37. Bessell, M.S. 1976, *PASP*, **88**, 557
38. Menzies, J.W. et al. 1991, *MNRAS*, **248**, 642

Absolute calibration of a star of the spectral type A0 V with the magnitude $V = 0$ [2] on the Johnson system is shown in Table 15.6.

Table 15.6. *Flux calibration for an A0 V star.*

Symbol	Flux (erg cm^{-2} s^{-1} Å^{-1})	λ_0 (μm)
U	4.22×10^{-9}	0.36
B	6.40×10^{-9}	0.44
V	3.75×10^{-9}	0.55
R	1.75×10^{-9}	0.71
I	8.4×10^{-10}	0.97

Useful relations for the UBV system [2]:

$$(U-B)_0 = 0.08 + 3.85(B-V)_0 \text{ unreddened main sequence, } (B-V)_0 < 0 \text{ and } (U-B)_0 < 0,$$

$$Q = (U-B) - 0.72(B-V) \text{ independent of reddening for early-type stars,}$$

$$\frac{E_{U-B}}{E_{B-V}} = \begin{cases} 0.65 - 0.05(U-B)_0 + 0.05E_{B-V}, & (U-B)_0 < 0, \\ 0.64 + 0.26(B-V)_0 + 0.05E_{B-V}, & (B-V)_0 > 0, \end{cases}$$

$$\frac{A_V}{E_{B-V}} = 3.30 + 0.28(B-V)_0 + 0.04E_{B-V},$$

where $E_{U-B} = (U-B) - (U-B)_0$, $A_V = V - V_0$, $E_{B-V} = (B-V) - (B-V)_0$; and V_0, $(B-V)_0$, and $(U-B)_0$ are the magnitude and color indices stars would have if space were transparent.

Useful relations for the *uvbyβ* system [15–20]:

$$c_1 = (u-v) - (v-b),$$
$$m_1 = (v-b) - (b-y),$$
$$\beta = 2.5\log(W/N),$$

where W and N are the fluxes measured through interference filters centered on Hβ with half-widths of about 150 and 30 Å, respectively.

$$\left.\begin{aligned} E(c_1) &= 0.20E(b-y), \\ E(m_1) &= -0.32E(b-y), \\ E(u-b) &= 1.50E(b-y), \end{aligned}\right\} \text{ color excesses according to standard reddening law,}$$

$$\left.\begin{aligned} [c_1] &= c_1 - 0.20(b-y), \\ [m_1] &= m_1 + 0.32(b-y), \\ [u-b] &= (u-b) - 1.50(b-y), \end{aligned}\right\} \text{ reddening independent quantities,}$$

$(b-y)_0 = -0.116 + 0.097c_1$ for an unreddened main-sequence B star,

$(b-y)_0 = 2.946 - 1.0\beta - 0.1\delta c_1$ ($-0.25\delta m_1$ if $m_1 < 0$) for A stars with $2.870 > \beta > 2.720$ and $\delta c_1 < 0.28$,

$(b-y)_0 = 0.222 + 1.11\Delta\beta + 2.7(\Delta\beta)^2 - 0.05\delta c_1 - (0.1 + 3.6\Delta\beta)\delta m_1$ for F stars with $2.630 < \beta < 2.720$ and $\delta c_1 < 0.28$, or $2.590 < \beta < 2.630$ and $\delta c_1 < 0.20$,

where $\Delta\beta = 2.720 - \beta$, $\delta c_1 = c_1 - c_{\text{std}}$, $\delta m_1 = m_{\text{std}} - m_1$; See Section 15.3.2 for c_{std} and m_{std}.

15.3.1 Calibration of MK Spectral Types [2, 21, 22]

Table 15.7 presents the absolute magnitude, color, effective surface temperature, and bolometric correction calibrations for the MK spectral classes. Table 15.8 gives the calibrated physical parameters for stars of the various spectral classes.

Table 15.7. *Calibration of MK spectral types.*

Sp	*M(V)*	*B − V*	*U − B*	*V − R*	*R − I*	T_{eff}	BC
MAIN SEQUENCE, V							
O5	−5.7	−0.33	−1.19	−0.15	−0.32	42 000	−4.40
O9	−4.5	−0.31	−1.12	−0.15	−0.32	34 000	−3.33
B0	−4.0	−0.30	−1.08	−0.13	−0.29	30 000	−3.16
B2	−2.45	−0.24	−0.84	−0.10	−0.22	20 900	−2.35
B5	−1.2	−0.17	−0.58	−0.06	−0.16	15 200	−1.46
B8	−0.25	−0.11	−0.34	−0.02	−0.10	11 400	−0.80
A0	+0.65	−0.02	−0.02	0.02	−0.02	9 790	−0.30
A2	+1.3	+0.05	+0.05	0.08	0.01	9 000	−0.20
A5	+1.95	+0.15	+0.10	0.16	0.06	8 180	−0.15
F0	+2.7	+0.30	+0.03	0.30	0.17	7 300	−0.09
F2	+3.6	+0.35	0.00	0.35	0.20	7 000	−0.11
F5	+3.5	+0.44	−0.02	0.40	0.24	6 650	−0.14
F8	+4.0	+0.52	+0.02	0.47	0.29	6 250	−0.16
G0	+4.4	+0.58	+0.06	0.50	0.31	5 940	−0.18
G2	+4.7	+0.63	+0.12	0.53	0.33	5 790	−0.20
G5	+5.1	+0.68	+0.20	0.54	0.35	5 560	−0.21
G8	+5.5	+0.74	+0.30	0.58	0.38	5 310	−0.40
K0	+5.9	+0.81	+0.45	0.64	0.42	5 150	−0.31
K2	+6.4	+0.91	+0.64	0.74	0.48	4 830	−0.42
K5	+7.35	+1.15	+1.08	0.99	0.63	4 410	−0.72
M0	+8.8	+1.40	+1.22	1.28	0.91	3 840	−1.38
M2	+9.9	+1.49	+1.18	1.50	1.19	3 520	−1.89
M5	+12.3	+1.64	+1.24	1.80	1.67	3 170	−2.73
GIANTS, III							
G5	+0.9	+0.86	+0.56	0.69	0.48	5 050	−0.34
G8	+0.8	+0.94	+0.70	0.70	0.48	4 800	−0.42
K0	+0.7	+1.00	+0.84	0.77	0.53	4 660	−0.50
K2	+0.5	+1.16	+1.16	0.84	0.58	4 390	−0.61
K5	−0.2	+1.50	+1.81	1.20	0.90	4 050	−1.02
M0	−0.4	+1.56	+1.87	1.23	0.94	3 690	−1.25
M2	−0.6	+1.60	+1.89	1.34	1.10	3 540	−1.62
M5	−0.3	+1.63	+1.58	2.18	1.96	3 380	−2.48

Table 15.7. *(Continued.)*

Sp	*M(V)*	*B − V*	*U − B*	*V − R*	*R − I*	$T_{\rm eff}$	BC
SUPERGIANTS, I							
O9	−6.5	−0.27	−1.13	−0.15	−0.32	32 000	−3.18
B2	−6.4	−0.17	−0.93	−0.05	−0.15	17 600	−1.58
B5	−6.2	−0.10	−0.72	0.02	−0.07	13 600	−0.95
B8	−6.2	−0.03	−0.55	0.02	0.00	11 100	−0.66
A0	−6.3	−0.01	−0.38	0.03	0.05	9 980	−0.41
A2	−6.5	+0.03	−0.25	0.07	0.07	9 380	−0.28
A5	−6.6	+0.09	−0.08	0.12	0.13	8 610	−0.13
F0	−6.6	+0.17	+0.15	0.21	0.20	7 460	−0.01
F2	−6.6	+0.23	+0.18	0.26	0.21	7 030	−0.00
F5	−6.6	+0.32	+0.27	0.35	0.23	6 370	−0.03
F8	−6.5	+0.56	+0.41	0.45	0.27	5 750	−0.09
G0	−6.4	+0.76	+0.52	0.51	0.33	5 370	−0.15
G2	−6.3	+0.87	+0.63	0.58	0.40	5 190	−0.21
G5	−6.2	+1.02	+0.83	0.67	0.44	4 930	−0.33
G8	−6.1	+1.14	+1.07	0.69	0.46	4 700	−0.42
K0	−6.0	+1.25	+1.17	0.76	0.48	4 550	−0.50
K2	−5.9	+1.36	+1.32	0.85	0.55	4 310	−0.61
K5	−5.8	+1.60	+1.80	1.20	0.90	3 990	−1.01
M0	−5.6	+1.67	+1.90	1.23	0.94	3 620	−1.29
M2	−5.6	+1.71	+1.95	1.34	1.10	3 370	−1.62
M5	−5.6	+1.80	+1.60:	2.18	1.96	2 880	−3.47

Table 15.8. *Calibration of MK spectral types.*[a]

Sp	$\mathcal{M}/\mathcal{M}_\odot$	$R/R_\odot$	$\log(g/g_\odot)$	$\log(\bar{\rho}/\bar{\rho}_\odot)$	$v_{\rm rot}$ (km s^{-1})
MAIN SEQUENCE, V					
O3	120	15	−0.3	−1.5	
O5	60	12	−0.4	−1.5	
O6	37	10	−0.45	−1.45	
O8	23	8.5	−0.5	−1.4	200
B0	17.5	7.4	−0.5	−1.4	170
B3	7.6	4.8	−0.5	−1.15	190
B5	5.9	3.9	−0.4	−1.00	240
B8	3.8	3.0	−0.4	−0.85	220
A0	2.9	2.4	−0.3	−0.7	180
A5	2.0	1.7	−0.15	−0.4	170
F0	1.6	1.5	−0.1	−0.3	100
F5	1.4	1.3	−0.1	−0.2	30
G0	1.05	1.1	−0.05	−0.1	10
G5	0.92	0.92	+0.05	−0.1	< 10
K0	0.79	0.85	+0.05	+0.1	< 10
K5	0.67	0.72	+0.1	+0.25	< 10
M0	0.51	0.60	+0.15	+0.35	
M2	0.40	0.50	+0.2	+0.8	
M5	0.21	0.27	+0.5	+1.0	
M8	0.06	0.10	+0.5	+1.2	