars (for spectral types earlier than O8 the only comparison stars are a O7 dwarf, 15 Mon, and a O4If supergiant, ζ Pup). The method applied for these stars was based on the observation that in spit of large differences in line spectra, the continua of early-type stars are almost identical for spectral types earlier than O8 (Fig. 1). The comparison spectrum was calculated as a weighted average of the spectra of 15 Mon, and ζ Pup with weights depending on the spectral type of the star. The errors introduced by this procedure appear to be comparable with instrumental uncertainties and are lower than the errors due to inaccurate classification for B stars. The uncertainties are entirely negligible outside the region $5.5 < \lambda^{-1} < 7.7\ \mu m^{-1}$.

3. Error analysis.

3.1 RANDOM NOISE IN IUE SPECTRA. — There are several sources of noise in IUE spectra associated predominantly with the difficult calibration and limited stability of the detectors. Apart from the quantum noise in the number of incoming photons, the most significant contributions come from the non-uniform response of the cameras, noise generated in the readout sections and telemetry, inaccuracies in the intensity transfer functions (ITF's) used to linearize the response of individual pixels, and uncertainties in the alignment of the spectrum with respect to flatfield exposures from which the ITF's are derived. Further sources of noise arise from radiation background, particles spikes and variations in the zero-level pedestal. The complex design of the camera and the highly non-uniform and non-linear response of the detectors make it difficult to estimate the quantum noise in the number of primary electrons generated in the target plate of the camera. In this study, the quantum noise was derived from the linearized fluxes using an approximate relation derived by Bohlin *et al.* (1980). The background noise, σ_B, which includes non-uniformities of the zero-level pedestal, thermal noise in the camera and, to some extent, radiation background, was estimated on the basis of the average background signal measured several pixels away from the projected image of the aperture and normalized to the same effective slit width. These two sources of noise were treated as independent and the effective S/N ratios quoted in table IV were derived using $\sigma = \sqrt{(\sigma_q^2 + \sigma_b^2)}$. Since the smoothing was based on an algorithm with an effective filter width of 21 points, the S/N ratios for smoothed spectra can be obtained by multiplying the numbers in table IV by 4.6. The increased noise resulting from the reduced extraction slit width in spectra processed with new IUE software (Bohlin *et al.*, 1981) was accounted for in the calculations, and no additional corrections are necessary.

3.2 ESTIMATED MAGNITUDE OF ERRORS. — We have divided the possible sources of error into several groups, whose influence on the extinction curves will be discussed separately. For each of these categories, an estimate of the uncertainty introduced in the extinction curves can be derived by retaining only the appropriate linear terms in the power series expansion of equations (1) and (3) :

1) Deviation of A_c form the average curve :

$$\Delta A = \Delta A_c \frac{E_c}{E_*} . \tag{4}$$

2) Instrumental errors :

$$\Delta A = 2 \frac{\Delta m^{(i)}}{E_*} . \tag{5}$$

3) Spectral mismatch :

$$\Delta A = \frac{\Delta m^{(s)}}{E_*} + A \frac{\Delta E}{E_*} ; \tag{6}$$

where $\Delta m^{(s)}$ is the magnitude error resulting from spectral mismatch and ΔE represents the error in the value of the colour excess. The error due to incorrect classification of the comparison spectrum can be derived from equation (6) by substituting $A_c . \Delta E_c/E_*$ for $A . \Delta E/E_*$.

All of these categories of errors are individually discussed below.

1) The deviation of A_c from the average is rather difficult to estimate directly. These are indications that O9V comparison stars may be affected by this error with a magnitude of ~ 1.5 at λ1300 Å in the E_{B-V} normalization. Assuming that, in general, ΔA_c should not exceed the maximum deviation from the average curve observed in the diffuse medium, which amounts to ~ 2.0 at λ1300 Å, the magnitude of the error is 2 E_c/E_* (from an analysis of the scatter of the extinction within associations, this value seems to be a gross overestimate of the real effect ; see Tab. III below).

TABLE III. — *Standard deviations of UV extinction for OB associations.*

Association	E_{B-V} = 1				E_{13-17} = 1
	λ = 1300 A	λ = 1700 A	λ = 2160 A	λ = 2500 A	λ = 1500 A
Cas OB6	0.38	0.19	0.14	0.15	0.019
Mon OB2	0.37	0.24	0.23	0.15	0.024
Sco OB1	0.46	0.23	0.15	0.17	0.061

2) The most important sources of instrumental uncertainties appear to be associated with variations in the sensitivity of the IUE detectors and wavelength calibration. The sensitivity variations have a 1 σ value of 3 % but may reach 10 % in individual spectra (Bohlin *et al.*, 1980). They appear to affect the whole spectrum independently of the wavelength and therefore do not increase the errors in colour excesses, such as $E_{13\text{-}17}$. A 3 % error is also estimated for the calibration function of Bohlin and Holm (1981). This function is free from the systematic errors which existed in the calibration function of Bohlin *et al.* (1980), giving rise to a 10-15 % mismatch between short and long wavelength images.

The relative calibration of IUE and OAO spectra was derived from the comparison of data for 4 stars observed by both instruments. The calibration function obtained in this programme differed by about 10 % from the results of Bohlin *et al.* (1980), presumably as a consequence of the improved IUE calibration. Systematic errors may be as high as 10 % for both spectrographs, but their effects are cancelled in the subtraction of logarithmic spectra.

Because of the steepness of the UV continumm in many stars, wavelengths errors may significantly affect the photometry. The rms deviation in the IUE wavelength calibration is ~ 3 Å (Turnrose *et al.*, 1981), but much larger error reaching a few resolution elements may occur as a result of thermal distortions in the imaging section of the camera. The largest wavelength misalignment measured in our sample was 6.7 Å, with typical values consistent with the 1σ deviation estimated by Turnrose *et al.* (1980). For a typical early-type spectrum (15 Mon), the 1 σ wavelength shift correspond to a photometric error of $0^m.03$, and the maximum value measured in this programme yields $0^m.06$. For HD 183143 (Sp = B7Ia, E_{B-V} = 1.28), which has the steepest FUV gradient in the sample, the corresponding numbers are $0^m.09$ and $0^m.17$.

The exposure times for all stars were corrected for the effects of discrete timing by the onboard computer (Heck and Patriarchi, 1982) ; the remaining uncertainty corresponds to a single command cycle of the computer and amounts to ± 0.03 s. For the shortest exposures used for some of the calibration stars in this programme (0.5 s), this uncertainty result in a photometric error of $0^m.06$.

The total rms value of the instrumental error, with the assumption that the individual sources of error are independent, is ~ $0^m.15$. Most of the spectra for which the errors appeared to be significantly larger than this value were not included in the sample presented in the catalogue. Several low quality images were retained because of their astrophysical interest.

3) The magnitude of errors due to spectral mismatch has been estimated by comparing unreddened stars with spectral classifications differing by one sub-class, which corresponds to the typical spectral class uncertainty in the sample. The results have been collected in table II for several spectral types represented in the atlas. The numbers have been derived by normalizing the pairs of spectra selected for comparison to the same visual magnitude. With a typical error in the spectral classification of 0.5-1 subclass, the magnitude of spectral classification errors is comparable to instrumental effects, except for the late B stars, for which it can be much larger. The errors in UV colour excesses, such as

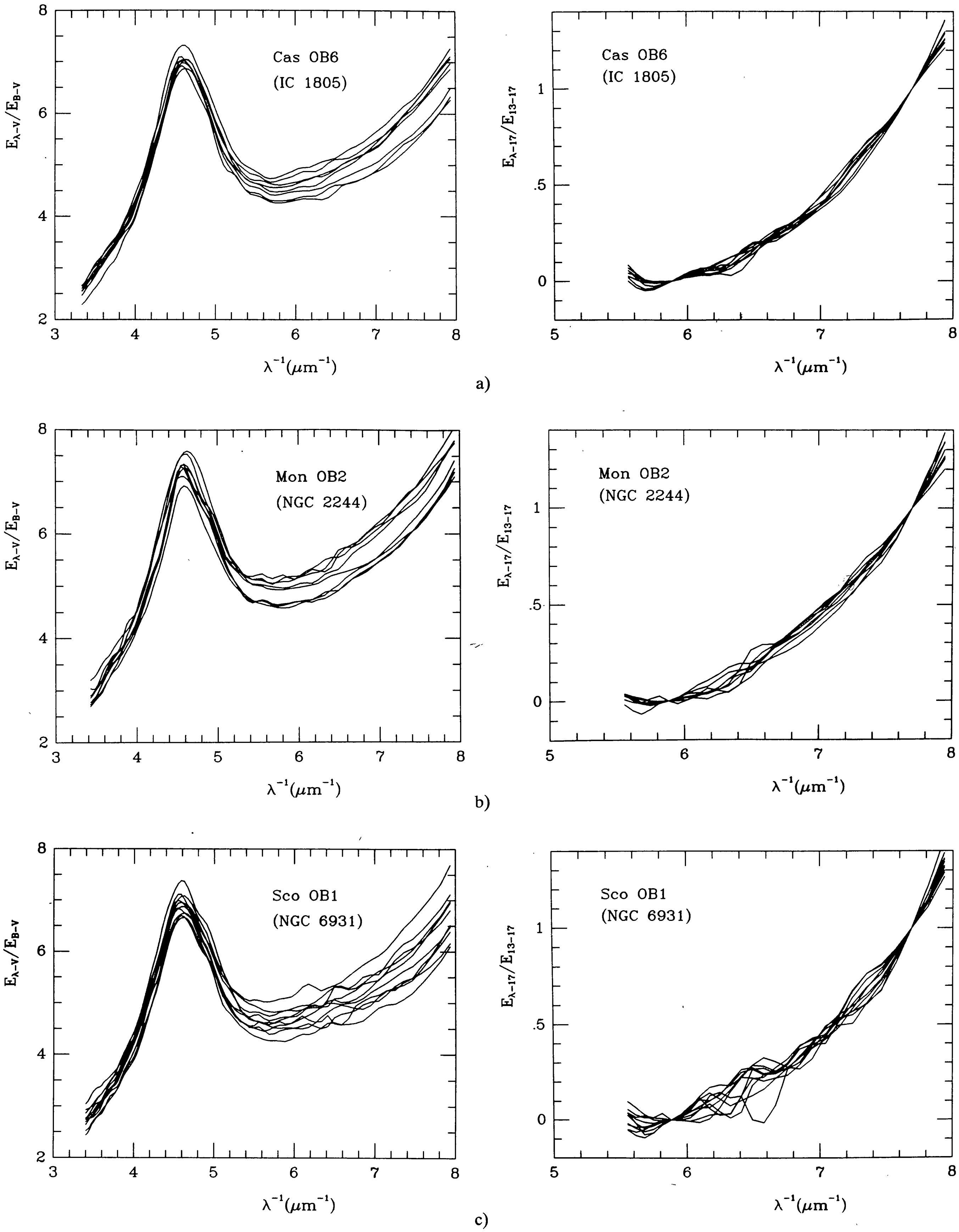

FIGURE 3. — Extinction curves for stars in selected OB associations. The open cluster at the core of each association has been indicated in parenthesis.

$E_{13\text{-}17}$, are generally much smaller, with typical values for all spectral types earlier than B5 of $0^m.20$ for $E_{13\text{-}17}$ and $0^m.15$ for $E_{22\text{-}25}$. Much less material is available for an estimate of the effects of luminosity mismatch. For early B types, where luminosity misclassification is frequent in the literature, the difference in UV fluxes between a dwarf and a giant is of similar magnitude as the effect of a one subclass spectral mismatch, but the luminosity determination is made much more accurate by the use of very sensitive UV criteria. These effects are illustrated by several curves for stars in the Perseus arm (Hiltner 188, BD+59 374, BD+55 393) contained in the catalogue, which appeared to have increased levels of FUV extinction (Morgan *et al.*, 1982), but turn out to be very close to the average curve when correct *Sp/L* classifications are used.

An estimate of the combined effect of all uncertainties is derived from the scatter of extinction values within selected associations, which show an extinction pattern close to the diffuse medium average with no suggestion of variations from star to star except for instrumental effects. Three such associations have been included in our sample : Cas OB6 (IC 1805), Mon OB2 (NGC 2244), and Sco OB1 (NGC 6231). Individual curves for these associations have been shown in figure 3 and the standard deviations from the average at several wavelengths have been collected in table III. The values we have obtained are in general similar to those derived for individual associations by Massa and Fitzpatrick (1985) except at 1300 Å, where our error estimates tend to be larger, presumably as a result of a wider spread of spectral types in our sample. The very high standard deviation at 1500 Å in Sco OB1 seems to be due to the unusual strength of the λ 1548 lines of CIV in early B stars in this association, which was noticed by Mass and Fitzpatrick (1985). The values listed in table II can be used as the most reliable estimates of errors expected for all stars in the sample.

4. Primary data for target and standard stars.

4.1 PRESENTATION OF TABLES IV AND V. — Read from left to right the table contains the following information :

Running Number (from 1 to 115) : in this table the stars are sorted in order of increasing galactic longitudes. Tables VII give the cross-references between star catalog numbers (HD or BD) and running numbers.

BD or HD Catalogues number and Alias.

Position : Right Ascension and Declination for the epoch 1950. The values are taken from Ochsenbein *et al.* (1979).

Galactic Longitude and Latitude.

Distances : mostly derived from the corrected distance modulus ($m - M = 5 \log D - 5$), the values of M are taken from Allen (1976). In several cases distances adopted from Humphreys (1978).

Association Membership : mostly from Ruprecht (1966), Schild *et al.* (1971), Humphreys (1978), Garmany *et al.* (1982).

Sp. T./L. : a comprehensive bibliography for the spectral class and luminosity of each star in our sample is reported in table Va, b, c. The label IUE means that the spectral type given in the table is based upon UV classification criteria (Heck *et al.*, 1984). The assumed *Sp./L.* class is underlined.

m_v, $B\text{-}V$: the values are taken mostly from Nicolet (1978).

IR magnitudes (J, H, K, L) : mostly from Gezari *et al.* (1984). Other sources are Castor and Simon (1983), Leitherer and Wolf (1984), Lopez and Walsh (1984).

$E(B\text{-}V)$: $(B\text{-}V) - (B\text{-}V)_0$ with $(B\text{-}V)_0$ taken from Fitzgerald (1980).

$E(V\text{-}K)$: $(V\text{-}K) - (V\text{-}K)_0$ with $(V\text{-}K)_0$ taken from Whittet and Van Breda (1980).

$E(13\text{-}17)$, $E(22\text{-}25)$, $E(22\text{-}V)$: derived from extinction data. This entry has been omitted for stars with either uncertain spectral classification or a poor signal-to-noise ratio.

R : computed assuming $R = 1.1 \times [E(V\text{-}K)/E(B\text{-}V)]$. Because of uncertainties in intrinsic colours for early O-type stars, the values for such objects are unreliable.

Standard Number : the running number of the standard stars in table V.

IUE Images : the numbers of the IUE images used to derive the extinction curves.

S/N : signal to noise ratio at the following wavelengths :

1300 Å-1600 Å-2100 Å-2700 Å .

4.2 EXTINCTION CURVES. — The extinction curves of each stars in the sample are presented with normalization to $E_{B\text{-}V} = 1$. The far ultraviolet portion ($\lambda < 1700$ Å) is shown also with normalization to $E_{13\text{-}17} = 1$.

For sake of comparison the average extinction curve for diffuse medium (dashed curve) and the average curve for the association to which the star belongs when in point (dashed-dotted curve) are shown.

Note added in proof: in table VIIa, the star Hiltner 188 is quoted as BD+59 1543.

References

AIELLO, S., BARSELLA, B., GUIDI, I., PENCO, U. and PERINOTTO, M. : 1982, *Astrophys. Space Sci.* **87,** 463.
ALLEN, C. W. : *Astrophysical Quantities* (The Athlone Press, London) 1977.
BARSELLA, B., PANAGIA, N., PERINOTTO, M. : 1982, *Astron. Astrophys.* **111,** 130.
BOHLIN, C. V., HOLM, A. V., SAVAGE, B. D., SNIJDERS, M. A. J. and SPARKS, W. M. : 1980, *Astron. Astrophys.* **85,** 1.
CASSATELLA, A., HOLM, A. V., PONZ, D. and SCHIFFER, III, F. H. : 1980, *ESA IUE Newsletters* **5,** 5.
CASSATELLA, A. and HARRIS, A. N. : 1983, *ESA IUE Newletters* **17,** 12.
CASTOR, J. I. and SIMON, T. : 1983, *Astrophys. J.* **265,** 304.
CHEWICKI, G. : 1985, *Thesis.*
CHLEWICKI, G. and GREENBERG, J. M. : 1986, in *Light on Dark Matter,* F. P. Israel Ed. (Reidel) p. 191.
CODE, A. D. and MEADE, M. R. : 1979, *Astrophys. J. Suppl. Ser.* **39,** 195.
GARMANY, C. P., CONTI, P. S. and CHIOSI, C. : 1982, Catalog of Galactic O-Type Stars, *Astrophys. J.* **263,** 277.
GEZARY, D. Y., SCHMITZ, M. and MEAD, J. M. : 1984, Catalog of Infrared observations, NASA Reference Publications 1118.
GREENBERG, J. M. and CHLEWICKI, G. : 1983, *Astrophys. J.* **272,** 563.
HECK, A. and PATRIARCHI, P. : 1982, *ESA IUE Newletters* **13,** 40.
HECK, A., EGRET, D., JASCHEK, M. and JASCHEK, C. : 1984, IUE Low- Dispersion Reference Atlas, Part. I. Normal Stars, ESA SP-1052.
HOLM, A. V. : 1979, *ESA IUE Newsletters* **4,** 5.
HUMPHREYS, R. : 1978, *Astrophys. J. Suppl. Ser.* **38,** 309.
LEITHERER, C. and WOLF, B. : 1984, *Astron. Astrophys.* **132,** 151.
LOPEZ, J. A. and WALSH, J. R. : 1984, *Rev. Mex. Astron. Astrofis.* **9,** 95.
MASSA, D. and FITZPATRICK, E. L. : 1985, *Astrophys. J. Suppl. Ser.* **60,** 305.
MORGAN, D. H., MCLACHLAN, A. and NANDY, K. : 1982, *Mon. Not. R. Astron. Soc.* **198,** 779.
NICOLET, B. : 1975, *Astron. Astrophys. Suppl. Ser.* **22,** 239.
OCHSENBEIN, F., BISCHOFF, M. and EGRET, D. : 1981, Catalogue of Stellar Identification, *Astron. Astrophys. Suppl. Ser.* **43,** 2599.
PATRIARCHI, P., CHLEWICKI, G., AIELLO, S., BARSELLA, B., GREENBERG, J. M., PERINOTTO, M. : 1988, in preparation.
RUPRECHT, J. : 1966, *Trans. IAU* **12B,** 350.
SHILD, R., NEUGEBAUER, G. and WESTPHAL, J. A. : 1971, *Astron. J.* **76,** 973.
TURNROSE, B. E., HARVEL, C. A. and STONE, D. F. : IUE Image Processing Manual Version 1.1, CSC/TM-81/6268.
WHITTET, D. C. B. and VAN BREDA, I. G. : 1980, *Mon. Not. Astron. Soc.* **192,** 467.

Atlas is to be found on one microfiche on cover three.

TABLE IV. — *Primary data for target stars.*

n.	star name (and alias)	RA	δ	l	b	r	Assoc.	Sp/L	m_V	B-V	J	H	K	L	E(B-V)	E(V-K)	E(13-17)	E(22-25)	E(22-V)	R	Std N	IUE images		S / N			
001	HD 162978	17 51 49.2	-24 52 43	4.5	+00.3	1.36	—	O8.5 III f	6.20	0.04	6.03	6.02	6.00	5.98	0.35	1.1	0.305	0.914	2.294	3.46	8	SWP8067L	LWR7033L	40	30	8	20
002	HD 164794 (9 Sgr)	18 00 47.3	-24 21 48	6.0	-01.2	1.58	Sgr OB1	O4 V	5.97	0.00	5.74	5.74	5.71	5.83	0.32	1.18	0.318	0.804	2.181	4.06	23	SWP8696L	LWR7443L	50	40	8	35
003	HD 164816	18 00 53.0	-24 18 56	6.1	-01.2	1.58	Sgr OB1	B0 V, O9 III p, O9 IV-V (IUE)	7.06	0.00					0.30		0.311	0.768	2.006		17	SWP14195L	LWR10788L	75	55	20	50
004	HD 165052	18 02 06.5	-24 24 11	6.1	-01.5	1.58	Sgr OB1	O6.5 V, O7 V	6.87	0.11					0.43		0.340	1.015	2.771		8	SWP14197L	LWR10790L	70	55	15	60
005	HD 164492	17 59 21.3	-23 01 54	7.0	-00.3	1.58	Sgr OB1	O7 I, O7.5 III, O7 V	7.63	0.00		7.32	7.17	7.24	0.31	1.38				4.90	8	SWP13463S	LWR10123L	40	30	30	20
006	HD 166937 (μ Sgr)	18 10 46.3	-21 04 26	10.0	-01.6	1.58	Sgr OB1	B8 I a	3.86	0.23					0.24						11	SWP6555L	LWR5654L	20	25	10	0
007	HD 168076	18 15 46.2	-13 49 16	16.9	+00.8	2.19	Ser OB1	O4 f, O4 V	8.21	0.48	6.90	6.66	6.68	6.68	0.80	2.45	1.157	1.976	4.957	3.97	23	SWP8697L	LWR7446L	40	50	2	30
008	HD 168112	18 15 52.8	-12 07 39	18.4	+01.6	1.90	Ser OB2	O5 III (f), O5.5 f	8.52	0.69	7.01	6.75	6.65	6.54	1.01		1.285	3.177	7.304		23	SWP8698L	LWR7445L	35	40	1	30
009	HD 154445	17 02 57.4	-00 49 28	19.3	+22.9	0.34	—	B1 V, B1.5 V	5.64	0.16	5.28	5.33	5.29	5.35	0.42	1.06				2.76	13	SWP11140L	LWR9769L	45	35	25	100
010	HD 183143	19 25 13.2	+18 11 36	53.2	+00.6	1.00	—	B7 Ia, B6 I a	6.87	1.24	4.13		3.47	3.22	1.28	3.39				2.91	11	SWP6550L	LWR5638L	10	25	1	0
011	HD 190603	20 02 38.3	+32 04 33	69.5	+00.4	0.92	—	B1.5 I a	5.64	0.54	4.50	4.14	4.11	4.12	0.72	1.99				3.04	19	SWP7366L	LWR7299L	25	25	1	20
012	HD 193682	20 18 17.7	+37 40 20	75.9	+00.8	1.82	Cyg OB1	O5, O5 V	8.41	0.51					0.83		0.884	2.461	6.297		8	SWP14010L	LWR10663L	30	30	4	30
013	HD 192281	20 10 46.7	+40 07 00	77.1	+03.4	2.29	Cyg OB8	O5.5 af, O5 V	7.55	0.38					0.70		1.284	1.980	5.060		8	SWP8700L	LWR7447L	35	40	2	25
014	HD 229196	20 21 23.9	+40 42 48	78.8	+02.1	1.20	Cyg OB9	O6 III	8.54	0.90					1.22						23	SWP14009L	LWR10662L	10	15	2	10
015	HD 198478 (55 Cyg)	20 47 13.9	+45 55 40	86.7	+01.6	0.83	Cyg OB7	B3 I a	4.84	0.41	3.89	3.78	3.67	3.62	0.54	1.17	0.759	1.668	3.795	2.93	20	SWP8563L	LWR7301L	25	35	2	35
016	HD 199579	20 54 48.7	+44 43 53	85.7	-00.3	2.51	Cyg OB7	O6 V, O6.5 III	5.96	0.05		5.88	5.9		0.37	1.00				2.97	8	SWP9429L	LWR8535L	25	30	10	25
017	HD 199478	20 54 08.3	+47 13 30	87.5	+01.4	1.80	NGC 6991	B8 I a	5.67	0.47	4.53	4.39	4.32	4.26	0.48	1.35	0.779	1.395	3.322	2.93	11	SWP7596L	LWR6573L	30	40	6	40
018	HD 197512	20 40 36.3	+49 33 16	87.9	+04.6	1.51	—	B1 V, B1.5 V	8.58	0.07					0.32		0.549	0.906	2.263		14	SWP14588L	LWR11184L	60	55	10	60
019	HD 199216	20 52 15.4	+49 20 32	88.9	+03.0	0.83	Cyg OB7	B1 II, B1 III, B2 II (IUE)	7.03	0.48			6.01	5.99	0.74	1.77	1.311	1.922	5.185	2.63	18	SWP13461L	LWR10121L	20	25	8	20
020	HD 239729	21 37 54.0	+57 15 23	99.3	+03.7	0.83	Cep OB2	B0 V, O9 V (IUE)	8.35	0.36					0.66		1.556	1.401	4.211		17	SWP13451L	LWR10114LS	25	30	20	30
021	HD 206165 (9 Cep)	21 36 34.7	+61 51 21	102.3	+07.2	0.83	Cep OB2	B2 I b	4.73	0.30	4.18	4.11	4.06	4.03	0.47	1.06	1.155	1.325	3.404	2.49	19	SWP7365S	LWR6357S	30	35	5	35
022	HD 207198	21 43 30.7	+62 13 46	103.1	+07.0	0.83	Cep OB2	O9 I-II, O9 I, O9 II-III (IUE)	5.95	0.31	5.41		5.35		0.59	1.41	1.567	1.691	4.145	2.63	10	SWP14008L	LWR10660SL	20	20	5	25
023	HD 200775	21 00 59.6	+67 57 55	104.1	+14.2	0.15	—	B5 V e, B3 e	7.35	0.38	6.04	5.42	4.49	3.59	0.54	3.18				6.25	12	SWP5967L	LWR5178SL	25	25	15	25
024	HD 209339	21 59 09.4	+62 14 49	104.6	+05.9	1.17	—	B0 IV, O9 V (IUE)	6.66	0.06					0.36						17	SWP13450L	LWR10113L	35	30	15	40
025	HD 215835	22 44 54.2	+57 49 14	107.1	-00.9	3.47	Cep OB1	O5.5, O6 V	8.58	0.32					0.64		1.496	1.658	4.385		8	SWP14633L	LWR11223L	20	25	6	25
026	HD 216532	22 50 34.2	+62 10 29	109.7	+02.7	0.87	Cep OB3	O8.5 V, O8 V	8.01	0.55					0.86		1.094	2.133	5.830		17	SWP7639L	LWR7154L	35	35	2	25
027	HD 216898	22 53 44.1	+62 02 20	109.9	+02.4	0.87	Cep OB3	O9 IV, O9 V	8.02	0.54			6.83	6.70	0.85	2.07	1.056	2.402	5.953	2.68	17	SWP7640L	LWR6647LS	40	35	10	25
028	HD 217086	22 54 48.9	+62 27 34	110.2	+02.7	0.87	Cep OB3	O6.5, O7 V	7.65	0.63	6.23	6.08	5.99	5.91	0.95		1.066	2.724	6.450		8	SWP7641L	LWR6648LS	40	40	8	35
029	HD 217463	22 57 43.2	+62 30 33	110.5	+02.6	0.87	Cep OB3	B2 V-II, B2 V	9.01	0.54					0.78		1.156	1.875	5.092		14	SWP7643L	LWR6649L	20	25	7	0
030	BD+60 2522	23 18 31.7	+60 55 13	112.2	+00.2	2.63	Cas OB2	O6.5 III ef	8.67	0.40		7.4	7.25	7.4	0.72	2.34	1.153	1.641	4.411	3.58	23	SWP4223L	LWR2007L	20	25	3	20

n.	star name (and alias)	RA	δ	l	b	r	Assoc.	Sp/L	m_V	B-V	J	H	K	L	E(B-V)	E(V-K)	E(13-17)	E(22-25)	E(22-V)	R	Std N	IUE images		S / N			
031	BD+63 1964	23 15 13.7	+63 50 53	112.9	+03.1	1.83	—	B0-0.5 I (IUE)	8.46	0.71					0.95		1.757	2.883	6.435		15	SWP11132L	LWR9762S	20	30	1	25
032	HD 2905 (κ Cas)	0 30 08.3	+62 39 22	120.8	+00.1	1.10	Cas OB14	B1 I a	4.16	0.14	3.99	3.77	3.92	3.92	0.33	0.78	0.552	0.880	2.180	2.60	19	SWP8564L	LWR7302L	40	35	6	0
033	BD+55 393	1 40 51.7	+55 54 40	130.4	-06.0	3.38	Cas OB10	B1 V, B2 V (IUE)	10.50	0.03					0.27		0.570	0.769	1.811		14	SWP7095L	LWR6029L	25	25	10	20
034	HD 12301 (53 Cas)	1 59 16.6	+64 08 59	130.6	+02.6	0.93	—	B8 I b	5.58	0.38					0.40						11	SWP7882S	LWR6276S	25	35	3	30
035	Hiltner 188	1 54 18.6	+59 43 55	131.2	-01.8	2.08	—	B1 V, B2.5 III (IUE)	9.96	0.43					0.65		1.370	1.925	4.478		18	SWP7096L	LWR6032L	15	25	2	20
036	HD 236923 (BD+59 374)	1 56 28.2	+59 28 48	131.5	-02.0	1.88	—	B1 V, B2.5 III (IUE)	9.65	0.40					0.62		1.281	2.002	4.465		18	SWP7089L	LWR60(26-31)L	15	20	8	20
037	HD 13268	2 08 02.6	+55 55 25	134.0	-05.0	2.29	Per OB1	O7, O8 IV (IUE)	8.18	0.13					0.44		0.997	1.213	3.037		8	SWP9923L	LWR8634LS	25	25	20	20
038	HD 14442 (BD+58 455)	2 18 31.9	+59 19 18	134.2	-01.3	2.29	Per OB1	O6 e, O5-6 III (IUE)	9.22	0.41					0.73		1.225	2.226	5.202		23	SWP7087L	LWR60(23-22)L	25	30	10	20
039	BD+60 497	2 28 08.3	+61 23 27	134.6	+01.0	2.19	Cas OB6	O7, O6 V	8.79	0.57			7.29		0.89	2.42	1.892	2.486	6.273	2.99	8	SWP4115L	LWR3660LS	20	20	3	20
040	HD 13621	2 11 06.6	+55 05 03	134.6	-05.7	2.04	—	B0.5 IV	8.10	0.06					0.34		0.592	1.122	2.421		26	SWP7097L	LWR6034LS	35	30	20	20
041	BD+60 501	2 28 47.7	+61 15 13	134.7	+00.9	2.19	Cas OB6	O6.5 V	9.59	0.46					0.78		1.169	2.111	5.358		8	SWP4114L	LWR3645LS	30	30	4	15
042	HD 15558 (BD+60 502)	2 28 53.9	+61 14 09	134.7	+00.9	2.19	Cas OB6	O5 III	7.83	0.51	6.76	6.61	6.55	6.46	0.83	2.6	1.254	2.342	5.817	3.44	8	SWP4113L	LWR3644LS	25	30	6	20
043	HD 14250	2 16 43.5	+56 52 11	134.8	-03.7	2.29	Per OB1	B1 III, B0 V n, B1.5 IV (IUE)	8.96	0.32	8.34	8.33	8.30		0.57	1.41	1.102	1.801	4.301		27	SWP9824L	LWR8635LS	25	30	9	10
044	HD 15570 (BD+60 504)	2 29 01.0	+61 09 21	134.8	+00.9	2.19	Cas OB6	O4 I f	8.11	0.69	6.43	6.18	6.04	5.89	1.01		1.831	2.688	7.043		23	SWP8285L	LWR3643LS	20	30	4	30
045	HD 15629 (BD+60 507)	2 29 31.3	+61 18 06	134.8	+01.0	2.19	Cas OB6	O5 V ((f))	8.42	0.43	7.53	7.38	7.28	7.54	0.75		1.162	2.293	5.269		8	SWP8287L	LWR7223S	25	35	2	20
046	BD+60 513	2 30 13.7	+61 10 03	134.9	+00.9	2.19	Cas OB6	O7.5 V	9.41	0.49					0.80		1.510	2.091	5.638		8	SWP4131L	LWR3661LS	25	25	4	10
047	HD 14947	2 23 07.9	+58 39 04	135.0	-01.7	2.29	Per OB1	O5 I f	8.01	0.45	6.89	6.74	6.65	6.45	0.77	1.91	1.644	2.091	5.314	2.73	23	SWP8284L	LWR7220L	15	25	2	20
048	HD 14434	2 18 20.1	+56 40 38	135.1	-03.8	2.29	Per OB1	O6 V (f), O5-6 III	8.50	0.16					0.48		0.939	1.346	3.389		8	SWP7088L	LWR6024L	25	30	5	20
049	HD 237019 (BD+59 562) *	2 49 34.8	+60 15 21	137.4	+01.1	2.19	Cas OB6	O8 V, O8.5 V (IUE)	9.73	0.47					0.78		1.495	2.229	5.365		17	SWP9925L	LWR8636L	30	35	5	15
050	BD+60 594	2 53 05.9	+61 13 54	137.4	+02.1	2.19	Cas OB6	O9 V, O8.5 V	9.30	0.36					0.67		1.263	2.056	4.904		17	SWP9921L	LWR8632LS	30	30	10	15
051	HD 16691	2 39 12.3	+56 41 32	137.7	-02.7	2.78	Cas OB6	O4 I f, O5 e, O5 I (IUE)	8.70	0.48					0.80		1.427	2.537	5.955		23	SWP8323L	LWR60(21-20)L	25	40	9	20
052	HD 18352	2 55 48.5	+61 05 30	137.7	+02.2	2.19	Cas OB6	B1 V, B1 III-IV	6.81	0.22					0.48						27	SWP9920L	LWR8631L	35	30	10	0
053	HD 21291	3 25 00.1	+59 46 05	141.5	+02.9	1.00	Cam OB1	B9 I a	4.21	0.41	3.23		3.00	2.85	0.41	1.34				3.60	11	SWP7280S	LWR3011LS	15	25	6	30
054	HD 30614 (α Cam)	4 49 03.8	+66 15 39	144.1	+14.0	1.03	—	O9.5 I a	4.29	0.03	4.20	4.22	4.22	4.17	0.30					3.01	10	SWP7368S	LWR6360L	40	35	8	20
055	HD 23060	3 40 13.1	+33 57 32	159.0	-16.5	0.65	—	B2 IV-V, B2.5 V	7.50	0.11	7.29	7.26	7.26	7.25	0.35	0.85				2.67	14	SWP11151L	LWR9783LS	35	30	15	25
056	BD+45 973	4 39 24.0	+45 32 11	159.3	-00.3	0.96	—	B3 V, B0.5 V, B1 V (IUE)	8.60	0.52					0.72		1.431	2.131	5.268		27	SWP11142L	LWR9771S	35	40	1	25
057	BD+31 643	3 41 25.8	+32 00 23	160.5	-17.8	0.23	IC 348	B5 V	8.53	0.69		6.69	6.47	6.44	0.85	2.48	1.341	1.737	5.175	3.21	2	SWP9821L	LWR8193L	20	30	2	20
058	HD 242908	5 19 12.0	+32 28 00	174.3	-02.2	1.32	Aur OB1	O4 V	9.05	0.28					0.60		0.903	1.662	4.056		8	SWP8341L	LWR7270L	40	45	3	30
059	HD 38131	5 41 44.8	+35 08 36	174.6	+03.1	1.32	Aur OB1	B0.5 V, B1 III	8.19	0.21					0.51		0.861	1.650	3.809		26	SWP15680L	LWR12102L	70	65	15	55
060	HD 37367	5 36 07.5	+29 11 18	179.0	-01.0	0.35	—	B2 IV-V	5.96	0.16					0.40						14	SWP15082L	LWR11610L	50	45	8	45

TABLE IV (continued).

n.	star name (and alias)	RA	δ	l	b	r	Assoc.	Sp/L	m_V	B-V	J	H	K	L	E(B-V)	E(V-K)	E(13-17)	E(22-25)	E(22-V)	R	Std N	IUE images		S / N			
061	HD 40893	5 59 52.4	+31 03 15	180.1	+04.3	2.85	—	B0 IV	8.90	0.16					0.46		0.853	1.624	3.563		24	SWP15682L	LWR132103LS	65	60	10	30
062	HD 36879	5 32 40.8	+21 22 20	185.2	-05.9	2.11	—	O7.5 III, O6-7 IV	7.57	0.19					0.50		0.662	1.630	3.599		8	SWP6900L	LWR5864L	20	20	3	20
063	HD 251204	6 02 03.0	+23 23 55	187.0	+01.0	3.74	—	B0 IV, B0 III	10.28	0.48					0.78		1.676	2.391	5.529		24	SWP15081L	LWR11609LS	20	25	7	10
064	HD 42087 (3 Gem)	6 06 41.8	+23 07 24	187.8	+01.8	1.51	Gem OB1	B2.5 I b	5.75	0.21			5.23		0.36	0.85	0.761	1.062	2.381	2.60	18	SWP8645L	LWR7394SL	25	30	10	0
065	HD 41117 (χ^2 Ori)	6 00 56.9	+20 08 27	189.7	-00.9	1.51	Gem OB1	B2 I a	4.63	0.28	4.05		3.86	3.73	0.45	1.16	0.963	1.445	3.310	2.84	19	SWP7364L	LWR6356L	20	20	4	25
066	HD 252325	6 06 01.3	+20 38 58	189.8	+00.4	2.59	—	B1 V:, B0-1 V	10.79	0.57					0.87		1.174	2.296	5.631		12	SWP15083L	LWR11611L	15	15	2	25
067	HD 47129	6 34 43.2	+06 10 44	205.9	-00.3	1.51	Mon OB2	O7.5 III f, O8 III	6.06	0.05			5.98	5.62	0.36	1.00	0.770	0.898	2.539	3.06	3	SWP16148L	LWR12459L	50	50	30	80
068	HD 46106	6 28 58.7	+05 03 46	206.2	-02.1	1.51	Mon OB2	B0 V	7.91	0.14	7.43		7.40	7.08	0.44	1.35	0.712	1.338	3.341	3.38	12	SWP13448L	LWR10111L	35	30	15	15
069	HD 46149	6 29 12.9	+05 04 10	206.2	-02.0	1.51	Mon OB2	O8.5 V	7.59	0.17	7.30		7.15		0.48	1.28	0.953	1.431	3.458	2.93	17	SWP6910L	LWR5872L	30	25	4	20
070	HD 46056	6 28 41.4	+04 52 13	206.3	-02.2	1.51	Mon OB2	O8 V	8.17	0.18					0.49		1.164	1.436	3.554		17	SWP6913L	LWR5875L	25	25	5	25
071	HD 46150	6 29 16.0	+04 58 46	206.3	-02.1	1.51	Mon OB2	O5.5, O6 V	6.73	0.13	6.49	6.45	6.41	6.03	0.45	1.24	0.871	1.254	3.208	3.03	8	SWP6909L	LWR5871L	25	30	5	20
072	HD 46202	6 29 31.0	+05 00 14	206.3	-02.0	1.51	Mon OB2	O9 V	8.18	0.18					0.49		1.098	1.483	3.579		17	SWP6911L	LWR5873L	25	25	4	20
073	HD 46223	6 29 29.9	+04 51 37	206.4	-02.1	1.51	Mon OB2	O5 ((f)), O4 V (IUE)	7.26	0.22	6.85	6.63	6.61	6.16	0.54	1.57	1.145	1.472	3.724	3.20	23	SWP6912L	LWR7269L	25	30	4	30
074	HD 37903	5 39 07.2	-02 16 56	206.9	-16.5	0.90	—	B1.5 V	7.83	0.10	7.36	7.28	7.28	7.44	0.35	1.25	0.460	0.723	2.114	3.93	13	SWP8057L	LWR7025LS	45	35	15	15
075	HD 47240	6 35 13.2	+05 00 04	207.0	-00.7	1.51	Mon OB2	B1 I b	6.15	0.14	5.75	5.73	5.71	5.76	0.33	0.98	0.651	0.997	2.487	3.27	19	SWP16122L	LWR12452L	45	45	20	70
076	HD 38087	5 40 29.4	-02 20 03	207.1	-16.3	0.35	—	B5 V	8.13	0.13	7.59	7.30	7.21	7.28	0.29	1.28	0.097	0.707	1.833	4.86	2	SWP10596L	LWR9276L	30	30	8	30
077	HD 36629	5 30 28.6	-04 36 00	208.0	-19.5	0.85	—	B2 V	7.69	0.03	7.45	7.46	7.42		0.27	0.93	0.180	0.575	1.615	3.79	14	SWP4545L	LWR3964L	55	45	20	50
078	HD 48434	6 41 00.4	+03 59 01	208.5	+00.1	1.01	—	B0 III, B0.5 III-II	5.90	-0.02			5.97		0.28	0.72				2.83	24						
079	HD 37061 (NU Ori)	5 33 03.7	-05 17 53	208.9	-19.3	0.43	—	B1 V	6.83	0.26	5.85	5.69	5.50	5.7	0.52	2.08	0.089	0.537	2.024	4.40	12	SWP6954L	LWR5970L	45	30	15	35
080	HD 48279	6 40 04.7	+01 45 58	210.4	-01.2	1.82	—	O8 V, O7.5 V	7.93	0.12			7.35		0.43	1.50	0.793	1.260	3.209	3.84	4	SWP11300L	LWR9910L	30	25	8	25
081	HD 53974	7 04 19.7	-11 12 55	224.7	-01.8	0.73	—	B0.5 IV, B0 III (IUE)	5.39	0.05		5.29	5.25		0.35	0.98	0.648	1.128	2.666	3.08	24	SWP8053L	LWR7022S	35	30	6	25
082	HD 54306	7 05 32.7	-11 50 03	225.4	-01.8	1.83	—	B2 V, B1.5 V	8.78	0.00					0.25						14	SWP10593L	LWR9284L	50	40	15	45
083	HD 61827	7 37 54.3	-32 27 43	247.1	-05.1	4.37	NGC 2439	B3 I a	7.68	0.56	6.37	6.20	6.05	5.90	0.69	1.90	1.977	1.834	4.724	3.03	20	SWP13978S	LWR106(49-26)L	15	35	6	20
084	HD 69464	8 13 54.4	-35 28 36	253.6	-00.3	4.14	—	O6.5 I b	8.84	0.31	7.92	7.80	7.67	7.65	0.63	2.09	1.001	1.681	4.201	3.65	3	SWP10157L	LWR8823L	30	35	4	30
085	HD 73882	8 37 19.4	-40 14 31	260.2	+00.6	1.82	Vel OB1	O8 V	7.24	0.40	6.13	5.99	5.93	5.93	0.71	2.23	1.561	1.100	3.909	3.45	17	SWP13980L	LWR106(28-27)L	35	45	25	25
086	HD 93129A	10 42 01.0	-59 17 05	287.4	-00.6	3.47	Tr 14	O3 I f	7.30	0.22	6.21	6.06	6.04	6.08	0.54	2.18	0.711	1.187	3.044	4.04	23	SWP8312L	LWR7259L	50	50	5	30
087	HD 93204	10 42 36.0	-59 24 43	287.5	-00.7	2.63	Tr 16	O5 V	8.42	0.11	7.96	7.92	7.90	7.98	0.43	1.44	0.575	0.762	2.239	3.68	8	SWP8313L	LWR7259L	40	40	8	25
088	HD 93250	10 42 48.3	-59 18 06	287.5	-00.5	2.63	Tr 16	O3 V	7.38	0.15	6.73	6.68	6.63	6.63	0.47	1.67	0.783	0.961	2.790	3.91	23	SWP11224L	LWR9840L	65	65	15	60
089	HD 93403	10 43 46.7	-59 08 40	287.5	-00.3	2.63	Tr 16	O5 III f	7.26	0.21					0.53		0.883	1.341	3.544		23	SWP8690L	LWR7439L	40	40	4	30
090	HD 93028	10 41 20.2	-59 56 17	287.6	-01.2	2.51	Coll 228	O9 III, O9 IV	8.37	-0.06	8.48	8.46	8.55	8.52	0.25	0.70				3.08	17	SWP11244L	LWR9866L	75	55	20	45
091	HD 93205	10 42 37.0	-59 28 26	287.6	-00.7	2.63	Tr 16	O3 V	7.75	0.05	7.34	7.32	7.31	7.35	0.37	1.36	0.525	0.747	2.054	4.04	23	SWP8314L	LWR7260L	40	40	8	35
092	HD 303308	10 43 09.2	-59 24 16	287.6	-00.6	2.63	Tr 16	O3 V	8.17	0.13	7.68	7.70	7.80	7.68	0.45	1.29	0.680	1.102	2.826	3.15	23	SWP8315L	LWR7261L	40	40	6	25
093	CPD-59 2600	10 42 45.3	-59 31 07	287.6	-00.7	2.63	Tr 16	O6 V	8.61	0.21					0.53		0.566	0.987	2.928		8	SWP11137L	LWR9842L	65	60	20	55
094	CD-59 2603	10 42 51.1	-59 28 07	287.6	-00.7	2.63	Tr 16	O7 V	8.77	0.14					0.46		0.674	0.875	2.667		8	SWP11226L	LWR9807L	65	55	20	55
095	HD 93222	10 42 40.3	-59 49 40	287.7	-01.0	2.51	Coll 228	O7 III f	8.11	0.05	7.55	7.40	7.39	7.45	0.37	1.64	0.509	0.755	2.178	4.88	8	SWP11135L	LWR9805L	60	50	25	60
096	HD 93843	10 46 40.1	-59 57 33	288.2	-00.9	2.51	Car OB1	O5 III	7.33	-0.05					0.27		0.356	0.588	1.700		23	SWP8691L	LWR7440L	55	50	10	35
097	HD 96715	11 05 25.8	-59 41 34	290.3	+00.3	2.00	Car OB2	O4 V	8.25	0.09					0.41		1.002	1.150	2.837		8	SWP8629L	LWR7441L	35	35	5	25.
098	HD 114213	13 07 11.4	-61 12 22	305.2	+01.3	2.51	Cen OB1	B1 I a	8.90	0.94	6.76	6.45	6.26	6.11	1.13	3.2				3.10	19	SWP14527L	LWR11100L	3	15	3	20
099	HD 120521	13 48 10.0	-58 17 32	310.7	+03.4	4.15	—	O8-9 I b	8.57	0.23					0.51		1.052	1.387	3.387		10	SWP9330L	LWR80(88-89)L	20	20	5	20
100	HD 123008	14 03 44.4	-64 13 53	311.0	-02.8	4.12	—	O9.5 I	8.86	0.37	7.95	7.82	7.73	7.84	0.64	1.88	0.848	1.740	4.128	3.23	10	SWP9328L	LWR8087L	20	15	3	20
101	HD 122879	14 02 52.5	-59 28 38	312.3	+01.8	2.00	—	B0 I a	6.42	0.12	6.07	6.03	6.00	5.99	0.36	1.1				3.36	9	SWP16060L	LWR12355L	75	60	20	65
102	HD 151515	16 46 17.2	-41 54 57	342.8	+01.7	1.91	Sco OB1	O7 II (f)	7.16	0.16	6.80	6.70	6.74	6.71	0.48	1.34	0.592	1.301	3.370	3.07	8	SWP16112L	LWR12434L	40	35	10	40
103	HD 152236 (ζ Sco)	16 50 27.7	-42 16 50	343.0	+00.9	1.91	Sco OB1	B1.5 I a	4.73	0.49	3.47	3.27	3.11	2.94	0.67	2.09				3.43	19	SWP8829L	LWR7611S	20	20	2	15
104	HD 152249	16 50 40.8	-41 46 07	343.4	+01.2	1.91	Sco OB1	O9.5 I	6.45	0.20	5.97	5.84	5.79	5.72	0.47	1.41	0.619	1.257	3.175	3.30	10	SWP16592L	LWR12828L	30	25	9	30
105	HD 152233	16 50 32.6	-41 42 37	343.5	+01.2	1.91	Sco OB1	O6 III f	6.59	0.13	6.25	6.25	6.17	6.15	0.45	1.34	0.790	1.163	3.121	3.28	23	SWP16596L	LWR12832L	25	25	10	30
106	HD 326329	16 50 42.9	-41 45 15	343.5	+01.2	1.91	Sco OB1	O9 V, O9 IV	8.53	0.19					0.50		0.811	1.289	3.455		17	SWP16594L	LWR12830SL	25	20	9	25
107	HD 326330	16 50 47.2	-41 46 43	343.5	+01.1	1.91	Sco OB1	B0.5 V	9.67	0.20					0.48		0.659	1.334	3.402		12	SWP16539L	LWR12829SL	25	20	7	20
108	CPD-41 7742	16 50 48.5	-41 45 24	343.5	+01.2	1.91	Sco OB1	O8 V	8.50	0.23					0.54		0.990	1.492	3.602		17	SWP16608L	LWR12848LS	30	30	15	30
109	HD 152248	16 50 39.4	-41 44 39	343.5	+01.2	1.91	Sco OB1	O7 I b, O7 e	6.11	0.14					0.46		0.755	1.209	3.164		3	SWP16609L	LWR12489SL	30	25	15	25
110	HD 152247	16 50 40.9	-41 33 40	343.6	+01.3	1.91	Sco OB1	O9 I-III, O9.5, B0 III	7.17	0.18	6.60	6.66	6.65	6.56	0.49	1.36	0.963	1.429	3.610	3.05	24	SWP16114L	LWR12435L	30	25	9	35
111	HD 152246	16 50 36.0	-40 59 55	344.0	+01.7	1.91	Sco OB1	O8.5 IV	7.30	0.17	6.95	6.86	6.84	6.80	0.48	1.38				3.16	17	SWP16116L	LWR12436L	35	30	10	35
112	HD 152245	16 50 32.1	-40 27 06	344.4	+02.0	1.91	Sco OB1	B0 III, O9 IV	8.37	0.12					0.42		0.559	1.138	2.803		17	SWP16118L	LWR12437L	30	25	8	25
113	HD 147701	16 21 19.2	-24 54 38	352.3	+16.8	0.20	Oph	B5 V	8.36	0.56	6.69	6.41	6.21	6.06	0.72	2.57	1.485	1.165	3.890	3.93	2	SWP13443L	LWR2427LS	30	45	20	25
114	HD 147889	16 22 22.7	-24 21 05	352.9	+17.0	0.20	Oph	B2 V	7.90	0.84	5.36	4.86	4.55	4.38	1.08	4.01	1.564	2.385	6.373	4.08	14	SWP10176L	LWR9831LS	25	30	4	25
115	HD 147933 (ρ Oph AB) *	16 22 34.9	-23 19 56	353.7	+17.7	0.18	Oph	B2 IV, B2 V	4.59	0.24	3.72	3.54	3.48	3.57	0.48	1.77	0.218	0.964	2.565	4.06	14	SWP6588L	LWR5639L	40	30	10	35

TABLE V. — *Primary data for standard stars.*

n.	star name (and alias)	RA	δ	l	b	Assoc.	Sp/L	m_V	B-V	J	H	K	L	E(B-V)	E(V-K)	R	IUE images	S/N			
01	HD 210424 (28 Aqr)	22 07 57.2	-11 48 42	47.4	-49.2	—	B6 III	5.46	-0.12					0.02			SWP 9040L LWR 7792L	35	30	15	25
02	HD 199081 (57 Cyg)	20 51 28.4	+44 11 49	84.9	-00.2	—	B5 V	4.78	-0.14	5.09	5.12	5.16	5.17	0.02			SWP 9450L LWR 8189L	30	25	10	25
03	HD 214680 (10 Lac)	22 37 00.7	+38 47 21	96.7	-17.0	—	O8 III	4.88	-0.20	5.41	5.28	5.55	5.50	0.11			O A O				
04	HD 14633	02 19 46.5	+41 15 12	140.8	-18.2	—	O8 V	7.46	-0.21					0.10			SWP 9922L LWR 8633LS	40	25	25	15
05	HD 32630 (η Aur)	05 03 00.2	+41 10 08	165.4	+00.3	—	B3 V	3.17	-0.18					0.02			SWP 6211L LWR 5383L	35	30	20	20
06	HD 23324 (18 Tau)	03 42 10.4	+24 41 02	165.7	-23.3	—	B8 V	5.64	-0.07					0.04			SWP 7922L LWR 6900L	35	40	20	40
07	HD 23408 (20 Tau)	03 42 50.7	+24 12 47	166.2	-23.5	—	B7 III	3.87	-0.07					0.05			SWP 7574L LWR 6552L	35	40	25	35
08	HD 47839 (15 Mon)	06 38 13.3	+09 56 36	202.9	+02.2	Mon OB1	O7 V	4.66	-0.25	5.30	5.21	5.30	5.39	0.07			SWP 2777S LWR 2471S	40	30	10	20
09	HD 37128 (ε Ori)	05 33 40.5	-01 13 56	205.1	-17.1	Ori OB1	B0 I a	1.70	-0.19					0.05			O A O				
10	HD 37742 (ζ Ori)	05 38 13.9	-01 58 00	206.5	-16.6	Ori OB1	O9.5 I b	1.77	-0.21	2.20	2.27	2.31	2.33	0.06			O A O				
11	HD 34085 (β Ori)	05 12 07.9	-08 15 27	209.2	-25.2	Ori OB1	B8 I a	0.12	-0.03	0.22		0.20	0.24	0.00			O A O				
12	HD 36512 (υ Ori)	05 29 30.5	-07 20 11	210.4	-21.0	Ori OB1	B0 V	4.62	-0.26	5.21	5.27	5.46	5.65	0.04			SWP 8164L LWR 7079L	70	50	30	50
13	HD 31726	04 55 27.3	-14 18 28	213.5	-31.5	—	B1 V, B2 V, B1.5 V (IUE)	6.15	-0.21					0.04			SWP 8165L LWR 7098L	75	55	30	55
14	HD 42690	06 09 25.7	-06 32 15	214.3	-11.8	—	B2 V	5.05	-0.20					0.04			SWP 6498L LWR 5572L	25	20	10	15
15	HD 38771 (κ Ori)	05 45 23.0	-09 41 09	214.5	-18.5	Ori OB1	B0.5 I a	2.06	-0.17					0.05			O A O				
16	HD 86360 (8 Leo)	09 55 32.1	+12 41 03	224.1	+46.9	—	B9 V	5.26	-0.04					0.03			SWP 9037L LWR 7791L	25	25	10	30
17	HD 57682	07 19 38.0	-08 52 59	224.4	+02.6	—	O9 IV	6.43	-0.19	6.79	6.86	6.91	7.08	0.12	0.40	3.67	SWP 11156L LWR 9788L	75	50	35	60
18	HD 51283	06 53 40.6	-22 52 32	234.0	-09.3	Coll 121	B2.5 III	5.30	-0.18					0.04			SWP 8167L LWR 7079	70	60	25	50
19	HD 91316 (ρ Leo)	10 30 10.7	+09 33 51	234.9	+52.8	—	B1 I ab	3.85	-0.14	4.18	4.21	4.30	4.25	0.05			SWP 8650L LWR 7396L	40	30	9	20
20	HD 53138 (o^2 CMa)	07 00 56.1	-23 45 31	235.6	-08.2	Coll 121	B3 I a	3.02	-0.08	3.20	3.2	3.24	3.21	0.05			SWP 8168L LWR 7102L	60	55	20	40
21	HD 52089 (ε CMa)	06 56 39.6	-28 54 11	239.8	-11.3	—	B2 II	1.50	-0.21					0.00			O A O				
22	HD 58350 (η CMa)	07 22 06.9	-29 12 14	242.6	-06.5	Coll 121	B5 I a	2.45	-0.08	2.57	2.55	2.56	2.55	0.01			------				
23	HD 66811 (ζ Pup)	08 01 49.5	-39 51 40	256.0	-04.7	—	O4 I f	2.25	-0.26	2.76	2.82	2.89	2.88	0.06			O A O				
24	HD 63922 (P Pup)	07 47 42.7	-46 14 46	260.2	-10.2	—	B0 III	4.11	-0.18	4.57	4.56	4.68	4.71	0.12	0.27	2.48	SWP 9511L LWR 8237L	65	35	30	45
25	HD 86440 (φ Vel)	09 55 06.2	-54 19 44	279.3	+00.1	—	B5 II-III	3.54	-0.08	3.70	3.70	3.69	3.76	0.07			SWP 9513L LWR 8239L	65	65	20	45
26	HD 118716 (ε Cen)	13 36 42.3	-53 12 47	310.1	+08.4	—	B1 III	2.30	-0.22					0.04			O A O				
27	HD 116658 (α Vir)	13 22 33.3	-10 54 01	316.1	+50.8	—	B1 V	0.98	-0.23	1.50	1.48	1.68	1.67	0.03			O A O				

TABLE VIa. — *Bibliographycal references (target stars).*

n	Name	
001	HD 162978	56Ha, 69HGS, 71CA, 72W, 74CLa
002	HD 164794	43MKK, 53J, 53MWC, 55MCW, 58Kb, 62B. 69HGS, 71CA, 72W, 74CLa
003	HD 164816	53MWC, 55MCW, 61M, IUE, 82GCC
004	HD 165052	43MKK, 51H, 53J, 53MCW, 55MCW, 56P, 56S, 57W, 61Ma, 69B, 71CA, 72W, 74CLa, 82GCC
005	HD 164492	51H, 53MWC, 54AW, 55MCW, 56Ha, 56HJ, 56P, 60B, 61M, 71CA, 74CLa, 75L, 82GCC
006	HD 166937	46ROC, 55MCW, 58K, 59B, 61BA, 62B, 69B, 69HGS, 71SS, 75L
007	HD 168076	53MWC, 55MCW, 69HM, 71CA, 74CLa, 82GCC
008	HD 168112	53MWC, 55MCW, 56Ha, 56HJ, 60B, 71CA, 74CLa, 82GCC
009	HD 154445	55MCW, 56S, 71W
010	HD 183143	50MR, 51H, 55MCW, 56Ha, 56S, 59B, 60B, 60SNS, 63W
011	HD 190603	52A, 53W, 54D, 55MCW, 55W, 56Ha, 56Sa, 58Kb, 58M, 58Wa, 59B, 60B, 60FTW, 61LO, 63W, 68L, 68R, 71W
012	HD 193682	51R, 53J, 53MWC, 55JMc, 55MCW, 61LO, 82GCC
013	HD 192281	53J, 55MCW, 56Ha, 58Kb, 72W, 74CLa, 82GCC
014	HD 229196	55MCW, 56Ha, 56HJ, 60B, 82GCC
015	HD 198478	43MKK, 50MR, 51H, 51M, 52A, 53H, 53JM, 53P, 54D, 55HS, 55MCW, 56Ha, 56Sa, 56SK, 57B, 58B, 58C, 58K, 58Ka, 58Kb, 58Wa, 60BS, 61E, 61LO, 61U, 68L, 71W
016	HD 199579	51H, 53J, 54D, 55MCW, 56Ha, 56HJ, 56P, 56SK, 58BC, 58K, 58Kb, 60B, 61LO, 68L, 71LA, 72W, 74CLa, 82GCC
017	HD 199478	51M, 55MCW, 56Ha, 56SK, 58K, 59K, 60B, 61LO, 68R
018	HD 197512	68G
019	HD 199216	54D, 55MCW, 56Ha, 56M, 56S, 56SK, 58K, 61LO, 63W, 71W, IUE
020	HD 239729	60BF, 71W, IUE
021	HD 206165	43MKK, 53H, 53JM, 55MCW, 58C, 58Kb, 68Sa, 71W
022	HD 207198	53H, 53J, 53MWC, 55MCW, 58Kb, 68Sa, 71CA, 72W, IUE, 82GCC
023	HD 200775	68G, 68R
024	HD 209339	53MWC, 54D, 55MCW, 56SK, 58Ka ,58Kb, 59BC, 59L, 63W, 68L, 68Sa, IUE
025	HD 215835	53J, 53MWC, 55MCW, 56Ha, 58Kb, 71CA, 74CLa, 82GCC
026	HD 216532	53MWC, 55MCW, 70G, 71CA, 71W, 82GCC
027	HD 216898	55MCW, 56Ha, 70G, 71CA, 71W, 82GCC
028	HD 217086	53MWC, 55MCW, 56Ha, 59BHJ, 62B, 70G, 71CA, 71W , 82GCC
029	HD 217463	56Ha, 59BHJ, 70G, 71W
030	BD+60 2522	55MCW, 56HJ, 61LO. 71CA, 74CLa, 82GCC
031	BD+63 1964	55JMa, 56Ha, IUE
032	HD 2905	43MKK, 50MR, 51H, 52A, 52B, 53H, 53JM, 53MHJ, 53P, 54D,55MCW, 55W, 56Ha, 56Sa, 56Sb, 56SK, 57B, 57GE, 57M, 58B, 58K, 58Ka, 58Kb, 58M, 58Wa, 59DN, 60B, 61BCSS, 68L, 71W
033	BD+55 393	55MCW, 56Ha, IUE
034	HD 12301	50MR, 51H, 55MCW, 56Ha, 56JH, 57M, 58C, 59HRSS, 60B, 68L
035	Hiltner 188	IUE
036	HD 236923	56Ha, STNS, IUE
037	HD 13268	55MCW, 56Ha, 56HJ, 56JH, 71CA, IUE, 82GCC
038	HD 14442	55JMa . 55MCW, 56Ha, 56HJ, 56JH, 71CA, 74CLa, IUE, 82GCC
039	BD+60 497	55MCW, 55JMa, 56Ha, 56HJ, 60B, 70I, 82GCC
040	HD 13621	55JMc, 55MCW, 56JH, 56Ha, 71W
041	BD+60 501	55MCW, 56Ha, 56HJ, 56JH, 71CA, 74CLa, 82GCC
042	HD 15558	55MCW, 56HJ, 56JH, 58Kb, 61LO, 71CA, 72W, 74CLa 82GCC
043	HD 14250	55JMc, 55MCW, 56Ha, 56JH, 60B, 63W, 68S, 73LA, IUE
044	HD 15570	55JMa, 55MCW, 56Ha, 56HJ, 58Kb, 71Ca, 72W, 74CLa, 82GCC
045	HD 15629	55MCW, 56Ha, 56HJ. 56JH, 58Kb, 61LO, 71CA, 72W, 74CLa, 82GCC
046	BD+60 513	70I, 71CA, 74CLa, 82GCC
047	HD 14947	50MB, 51H, 55JMA, 55MCW, 56Ha, 56HJ, 56JH, 58Kb, 60B, 61LO, 71CA, 74CLa, 82GCC
048	HD 1443	55JMc, 55MCW, 56Ha, 56HJ, 58Kb, 71CA, 72W, 74CLa, 82GCC
049	HD 237019	55MCW, 56Ha, 56HJ, 56JH, IUE, 82GCC
050	BD+60 594	55MCW, 56Ha, 56HJ, 56JH, 71CA, 74CLa, 82GCC
051	HD 16691	55JMa, 55MCW, 56Ha, 56HJ, 56JH, 71CA, 74CLa, 82GCC, IUE
052	HD 18352	55MCW, 56Ha
053	HD 21291	50MR, 51H, 52A, 53JM, 53MWC, 54S, 55MCW, 56Ha, 56Sb, 57B , 57M, 58C , 59DN, 59HRSS, 59K, 60B, 68R, 69CCJJ
054	HD 30614	43MKK, 50MR, 53H, 55MCW, 58Kb, 62B, 71CA, 71W, 74CLa, 82GCC
055	HD 23060	56Ha, 58C, 71W
056	BD+45 973	58BF, 60BF, IUE
057	BD+31 643	54HMR, 56Ha, 60J, 62B, 68R
058	HD 242908	55JM, 55MCW, 56Ha, 62B, 82GCC
059	HD 38131	55MCW, 56Ha
060	HD 37367	56B, 60B, 68L
061	HD 40893	55MCW, 56Ha
062	HD 36879	55JMb, 55MCW, 56Ha, 56HJ, 71Ca, 74CLa, 82GCC
063	HD 251204	56Ha
064	HD 42087	53MWC, 55CLMS, 55MCW, 56Ha, 57B, 58M, 59B, 60BS, 60FTW, 60HSG, 61BCSS, 68L, 71W
065	HD 41117	43MKK, 48U, 49V, 50MR, 51M, 52A, 52S, 53H, 53JM, 53MHJ, 53MWC, 54D, 54Sa, 55CLMS, 55HS, 5MCW, 56S, 57B, 58BS, 58C, 58K, 58Ka, 58Kb, 58M, 60B, 60HSG, 60U, 61BCSS, 63W, 68L, 71W, 73MK,
066	HD 252325	56Ha
067	HD 47129	55MCW, 56Ha, 58Kb, 68L, 71CA, 72W, 74CLa, 82GCC
068	HD 46106	53JM, 58Kb, 71W
069	HD 46149	53JM, 55MCW, 56Ha, 58Kb, 71CA, 71W, 74CLa, 82GCC
070	HD 46056	53MWC, 56Ha, 58Kb, 71CA, 71W, 74CLa, 82GCC
071	HD 46150	53JM, 55MCW, 56Ha, 58Kb, 71CA, 72W, 73MK, 75CLa, 82GCC
072	HD 46202	53JM, 55MCW, 58Kb, 71CA, 71W, 74CLa, 82GCC
073	HD 46223	53JM, 55MCW, 56Ha, 58Kb, 59B, 71CA, 72W, 73MK, 74CLa, 82GCC, IUE
074	HD 37903	52S, 58C, 68R
075	HD 47240	53MWC, 55MCW
076	HD 38087	71SC
077	HD 36629	52S, 56JH, 56S
078	HD 48434	50MR, 53JM, 55MCW, 56S, 58Kb,58T, 59B, 59HS, 60O, 63W, 68L, 71W
079	HD 37061	51W, 52S, 54D, 56S, 58S, 71SC
080	HD 48279	51H, 55MCW, 56JH, 56Ha, 56Sa, 71CA, 71W, 74CLa, 82GCC
081	HD 53974	46ROC, 55MCW, 57O, 68L, 68R, 74C, IUE
082	HD 54306	74C, STNS
083	HD 61827	56S, 76S, 82H
084	HD 69464	55MCW, 63W, 71C, 72W, 73GG, 82GCC, 82H
085	HD 73882	46ROC, 55FTW, 55MCW, 56S, 69B, 78H, 82GCC
086	HD 93129A	82GCC
087	HD 93204	72W, 75HC, 82GCC
088	HD 93250	55MCW, 72W, 73TTW, 75HC, 82GCC
089	HD 93403	55MCW, 56SK, 57FTW, 62B, 72W, 75HC
090	HD 93028	57FTW, 72W, 73H, 75HC, STNS, 82GCC
091	HD 93205	STNS, 72W, 75HC, 82GCC
092	HD 303308	STNS, 72W, 82GCC
093	CPD-59 2600	STNS, 55MCW, 82GCC
094	CD-59 2603	82GCC
095	HD 93222	55MCW, 72W, 75HC, 82GCC
096	HD 93843	56Hb, 57FTW, 71W, 75HC, 82GCC
097	HD 96715	71W, 74TA, 75HC, 82GCC
098	HD 114213	61FSTW, 63W, 75HC
099	HD 120521	57FTW, 61B, 75H, 75HC, 82GCC
100	HD 123008	57FTW, 75H, 75HC, 82GCC
101	HD 122879	56S, 57FTW, 61B, 61M, 63W, 69B, 69HGS, 75HC
102	HD 151515	61M, 69SHS, 72W, 73TTW, 78H, 82GCC
103	HD 152236	54B, 56Hb, 60WW, 69HGS, 69SHS, 78H
104	HD 152249	53MWC, 54B, 59B, 60WW, 69HGS, 71CA, 72W, 74CLa, 78H, 82GCC
105	HD 152233	53MWC, 55JMb, 71CA, 72W, 74CLa, 78H, 82GCC
106	HD 326329	69SHS, 82GCC
107	HD 326330	71SNW
108	CPD-41 7742	69SHS, 71SNW, 82GCC
109	HD 152248	53MWC, 60WW, 69SHS, 72W, 78H, 82GCC
110	HD 152247	53MWC, 60WW, 69SHS, 75HC, 78H, 82GCC
111	HD 152246	55MCW, 60WW, 69SHS, 73TTW, 78H, 82GCC
112	HD 152245	55MCW, 60WW, 69SHS, 78H, 82GCC
113	HD 147701	67G
114	HD 147889	56Ha, 58C, 63W, 67G
115	HD 147933	58Ka, 69HGS

TABLE VIb. — *Bibliographycal references (standard stars).*

n	Name	
01	HD 210424....	55HS, 68L
02	HD 199081............	58KB, 59BC, 68L
03	HD 214680............	43MKK, 53JM, 53MWC, 58Kb, 72W, 73MK, 82GCC,
04	HD 14633............	53JM, 55MCW, 71CA, 72W, 74CLa, 82GCC
05	HD 32630............	43MKK, 53JM, 58Kb, 71W, 73MK
06	HD 23324............	58C, 59O, 73MK
07	HD 23408............	58C, 58KB, 68L, 68PWJW
08	HD 47839............	53W, 55MCW, 68L, 71CA, 72W, 73MK, 82GCC
09	HD 37128............	43MKK, 53JM, 55MCW, 58Kb, 71W, 73MK
10	HD 37742............	50MR, 71CA, 71W, 58C, 82GCC
11	HD 34085............	43MKK, 50MR, 53JM, 55MCW, 73MK
12	HD 36512............	51W, 53JM, 55MCW, 58Kb, 71W, 73MK
13	HD 31726............	55MCW, 63W, 68L, IUE
14	HD 42690............	55MS, 58W, 68L
15	HD 38771............	43MKK, 50MR, 53JM, 58Kb, 71W, 73MK
16	HD 86360............	59O, 68PWJW, 59CCJJ
17	HD 57682............	53J, 55MCW, 59B, 56HJ, 58KB, 59B, 68L, 71CA, 82GCC
18	HD 51283............	55MCW, 69HGS
19	HD 91316............	43MKK, 48U, 50MR, 55MCQ, 58C, 59B, 69HGS
20	HD 53138............	43MKK, 50MR, 55MCW, 69HGS, 71W, 73MK
21	HD 52089............	43MKK, 50MR, 55MCW, 58W, 58KB, 69HGS
22	HD 58350............	50MR, 55MCW, 59B, 61Ba, 62B, 82M
23	HD 66811............	43MKK, 55JMa, 55MCW, 58W, 69HGS, 71CA, 72W, 73MK, 82GCC
24	HD 63922............	46ROC, 52G, 57DVb, 69HGS, 75HC, 82M
25	HD 86440............	57DVa, 58W, 61M, 69HGS, 75HC
26	HD 118716............	50G, 57DVa, 57FTW, 61Ba, 62B, 69HCS, 75HC, 78M
27	HD 116658	43MKK, 53JM, 55MCW, 58Kb, 62B

TABLE VIc. — *Bibliography for sample and standard stars.*

43MKK	Morgan, W.W., Keenan, P.C., Kellman, E., 1943, Astrophys. Monographs, University of Chicago Press
46ROC	Royal Observatory Cape Min., 12 (1945/1961)
48U	Underhill, A.B., 1948, Ap.J. 107, 349
49V	Van Dien, E., 1949, Ap.J. 109, 452
50G	Gascoigne, S.C.B., 1950, M.N.R.A.S. 110, 15
50MB	Merrill, P.W., Burwell, C.G., 1950, Ap.J. 114, 241
50MR	Morgan, W.W., Roman, N.G., 1950, Ap.J. 112, 362
51H	Hiltner, W.A., 1951, Ap.J. 114, 241
51M	Miczaika, G.R., 1951, Zeitschr. Astrophys. 29, 262
51R	Roman, N.G., 1951, Ap.J. 114, 492
51W	Wenzel, W., 1951, Veroeff. Sternwarte Sonnenberg 5, 1
52A	Ahmad, I.I., 1952, Ap.J. 115, 341
52B	Bidelman, W.P., 1952, Ap.J. 116, 227
52G	Gum, C.S., 1952, J. Br. Astr. Soc. 72, 151
52S	Sharpless, S., 1952, Ap.J. 116, 251
53H	Hack, M., 1953, Ann. Astrophys. 16, 417
53J	Johnson, H.L., 1953, Ap.J. 118, 370
53JM	Johnson, H.L., Morgan, W.W., 1953, Ap.J. 117, 313
53MHJ	Morgan, W.W., Harris, D.L., Johnson, H.L., 1953, Ap.J. 118, 92
53MWC	Morgan, W.W., Whitford, A.E., Code, A.D., 1953, Ap.J. 118, 318
53P	Pecker, C,. 1953, Ann. Astrophys. 16, 321
53W	Weaver, H.F., 1953, Astron. J. 58, 177
54AW	Aller, L.H., Wilson, O.C., 1954, Ap.J. 119, 243
54B	Bidelman, W.P., 1954, Publ. Ast. Soc. Pac. 66, 249
54D	Divan, L., 1954, Ann. Astrophys. 17, 456
54F	Fehrenbach, C., 1954, J. Obs. 38, 165
54HMR	Harris, D.L. Morgan, W.W., Roman, N.G., 1954, Ap.J. 119, 622
54S	Slettebak, A., 1954, Ap.J. 119, 146
54Sa	Sharpless, S., 1954, Ap.J. 119, 200
55CLMS	Crawford, D., Limber, D.M., Mendoza, E., Schulte, D., Steinman, H., Swihart, T., 1955, Ap.J. 121, 24
55FTW	Feast, M.W., Thackeray, A.D., Wesselink, Astron .J., 1955, Mem. Roy. Astr. Soc. 67
55HS	Herbig, G.H., Spalding JR.J., 1955, Ap.J. 121, 118
55JMa	Johnson H.L., Morgan W.W., 1955, Ap.J. 122, 142

TABLE VIc *(continued).*

55JMb	Johnson H.L., Morgan W.W., 1955, Ap.J. 122, 242
55JMc	Johnson H.L., Morgan W.W., 1955, Ap.J. 122, 429
55MCW	Morgan W.W., Code, A.D., Whitford, A.E., 1955, Ap.J. Suppl. Ser. 2, 41
55W	Wilson, R., 1955, J. Br. Astron. Soc. 75, 222
56B	Blaauw, A., 1956, Ap.J. 123, 408
56Ha	Hiltner, W.A., 1956, Ap.J. Suppl. 2, 389
56Hb	Hoffleit, D., 1956, Ap.J. 124, 61
56HJ	Hiltner, W.A., Johnson, H.L., 1956, Ap.J. 124, 367
56JH	Johnson, H.L., Hiltner, W.A., 1956, Ap.J. 123, 267
56M	Munch, G., 1956, Ap.J. 125, 42
56P	Pottasch, S., 1956, Bull. Astron. Soc. NL 13, 77
56S	Smith, E. van P., 1956, Ap.J. 124, 43
56Sa	Slettebak, A., 1956, Ap.J. 124, 173
56Sb	Stock, J., 1956, Ap.J. 123, 253
56SK	Stebbins, J., Kron, G.E., 1956,Ap.J. 123, 440
57B	Bouigue, M.R., 1957, Publ. Obs. Hte Provence 4, 52
57DVa	De Vaucouleurs, A., 1957, M.N.R.A.S. 117, 444
57DVb	De Vaucouleurs, A., 1957, M.N.R.A.S. 117, 449
57FTW	Feast, M.W., Thackeray, A.D., Wesselink, A.J., 1957, Mem. Roy. Astr. Soc. 68, 1
57GE	Gascoigne, S.C., Eggen, O.J., 1957, M.N.R.A.S. 123, 521
57M	Munch, G., 1957, Ap.J. 125, 42
57O	Oke, J.B., 1957, Ap.J. 126, 509
57W	Walker, M.F., 1957, Ap.J. 125, 636
58B	Bahng, J.D.R., 1958, Ap.J. 128, 572
58BF	Boulon, J., Fehrenbach, C., 1958, J. Obs. 42, 149
58BS	Butler, H.E., Seddon, H., 1958, Publ. R. Obs. Edinburgh 2 n4, 113
58C	Crawford, D.L., 1958, Ap.J. 128, 185
58K	Kron, G.E., 1958, Publ. Astron. Soc. Pac. 70, 561
58Ka	Kopylov, I.M., 1958, Izv. Krym. Astrofiz. Obs. 20, 123
58Kb	Kopylov, I.M., 1958, Izv. Krym. Astrofiz. Obs. 20, 156
58M	Mendoza, E.E.V., 1958, Ap.J. 128, 207
58S	Strand, K.A., 1958, Ap.J. 128, 14
58T	Tifft, W.G., 1958, Astron. J. 63, 127
58W	Woods, M.L., 1958, Mem. Mount Stromlo Obs. 16, 125
58Wa	Whitford, A.E., 1958, Astron. J. 63, 201
59B	Buscombe, W., 1959, Mount Stromlo Obs. Mim. 3
59BC	Belyakina, T.S., Chugainov, P.F., 1959, Izv. Krym. Astrophiz. Obs. 20, 156
59BHJ	Blaawn, A., Hiltner, W.A., Johnson, H.L., 1959, Ap.J. 130, 69
59DN	Dimov, N.A., Nikonov, V.B., 1959, Izv. Krym. Astrofiz. Obs. 22, 176
59HS	Hoag, A.A., Smith, E.V.P., 1959, Publ. Astron. Soc. Pac. 71, 32
59HRSS	Hardorp, J., Rohlfs, K., Slettebak, A., Stock, J., 1959, "Luminous stars in the Northern Milky Way. Part I"
59K	Kopylov, I.M., 1959, Izv. Krym. Astrfiz. Obs. 22, 189
59L	Lynds, C.R., 1959, Ap.J. 130, 577
59O	Osawa, K., 1959, Ap.J., 130, 159
60B	Borgman, J., 1960, Bull. Astron. Inst. NL 15, 255
60BF	Boulon, J., Fehrenbach, C., 1960, Publ. Obs. Hte. Provence 4, 55
60BM	Buscombe, W., Morris, P.M., 1960, M.N.R.A.S. 121, 263
60BS	Butler, H.E., Seddon, H., 1960, Publ. R. Obs. Edinburgh 2, n5, 187
60FTW	Feast, M.W., Thackeray, A.D., Wesselink, A.J., 1960, M.N.R.A.S. 121, 337
60HSG	Hardie, R.H., Seyfert, C.K., Gulledge, I.S., 1960, Ap.J. 132, 361
60J	Johnson, H.M., 1960, Publ. Astron. Soc. Pac. 72, 10
60O	Oosterhoff, P.T., 1960, Bull. Astron. Instr. NL 15, 199
60SNS	Stock, J., Nassau, J.J., Stephenson, C.B., 1960, "Luminous stars in the Northern Milky Way"
60U	Underhill, A.B., 1960, Publ. Astr. Soc. Pac. 72, 363
60WW	Walraven, T., Walraven, J.H., 1960, Bull. Astr. Inst. NL 15, 67
61B	Beer, A., 1961, Contr. Cambridge Observ. 44, 148
61Ba	Buscombe, W., 1961, Mount Stromlo Obs. Mim. 2
61BCSS	Bappu, M.K.V., Chandra, S., Sanwal, N.B., Sinvhal, S.D., 1961, M.N.R.A.S. 123, 521
61E	Eggen, O.J., 1961, R. Obs. Bull. 41
61FSTW	Feast, M.W., Stoy, R.H., Thackeray, A.D., Wesselink, A.J., 1961, M.N.R.A.S. 122, 239
61LO	Ljunggren, B., Oja, T., 1961, Uppsala Astron. Obs. Ann. 4, 10
61M	Morris, P.M., 1961, M.N.R.A.S. 122, 325
61Ma	Meadows, A.J., 1961, M.N.R.A.S. 123, 81
61U	Underhill, A.B., 1961, Publ. Astron. Soc. Pac. 72, 363
62B	Buscombe, W., 1962, Mount Stromlo Obs. Mim. 4
63W	Walker, G.A.H., 1963, M.N.R.A.S. 125, 141
66R	Roslund, C., 1966, Ark. Astron. 4, 73
67G	Garrison, R.F., 1967, Ap.J. 147, 1003
68G	Guetter, H.H., 1968, Publ. Astron. Soc. Pac. 80, 197
68L	Lesh, J.R., 1968, Ap.J. Suppl. Ser. 17, 371

TABLE VIc *(continued)*.

68PWJW	Palmer, D.R., Walker, E.N., Jones, D.H.P., Wallis, R.E., 1968 R. Obs. Bull., 135, 385
68R	Racine, R., 1968, Astron .J. 73, 588
68S	Sletteback, A., 1968, Ap.J. 154, 933
68Sa	Simonson, S.C.B., 1968, Ap.J. 154, 923
69B	Buscombe, W., 1969, M.N.R.A.S. 144, 31
69CCJJ	Cowley, A., Cowley, G., Jaschek, M. Jaschek, C., 1969, Astron. J. 74, 375
69HGS	Hiltner, W.A., Garrison, R.F., Schild, R.E., 1969, Ap.J. 157, 313
69HM	Hiltner, W.A., Morgan, W.W., 1969, A.J., 74, 1152
69SHS	Schild, R.E., Hiltner, W.A., Sanduleak, N., 1969, Ap.J. 156, 609
70G	Garrison, R.F., 1970, Astron. J. 75, 1001
70H	Hill, P.W., 1070, M.N.R.A.S. 150, 23
70I	Ishida, K., 1970, Pub. Astr. Soc. Jap. 22, 277
71C	Crampton, D., 1971, Astron. J. 76, 260
71CA	Conti, P.S., Alschuler, W.R., 1971, Ap.J. 170, 325
71SC	Schild, R.E., Chaffee, F., 1971, Ap.J. 169, 529
71SNW	Schild, R., Neugebauer, G., Westphal, J.A., 1971, Astron. J. 76, 973
71SS	Stephenson, C.B., Sanduleak, N., 1971, "Luminous stars in the southern Milky Way"
71W	Walborn, N.R., 1971, Ap.J. Suppl. Ser. 23, 257
72W	Walborn, N.R., 1972, Astron. J. 77, 312
73GG	Georgelin, Y.M., Georgelin, Y.P., 1973, Astron. Astrophys. 25, 337
73H	Humphreys, R.M., 1973, Astron. Astrophys. Suppl. Ser. 9, 85
73LA	Lesh, J.R., Aizenman, M.L., 1973, Astron. Astrophys. 22, 229
73MK	Morgan, W.W., Keenan, P.C., 1973, Ann. Rev. A.A. 11, 29
73TTW	Thackeray, A.D., Tritton, S.B., Walker, E.N., 1973, Mem. R. Astron. Soc. 77, 199
74C	Claria, J.J., 1974, Astron. J. 79, 1022
74CLa	Conti, P.S., Leep, E.M., 1974, Ap.J. 193, 113
74CLb	Conti, P.S., Leep, E.M., 1974, Ap.J. 193, 124
74HKB	Hill, P.W., Kilkenny, D., van Breda, I.G., 1974, M.N.R.A.S. 168, 451
74TA	Thackeray, A.D., Andrews, P.J., 1974, Astron. Astrophys. Suppl. Ser. 16, 323
74WQ	Walker, E.N., Quintanilla, A.R., 1974, M.N.R.A.S. 169, 247
75H	Humphreys, R.M., 1975, Astron. Astrophys. Suppl. Ser. 19, 243
75HC	Houk, N., Cowley, A.P., 1975, "Michigan Catalogue of 2-dimensional spectral types for the HD stars, vol. I: 53 degrees to South Pole."
75L	Levato, A., 1975, Astron. Astrophys. Suppl. Ser. 19, 91
76E	Edwards, T.W., 1976, Astron. J. 81, 245
76S	Smith, M.A., 1976, Ap.J. 203, 603
78H	Houk, N., 1978, "Michigan catalogue of 2-dimensional spectral types for the HD stars. Vol 1. 2: -40 to -53 degrees"
82GCC	Garmany, C.D., Conti, P.S., Chiosi, C., 1982, Ap.J. 263, 777
82H	Houk, N., 1982, "Catalogue of Two-Dimensional Spectral Types for the HD stars, -40 to -26 degrees"
STNS	from STRASBOURG bibliography with unknown source
IUE	classification based upon IUE UV classification criteria

TABLE VIIa. — *List of stars ordered by running number.*

001	HD 162978	039	BD+60 497	077	HD 36629
002	HD 164794	040	HD 13621	078	HD 48434
003	HD 164816	041	BD+60 501	079	HD 37061
004	HD 165052	042	HD 15558	080	HD 48279
005	HD 164492	043	HD 14250	081	HD 53974
006	HD 166937	044	HD 15570	082	HD 54306
007	HD 168076	045	HD 15629	083	HD 61827
008	HD 168112	046	BD+60 513	084	HD 69464
009	HD 154445	047	HD 14947	085	HD 73882
010	HD 183143	048	HD 14434	086	HD 93129A
011	HD 190603	049	HD 237019	087	HD 93204
012	HD 193682	050	BD+60 594	088	HD 93250
013	HD 192281	051	HD 16691	089	HD 93403
014	HD 229196	052	HD 18352	090	HD 93028
015	HD 198478	053	HD 21291	091	HD 93205
016	HD 199579	054	HD 30614	092	HD 303308
017	HD 199478	055	HD 23060	093	CPD-59 2600
018	HD 197512	056	BD+45 973	094	CD-59 2603
019	HD 199216	057	BD+31 643	095	HD 93222
020	HD 239729	058	HD 242908	096	HD 93843
021	HD 206165	059	HD 38131	097	HD 96715
022	HD 207198	060	HD 37367	098	HD 114213
023	HD 200775	061	HD 40893	099	HD 120521
024	HD 209339	062	HD 36879	100	HD 123008
025	HD 215835	063	HD 251204	101	HD 122879
026	HD 216532	064	HD 42087	102	HD 151515
027	HD 216898	065	HD 41117	103	HD 152236
028	HD 217086	066	HD 252325	104	HD 152249
029	HD 217463	067	HD 47129	105	HD 152233
030	BD+60 2522	068	HD 46106	106	HD 326329
031	BD+63 1964	069	HD 46149	107	HD 326330
032	HD 2905	070	HD 46056	108	CPD-41 7742
033	BD+55 393	071	HD 46150	109	HD 152248
034	HD 12301	072	HD 46202	110	HD 152247
035	BD+59 1543	073	HD 46223	111	HD 152246
036	HD 236923	074	HD 37903	112	HD 152245
037	HD 13268	075	HD 47240	113	HD 147701
038	HD 14442	076	HD 38087	114	HD 147889
				115	HD 147933

TABLE VIIb. — *List of stars ordered by catalogue number.*

BD+31 643	057	HD 42087	064	HD 152248	109
BD+45 973	056	HD 46056	070	HD 152249	104
BD+55 393	033	HD 46106	068	HD 154445	009
BD+60 497	039	HD 46149	069	HD 162978	001
BD+60 501	041	HD 46150	071	HD 164492	005
BD+60 513	046	HD 46202	072	HD 164794	002
BD+60 594	050	HD 46223	073	HD 164816	003
BD+60 2522	030	HD 47129	067	HD 165052	004
BD+63 1964	031	HD 47240	075	HD 166937	006
CD-59 2603	094	HD 48279	080	HD 168076	007
CPD-41 7742	198	HD 48434	078	HD 168112	008
CPD-59 2600	093	HD 53974	081	HD 183143	010
Hiltner 188	035	HD 54306	082	HD 190603	011
HD 2905	032	HD 61827	083	HD 192281	013
HD 12301	034	HD 69464	084	HD 193682	012
HD 13268	037	HD 73882	085	HD 197512	018
HD 13621	040	HD 93028	090	HD 198478	015
HD 14250	043	HD 93129A	086	HD 199216	019
HD 14434	048	HD 93204	087	HD 199478	017
HD 14442	038	HD 93205	091	HD 199579	016
HD 14947	047	HD 93222	095	HD 200775	023
HD 15558	042	HD 93250	088	HD 206165	021
HD 15570	044	HD 93403	089	HD 207198	022
HD 15629	045	HD 93843	096	HD 209339	024
HD 16691	051	HD 96715	097	HD 215835	025
HD 18352	052	HD 114213	098	HD 216532	026
HD 21291	053	HD 120521	099	HD 216898	027
HD 23060	055	HD 122879	101	HD 217086	028
HD 30614	054	HD 123008	100	HD 217463	029
HD 36629	077	HD 147701	113	HD 229196	014
HD 36879	062	HD 147889	114	HD 236923	036
HD 37061	079	HD 147933	115	HD 237019	049
HD 37367	060	HD 151515	102	HD 239729	020
HD 37903	074	HD 152233	105	HD 242908	058
HD 38087	076	HD 152236	103	HD 251204	063
HD 38131	059	HD 152245	112	HD 252325	066
HD 40893	061	HD 152246	111	HD 303308	092
HD 41117	065	HD 152247	110	HD 326329	106
				HD 326330	107