

三角测量归心改正计算用表

测量计算用表编算组编算

测绘出版社

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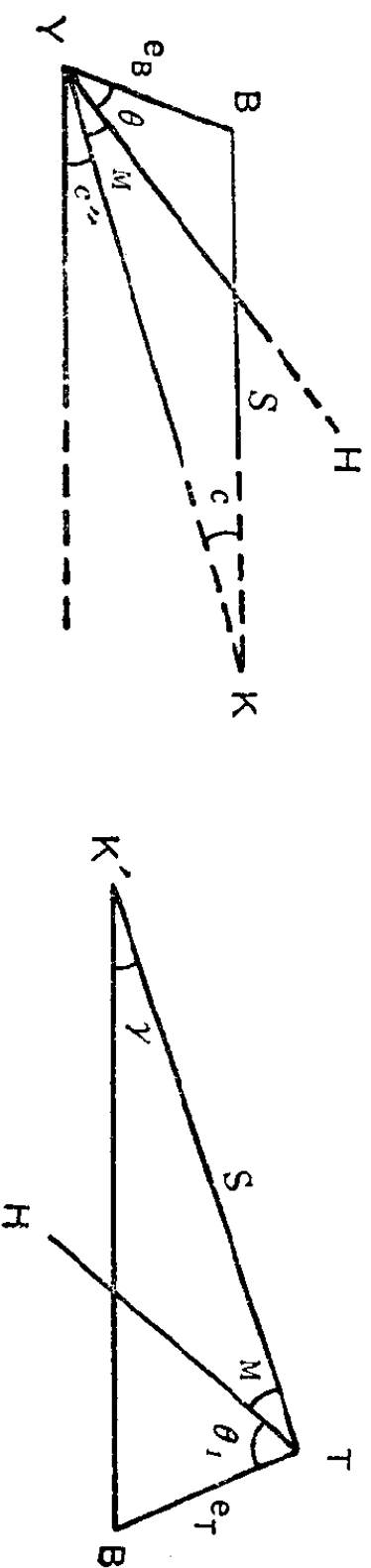
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用 表 说 明

归心改正计算，在三角测量概算工作中，是一项不可缺少而又占据一定比重的工作。根据几年来的大地计算工作，使我们体会到如果将归心改正计算按公式编算成在任何情况下都能适合的用表，则可简化它的运算程序，提高计算速度。为此，我组于1958年5月参照国内已有的归心改正计算用表，重新编算了这本“归心改正数计算用表”。

本表编算时，对表格的组成形式及 $(M + \theta)$ 之表差与 d'' 之精度，都作了适当的调整，并重新计算了所有的数字。

造 表 公 式



归心改正之现行公式是：

$$\begin{aligned} c'' \text{ 或 } \gamma'' &= \frac{e \cdot \rho'' \cdot \sin(M + \theta)}{S} = \frac{e^m \cdot \rho'' \cdot \sin(M + \theta) 10^{-3}}{S^{km}} \\ &= \frac{206.265 e'' \cdot \sin(M + \theta)}{S^{km}} = \frac{d''}{S^{km}} \end{aligned}$$

式中： $d'' = 206.265 e'' \cdot \sin(M + \theta)$ ， e 以米为单位； S^{km} 为以公里计算之边长。

因为 $\rho'' \cdot 10^{-3} = 206.265$ 是常数，故 d'' 表（归心改正计算用表）是以离心距 e 及角度 $(M + \theta)$ 为引数编制，表内 $(M + \theta)$ 每隔 $5'$ 一载，而离心距 e 每隔 $1''$ 列一值。

为了适用计算机计算，又在表 I 基础上，抽出 $e = 0.01$ 各栏编成表 II，当计算机可以连乘时，使用表 II 是方便的。

表 的 用 法

表 I 用法：

1. 按归心原素表内所列之 $(M + \theta)$ 值直接用与表内所载之 $(M + \theta)$ 值靠近的一列值即可，不必进行内插。
2. $1-9^{\text{cm}}$ 直接利用所查 $(M + \theta)$ 列之数值，而 $1-9^{\text{mm}}$ 则用同列将小数位前移一位（即以 10 除原数）之数值； $1-9^{\text{dm}}$ 则用同列将小数位后移一位（即乘以 10）之数值。

3. 如果 e 值非整分米、厘米时，则将按上述方法求得之（三个）表列值用算盘相加即得 d'' 。

4. 将查得之 d'' 除以公里为单位之边长 S 即得 c'' 或 γ'' 。

5. $(M + \theta)$ 在 $0—90$ 度或 $180—270$ 度时，于左边查取； $90—180$ 度或 $270—360$ 度时，于右边查取。

6. 因 $(M + \theta)$ 在 $0—90$ 度及 $90—180$ 度之归心改正为正，而 $180—270$ 度及 $270—360$ 度之归心改正为负，故在表内 $(M + \theta)$ 之上方附以正、负号以表示之。

现举出四个例子如下：

区 分	按一般方法	按 d'' 表 计 算	备 考
例	$(M + \theta) = 194^{\circ}53'$ $e = 0.003^m$ $S = 9.456^{km}$		
ρ'' e $\sin(M + \theta)$ S^m c'' 或 γ''	206265 0.003 0.256852 9456 0".017	d'' S^{km} c'' 或 γ''	— 0.15929 9.456 — 0".017 1. 因 $194^{\circ}53'$ 靠近 $194^{\circ}55'$ ，故查表时 角度引数为 $194^{\circ}55'$ 。 2. 将由表内查得之 d'' 除以 10（即将小 数点前移一位）即得 -0.15929

区 分	按一般方法	按 d'' 表	计 算	备 考	
例 二	$(M+\Theta)=154^{\circ}36'$		$e=0.020''$	$S=15.672^{km}$	
ρ'' e	206265 0.020	d''	+	1.77057	1. 因 $154^{\circ}36'$ 靠近 $154^{\circ}35'$, 故查表时 角度引数为 $154^{\circ}35'$ 。
$\sin(M+\Theta)$	+	0.428935		15.672	
S^m	15672	S^{km}			
c'' 或 γ''	+	0".113	+	0".113	
例 三	$(M+\Theta)=317^{\circ}44''$		$e=0.500''$	$S=18.946^{km}$	
ρ'' e	206265 0.500	d''	—	69.34290	1. 因 $317^{\circ}44'$ 靠近 $317^{\circ}45'$, 故查表时 角度引数为 $317^{\circ}45'$ 。 2. 将由表内查得 d'' 乘以10 (即将小数 点后移一位) 即得—69.34290。
$\sin(M+\Theta)$	—	0.672582		18.946	
S^m	18946	S^{km}			
c'' 或 γ''	—	3".661	—	3".660	
例 四	$(M+\Theta)=266^{\circ}37'$		$e=0.478''$	$S=20.631^{km}$	
ρ'' e	206265 0.478	d''	—	98.41948	d'' 为下列三个数之和, 即 82.35940 14.41289 + 1.64719 98.41948
$\sin(M+\Theta)$	0.998257	S^{km}		20.631	
S^m	20631				
c'' 或 γ''	—	4".771	—	4".770	

上面四个例子系按一等精度要求计算。二、三、四等三角测量归心计算时 d'' 之小数位可只取至 $0''.001$ (二等) 或 $0''.01$ (三、四等)

表 I 的用法: 以 $(M + \theta)$ 为引数, 查得 $e = 0''.01$ 时的数值, 乘以实际之 e (计算时 e 以厘米为单位, 如欲乘 $0''.225$, 则改为 $22''.5$ 相乘), 即得 d'' , 再除以以公里为单位的边长 S , 就得到所求的 c'' 或 γ'' 。

精 度 分 析

编算本表的角度间隔为 $5'$, 而归心计算查表时表列引数之最大误差是 $2'$, 由归心改正公式微分得:

$$dc'' = \frac{e \cdot \rho''}{S} \cdot \cos(M + \theta) d(M + \theta)$$

设 $\cos(M + \theta)$ 之最大值为 1, 则

$$dc'' = \frac{e \cdot \rho''}{S} \cdot \frac{d(M + \theta)''}{\rho''} = \frac{e}{S} d(M + \theta)'' = \frac{e}{S} 120''$$

各级三角测量对归心计算的精度要求, 按“国家三角测量和精密导线测量规范”的规定, 一、二等为 $0''.01$, 三、四等为 $0''.1$ 。

为保证达到上述精度, 在一、二等三角应使 $dc'' = \frac{e \cdot 120''}{S} < 0''.005$, 当一、二等三

角边长为10公里时, 应使 $e < \frac{10000'' \times 0''.005}{120''} \approx 0.4''$ 。在三、四等三角应使 $dc'' = \frac{e \cdot 120''}{S} < 0''.05$, 当三、四等三角边长为2公里时, 应使 $e < \frac{2000'' \times 0''.05}{120''} \approx 0.8''$ 。

根据上述分析, 在一、二等三角边长小于10公里, 且 e 值大于 $0.4''$, 以及三、四等三角边长小于2公里, 且 e 值大于 $0.8''$ 时, 应用本表需进行内插外, 其他情况用此表时不用内插, 即可保证各级三角测量对归心改正数计算之精度要求。

本表不但适用于真数计算, 同时也适用于对数计算。利用对数计算归心改正时, 可由表内查得之 d'' 换算成对数, 按下列公式

$$\log c'' \text{ 或 } \log \gamma'' = \log d'' - \log S_{e''}$$

计算测站归心与照准点归心改正数。

表 I

1

$M + \theta$		e	m									e	$M + \theta$	
+			0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09		+	
0°	180° 00'	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	180° 00'	360°	
	05	0.00300	0.00600	0.00900	0.01200	0.01500	0.01799	0.02099	0.02399	0.02699	0.02999	05		
	10	0.00600	0.01200	0.01800	0.02400	0.03000	0.03600	0.04200	0.04800	0.05400	0.05999	10		
	15	0.00900	0.01800	0.02700	0.03600	0.04500	0.05400	0.06300	0.07200	0.08099	0.08999	15		
	20	0.01200	0.02400	0.03600	0.04800	0.06000	0.07200	0.08400	0.09600	0.10800	0.11999	20		
	25	0.01500	0.03000	0.04500	0.06000	0.07500	0.09000	0.10500	0.12000	0.13500	0.15000	25		
	30	0.01800	0.03600	0.05400	0.07200	0.09000	0.10800	0.12601	0.14401	0.16201	0.18000	30		
	35	0.02100	0.04200	0.06300	0.08400	0.10500	0.12600	0.14700	0.16800	0.18900	0.21000	35		
	40	0.02400	0.04800	0.07200	0.09600	0.11999	0.14399	0.16799	0.19199	0.21599	0.24000	40		
	45	0.02700	0.05400	0.08100	0.10800	0.13500	0.16200	0.18900	0.21600	0.24300	0.27000	45		
	50	0.03000	0.06000	0.09000	0.12000	0.15000	0.18000	0.20999	0.23999	0.26999	0.29999	50		
	55	0.03300	0.06600	0.09899	0.13199	0.16499	0.19799	0.23099	0.26399	0.29699	0.32999	55		
1	181	0.03600	0.07199	0.10799	0.14399	0.17999	0.21598	0.25198	0.28798	0.32398	0.35998	179		
	00	0.03900	0.07800	0.11700	0.15599	0.19499	0.23399	0.27299	0.31199	0.35099	0.38999	00		
	05	0.04200	0.08400	0.12599	0.16799	0.20999	0.25199	0.29398	0.33598	0.37798	0.41997	05		
	10	0.04500	0.08999	0.13499	0.17999	0.22498	0.26998	0.31498	0.35997	0.40497	0.44997	10		
	15	0.04800	0.09599	0.14399	0.19198	0.23998	0.28797	0.33597	0.38397	0.43196	0.47996	15		
	20	0.05099	0.10199	0.15298	0.20398	0.25497	0.30597	0.35696	0.40796	0.45895	0.50995	20		
2	182	0.05399	0.10799	0.16198	0.21598	0.26997	0.32396	0.37796	0.43195	0.48595	0.53993	178		
	00	0.05699	0.11399	0.17098	0.22797	0.28497	0.34196	0.39895	0.45594	0.51294	0.56992	00		
	05	0.05999	0.11998	0.17998	0.23997	0.29996	0.35995	0.41995	0.47994	0.53993	0.59991	05		
	10	0.06299	0.12598	0.18897	0.25197	0.31496	0.37795	0.44094	0.50393	0.56692	0.62991	10		
	15	0.06599	0.13198	0.19796	0.26395	0.32994	0.39593	0.46192	0.52791	0.59389	0.65988	15		
	20	0.06899	0.13797	0.20696	0.27595	0.34494	0.41392	0.48291	0.55190	0.62089	0.68988	20		
		0.07198	0.14397	0.21595	0.28794	0.35992	0.43191	0.50389	0.57588	0.64786	0.71985			

$M + \theta$		e		$M + \theta$	
$+$		$+$		$+$	
$M + \theta$	m	m	m	m	m
2°	182°	$00'$	0.07198	0.14397	0.21595
		05	0.07498	0.14997	0.22495
		10	0.07798	0.15596	0.23394
		15	0.08098	0.16196	0.24294
		20	0.08398	0.16795	0.25193
		25	0.08697	0.17395	0.26092
		30	0.08997	0.17994	0.26991
		35	0.09297	0.18594	0.27890
		40	0.09596	0.19193	0.28789
		45	0.09896	0.19792	0.29688
		50	0.10196	0.20392	0.30588
		55	0.10495	0.20991	0.31486
3	183	00	0.10795	0.21590	0.32385
		05	0.11095	0.22189	0.33284
		10	0.11394	0.22789	0.34183
		15	0.11694	0.23388	0.35081
		20	0.11993	0.23987	0.35980
		25	0.12293	0.24586	0.36878
		30	0.12592	0.25185	0.37777
		35	0.12892	0.25783	0.38675
		40	0.13191	0.26382	0.39573
		45	0.13490	0.26981	0.40471
		50	0.13790	0.27579	0.41369
		55	0.14089	0.28178	0.42267
4	184	00	0.14388	0.28776	0.43165
					0.57553
					0.71941
					0.86329
					1.00718
					1.15106
					1.29494
					1.43882
					1.58270
					1.72658
					1.87046
					2.01434
					2.15822
					2.30210
					2.44598
					2.58986
					2.73374
					2.87762
					3.02150
					3.16538
					3.30926
					3.45314
					3.59702
					3.74090
					3.88478
					4.02866
					4.17254
					4.31642
					4.46030
					4.60418
					4.74806
					4.89194
					5.03582
					5.17970
					5.32358
					5.46746
					5.61134
					5.75522
					5.89910
					6.04298
					6.18686
					6.33074
					6.47462
					6.61850
					6.76238
					6.90626
					7.05014
					7.19402
					7.33790
					7.48178
					7.62566
					7.76954
					7.91342
					8.05730
					8.20118
					8.34506
					8.48894
					8.63282
					8.77670
					8.92058
					9.06446
					9.20834
					9.35222
					9.49610
					9.63998
					9.78386
					9.92774
					10.07162
					10.21550
					10.35938
					10.50326
					10.64714
					10.79102
					10.93490
					11.07878
					11.22266
					11.36654
					11.51042
					11.65430
					11.79818
					11.94206
					12.08594
					12.22982
					12.37370
					12.51758
					12.66146
					12.80534
					12.94922
					13.09310
					13.23698
					13.38086
					13.52474
					13.66862
					13.81250
					13.95638
					14.10026
					14.24414
					14.38802
					14.53190
					14.67578
					14.81966
					14.96354
					15.10742
					15.25130
					15.39518
					15.53906
					15.68294
					15.82682
					15.97070
					16.11458
					16.25846
					16.40234
					16.54622
					16.69010
					16.83398
					16.97786
					17.12174
					17.26562
					17.40950
					17.55338
					17.69726
					17.84114
					17.98502
					18.12890
					18.27278
					18.41666
					18.56054
					18.70442
					18.84830
					18.99218
					19.13606
					19.27994
					19.42382
					19.56770
					19.71158
					19.85546
					19.99934
					20.14322
					20.28710
					20.43098
					20.57486
					20.71874
					20.86262
					21.00650
					21.15038
					21.29426
					21.43814
					21.58202
					21.72590
					21.86978
					22.01366
					22.15754
					22.30142
					22.44530
					22.58918
					22.73306
					22.87694
					23.02082
					23.16470
					23.30858
					23.45246
					23.59634
					23.74022
					23.88410
					24.02798
					24.17186
					24.31574
					24.45962
					24.60350
					24.74738
					24.89126
					25.03514
					25.17902
					25.32290
					25.46678
					25.61066
					25.75454
					25.89842
					26.04230
					26.18618
					26.33006
					26.47394
					26.61782
					26.76170
					26.90558
					27.04946
					27.19334
					27.33722
					27.48110
					27.62498
					27.76886
					27.91274
					28.05662
					28.20050
					28.34438
					28.48826
					28.63214
					28.77602
					28.91990
					29.06378
					29.20766
					29.35154
					29.49542
					29.63930
					29.78318
					29.92706
					30.07094
					30.21482
					30.35870
					30.50258
					30.64646
					30.79034
					30.93422
					31.07810
					31.22198
					31.36586
					31.50974
					31.65362
					31.79750
					31.94138
					32.08526
					32.22914
					32.37302
					32.51690
					32.66078
					32.80466
					32.94854
					33.09242
					33.23630
					33.38018
					33.52406
					33.66794
					33.81182
					33.95570
					34.09958
					34.24346
					34.38734
					34.53122
					34.67510
					34.81898

$\frac{e}{M+\theta}$		$\frac{e}{M+\theta}$	
$M+\theta$	e	m	m
+	-	0.01	0.02
4°	184° 00'	0.14388	0.28776
	05	0.14688	0.29375
	10	0.14987	0.29974
	15	0.15286	0.30572
	20	0.15585	0.31170
	25	0.15884	0.31769
	30	0.16183	0.32367
	35	0.16482	0.32965
	40	0.16782	0.33563
	45	0.17080	0.34161
	50	0.17379	0.34759
	55	0.17678	0.35357
			0.53035
			0.67126
			0.83908
			1.00689
			1.17471
			1.34252
			1.51034
			1.67815
			1.84596
			2.01377
			2.18158
			2.34939
			2.51720
			2.68501
			2.85282
			3.02063
			3.18844
			3.35625
			3.52406
			3.69187
			3.85968
			4.02749
			4.19530
			4.36311
			4.53092
			4.69873
			4.86654
			5.03435
			5.20216
			5.36997
			5.53778
			5.70559
			5.87340
			6.04121
			6.20902
			6.37683
			6.54464
			6.71245
			6.88026
			7.04807
			7.21588
			7.38369
			7.55150
			7.71931
			7.88712
			8.05493
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			8.39055
			8.55836
			8.72617
			8.89398
			9.06179
			9.22960
			9.39741
			9.56522
			9.73303
			9.90084
			10.06865
			10.23646
			10.40427
			10.57208
			10.73989
			10.90770
			11.07551
			11.24332
			11.41113
			11.57894
			11.74675
			11.91456
			12.08237
			12.25018
			12.41799
			12.58580
			12.75361
			12.92142
			13.08923
			13.25704
			13.42485
			13.59266
			13.76047
			13.92828
			14.09609
			14.26390
			14.43171
			14.59952
			14.76733
			14.93514
			15.10295
			15.27076
			15.43857
			15.60638
			15.77419
			15.94200
			16.10981
			16.27762
			16.44543
			16.61324
			16.78105
			16.94886
			17.11667
			17.28448
			17.45229
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			45.98021
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			46.48364
			46.65145
			46.81926
			46.98707
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			62.92902
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			63.26464
			63.43245
			63.60026
			63.76807

$M + \theta$		e		m		m		m		m		m		m		m		m		c		$M + \theta$			
$+$		$-$		0.01		0.02		0.03		0.04		0.05		0.06		0.07		0.08		0.09		$+$		$-$	
6°		$186^\circ 00'$		0.21560		0.43121		0.64681		0.86242		1.07802		1.29363		1.50923		1.72484		1.94044		$174^\circ 00'$		354°	
		05		0.21859		0.43718		0.65577		0.87436		1.09295		1.31154		1.53013		1.74871		1.96730		55			
		10		0.22157		0.44314		0.66472		0.88629		1.10786		1.32943		1.55100		1.77258		1.99415		50			
		15		0.22455		0.44911		0.67366		0.89822		1.12277		1.34733		1.57188		1.79644		2.02099		45			
		20		0.22754		0.45507		0.68261		0.91015		1.13769		1.36522		1.59276		1.82030		2.04783		40			
		25		0.23052		0.46104		0.69155		0.92207		1.15259		1.38311		1.61362		1.84414		2.07466		35			
		30		0.23350		0.46700		0.70049		0.93399		1.16749		1.40099		1.63449		1.86799		2.10148		30			
		35		0.23648		0.47296		0.70944		0.94591		1.18239		1.41887		1.65535		1.89183		2.12831		25			
		40		0.23946		0.47892		0.71838		0.95784		1.19730		1.43676		1.67621		1.91567		2.15513		20			
		45		0.24244		0.48488		0.72731		0.96975		1.21219		1.45463		1.69706		1.93950		2.18194		15			
		50		0.24542		0.49084		0.73625		0.98167		1.22709		1.47251		1.71793		1.96335		2.20876		10			
		55		0.24840		0.49679		0.74519		0.99359		1.24198		1.49038		1.73878		1.98717		2.23557		05			
7		187		0.25137		0.50275		0.75412		1.00549		1.25687		1.50824		1.75961		2.01098		2.26236		173		353	
		00		0.25435		0.50870		0.76305		1.01741		1.27176		1.52611		1.78046		2.03481		2.28916		55			
		10		0.25733		0.51466		0.77198		1.02931		1.28664		1.54397		1.80130		2.05862		2.31595		50			
		15		0.26030		0.52061		0.78091		1.04122		1.30152		1.56183		1.82213		2.08243		2.34274		45			
		20		0.26328		0.52656		0.78984		1.05312		1.31640		1.57968		1.84297		2.10625		2.36953		40			
		25		0.26626		0.53251		0.79877		1.06502		1.33128		1.59753		1.86379		2.13004		2.39630		35			
		30		0.26923		0.53846		0.80769		1.07692		1.34615		1.61538		1.88461		2.15384		2.42307		30			
		35		0.27220		0.54441		0.81661		1.08882		1.36102		1.63322		1.90543		2.17763		2.44983		25			
		40		0.27518		0.55036		0.82553		1.10071		1.37589		1.65107		1.92625		2.20143		2.47660		20			
		45		0.27815		0.55630		0.83445		1.11260		1.39075		1.66890		1.94705		2.22520		2.50335		15			
		50		0.28112		0.56225		0.84337		1.12449		1.40561		1.68674		1.96786		2.24898		2.53010		10			
		55		0.28409		0.56819		0.85228		1.13638		1.42047		1.70457		1.98866		2.27276		2.55685		05			
8		188		0.28707		0.57413		0.86120		1.14826		1.43533		1.72239		2.00946		2.29652		2.58359		172		352	

$\frac{e}{M+\theta}$		$\frac{m}{m}$										$\frac{e}{M+\theta}$			
		c													
$+$	$-$											$+$	$-$		
10°	190°	$00'$	05	10	15	20	25	30	35	40	45	50	55	170°	350°
		0.35818	0.71635	1.07453	1.43270	1.79088	2.14905	2.50723	2.86540	3.22358					
		0.36113	0.72226	1.08339	1.44452	1.80564	2.16677	2.52790	2.88903	3.25016					
		0.36408	0.72816	1.09225	1.45633	1.82041	2.18449	2.54858	2.91266	3.27674					
		0.36704	0.73407	1.10111	1.46814	1.83518	2.20222	2.56925	2.93629	3.30333					
		0.36999	0.73998	1.10996	1.47995	1.84994	2.21993	2.58991	2.95990	3.32989					
		0.37294	0.74587	1.11881	1.49175	1.86469	2.23762	2.61056	2.98350	3.35644					
		0.37589	0.75178	1.12767	1.50356	1.87945	2.25533	2.63122	3.00711	3.38300					
		0.37884	0.75767	1.13651	1.51535	1.89418	2.27302	2.65186	3.03069	3.40953					
		0.38179	0.76357	1.14536	1.52714	1.90893	2.29072	2.67250	3.05429	3.43608					
		0.38473	0.76947	1.15420	1.53893	1.92367	2.30840	2.69314	3.07787	3.46260					
		0.38768	0.77536	1.16304	1.55073	1.93841	2.32609	2.71377	3.10145	3.48913					
		0.39063	0.78125	1.17188	1.56251	1.95313	2.34376	2.73439	3.12501	3.51564					

$\frac{e}{M+\theta}$		m										$\frac{e}{M+\theta}$	
+	-	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09		+	-
12°	192° 00'	0.42885	0.85770	1.28655	1.71540	2.14425	2.57310	3.00195	3.43080	3.85965	168° 00'	348°	
	05	0.43178	0.86357	1.29535	1.72713	2.15891	2.59070	3.02243	3.45426	3.88604	55		
	10	0.43472	0.86943	1.30415	1.73886	2.17358	2.60830	3.04301	3.47773	3.91244	50		
	15	0.43765	0.87530	1.31295	1.75060	2.18824	2.62589	3.06354	3.50119	3.93884	45		
	20	0.44058	0.88116	1.32174	1.76232	2.20290	2.64348	3.08406	3.52464	3.96522	40		
	25	0.44351	0.88702	1.33053	1.77404	2.21754	2.66105	3.10456	3.54807	3.99158	35		
	30	0.44644	0.89288	1.33932	1.78576	2.23220	2.67864	3.12508	3.57152	4.01796	30		
	35	0.44937	0.89873	1.34810	1.79747	2.24683	2.69620	3.14557	3.59493	4.04430	25		
	40	0.45230	0.90459	1.35689	1.80918	2.26148	2.71377	3.16607	3.61837	4.07066	20		
	45	0.45522	0.91044	1.36566	1.82088	2.27610	2.73132	3.18654	3.64177	4.09699	15		
	50	0.45815	0.91630	1.37444	1.83259	2.29074	2.74889	3.20703	3.66518	4.12333	10		
	55	0.46107	0.92214	1.38322	1.84429	2.30536	2.76643	3.22751	3.68858	4.14965	05		
13	193 00	0.46400	0.92799	1.39199	1.85598	2.31998	2.78397	3.24797	3.71196	4.17596	167 00	347	
	05	0.46692	0.93384	1.40075	1.86767	2.33459	2.80151	3.26843	3.73534	4.20226	55		
	10	0.46984	0.93968	1.40952	1.87935	2.34919	2.81903	3.28887	3.75871	4.22855	50		
	15	0.47276	0.94552	1.41828	1.89104	2.36380	2.83656	3.30932	3.78208	4.25483	45		
	20	0.47568	0.95136	1.42704	1.90272	2.37840	2.85408	3.32976	3.80544	4.28112	40		
	25	0.47860	0.95720	1.43580	1.91439	2.39299	2.87159	3.35019	3.82879	4.30739	35		
	30	0.48152	0.96303	1.44455	1.92606	2.40758	2.88909	3.37061	3.85212	4.33364	30		
	35	0.48443	0.96886	1.45330	1.93773	2.42216	2.90659	3.39102	3.87546	4.35989	25		
	40	0.48735	0.97470	1.46205	1.94939	2.43674	2.92409	3.41144	3.89879	4.38614	20		
	45	0.49026	0.98053	1.47079	1.96105	2.45132	2.94158	3.43184	3.92210	4.41237	15		
	50	0.49318	0.98635	1.47953	1.97270	2.46588	2.95905	3.45223	3.94540	4.43858	10		
	55	0.49609	0.99218	1.48826	1.98435	2.48044	2.97653	3.47262	3.96870	4.46479	05		
14	194 00	0.49900	0.99800	1.49700	1.99600	2.49500	2.99400	3.49300	3.99200	4.49100	166 00		346

$\frac{M+\theta}{e}$	m	m	m	m	m	m	m	m	m	e	$\frac{M+\theta}{e}$
+ -	-	-	-	-	-	-	-	-	-	+ +	-
14° 00'	0.49900	0.99800	1.49700	1.99600	2.49500	2.99400	3.49300	3.99200	4.49100	166° 00'	346°
05	0.50191	1.00382	1.50573	2.00764	2.50955	3.01146	3.51338	4.01529	4.51720	55	
10	0.50482	1.00964	1.51446	2.01928	2.52410	3.02891	3.53373	4.03855	4.54337	50	
15	0.50773	1.01545	1.52318	2.03091	2.53864	3.04636	3.55409	4.06182	4.56955	45	
20	0.51064	1.02127	1.53191	2.04254	2.55318	3.06381	3.57445	4.08509	4.59572	40	
25	0.51354	1.02708	1.54063	2.05417	2.56771	3.08125	3.59479	4.10834	4.62188	35	
30	0.51645	1.03289	1.54934	2.06579	2.58223	3.09868	3.61512	4.13157	4.64802	30	
35	0.51935	1.03870	1.55805	2.07740	2.59675	3.11610	3.63545	4.15480	4.67415	25	
40	0.52225	1.04451	1.56676	2.08901	2.61126	3.13352	3.65577	4.17802	4.70027	20	
45	0.52515	1.05031	1.57546	2.10062	2.62577	3.15093	3.67608	4.20124	4.72639	15	
50	0.52805	1.05611	1.58416	2.11222	2.64027	3.16833	3.69638	4.22444	4.75249	10	
55	0.53095	1.06191	1.59286	2.12382	2.65477	3.18573	3.71668	4.24764	4.77859	05	
15 00	0.53385	1.06771	1.60156	2.13541	2.66927	3.20312	3.73697	4.27082	4.80468	165 00	345
05	0.53675	1.07350	1.61025	2.14700	2.68376	3.22051	3.75726	4.29401	4.83076	55	
10	0.53965	1.07929	1.61894	2.15859	2.69823	3.23788	3.77753	4.31718	4.85682	50	
15	0.54254	1.08508	1.62762	2.17016	2.71270	3.25525	3.79779	4.34033	4.88287	45	
20	0.54543	1.09087	1.63630	2.18174	2.72717	3.27261	3.81804	4.36348	4.90891	40	
25	0.54833	1.09666	1.64499	2.19331	2.74164	3.28997	3.83830	4.38663	4.93496	35	
30	0.55122	1.10244	1.65366	2.20487	2.75609	3.30731	3.85853	4.40975	4.96097	30	
35	0.55411	1.10822	1.66233	2.21644	2.77055	3.32466	3.87877	4.43288	4.98699	25	
40	0.55700	1.11400	1.67099	2.22799	2.78499	3.34199	3.89899	4.45598	5.01298	20	
45	0.55989	1.11977	1.67966	2.23954	2.79943	3.35931	3.91920	4.47909	5.03897	15	
50	0.56277	1.12555	1.68832	2.25109	2.81387	3.37664	3.93941	4.50219	5.06496	10	
55	0.56566	1.13132	1.69698	2.26264	2.82830	3.39395	3.95961	4.52527	5.09093	05	
16 00	0.56854	1.13709	1.70563	2.27417	2.84271	3.41126	3.97980	4.54834	5.11688	164 00	344