

12 METER MILLIMETER WAVE TELESCOPE

MEMO No. 204

TO: 12M WORKING GROUP

FROM: L. J. KING

SUBJECT: SURFACE ADJUSTMENTS FOR GRAVITATIONAL FORCES

THE PRESENT SURFACE OF 12M MAY ONLY BE ACCURATELY ADJUSTED WITH REFLECTOR IN ZENITH POSITION. FOR BEST PERFORMANCE OF THE TELESCOPE UNDER GRAVITATIONAL FORCES, THE SURFACE SHOULD BE ADJUSTED AT A DIRECTION AWAY FROM ZENITH. FIGURE 1 OF MEMO. #192 SHOWS TWO SURFACE ERROR CURVES FOR REFLECTOR ADJUSTED AT REF ZENITH ANG OF 30 AND 40 DEGREES, RESPECTIVELY.

ONCE THE REFERENCE IS CHOSEN, THE DEPARTURES OF SURFACE FROM THE PERFECT PARABOLOID IN ZENITH POSITION MAY BE CALCULATED.

THE REQUIRED DEPARTURES OF THE SURFACE AT 12 SENSORS OF 144 RADII ON THE SURFACE ARE TABULATED ON THE FOLLOWING PAGES.

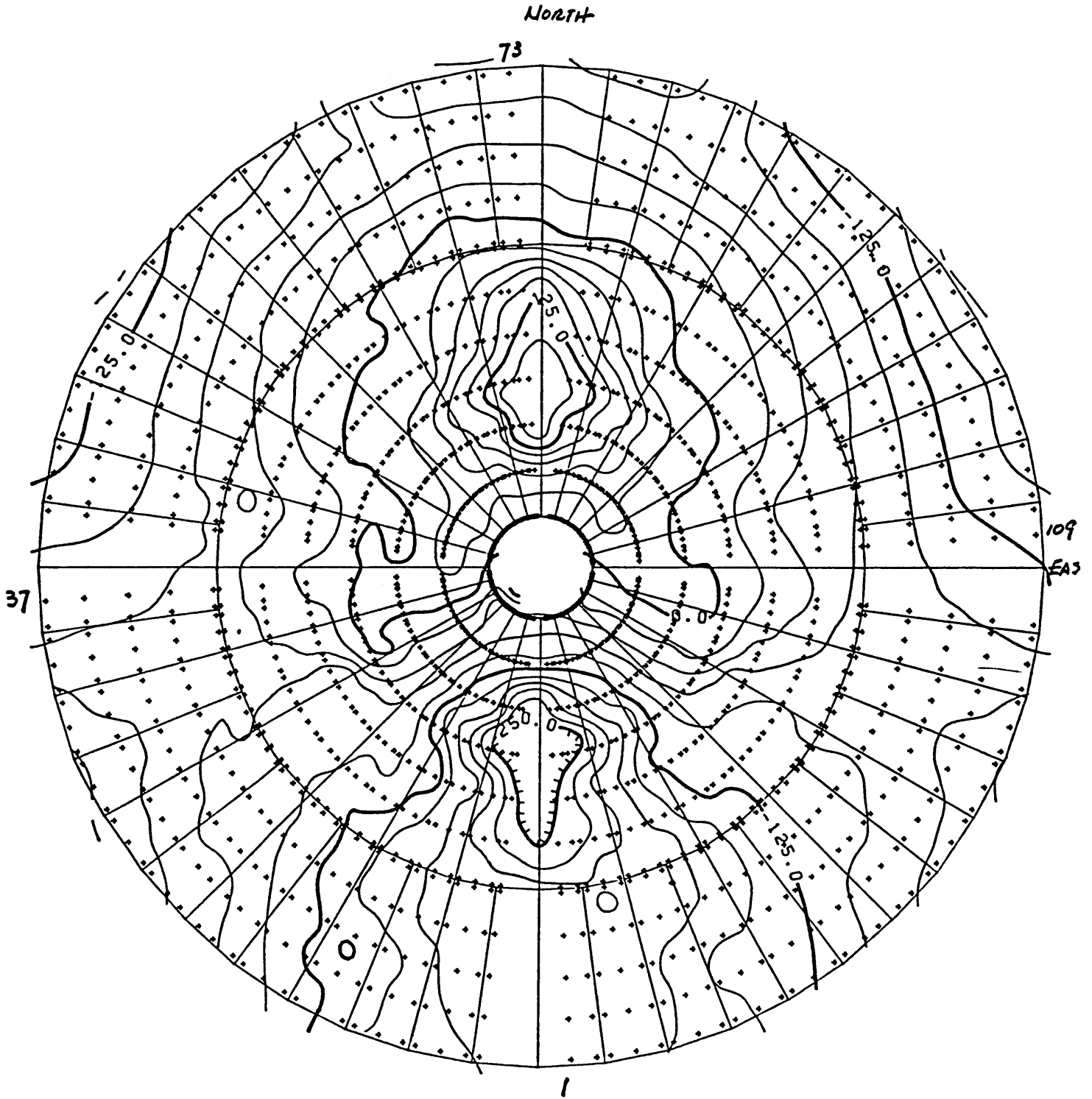
- (1) P.2 THRU P.7 FOR REF ZA=40 DEG.
- (2) P.8 THRU P.13 FOR REF ZA=30 DEG.

NOTE: (1) LENGTH UNIT IN MICRONS.
(2) POSITIVE VALUES FOR DEPARTURES ABOVE THE PERFECT PARABOLOID.

12M SURF ADJ --- 90WRT50

REF. ZA = 40°

CONTOUR @ 25 μm



RADIUS ID	S E N S O R N U M B E R											
	1	2	3	4	5	6	7	8	9	10	11	12
1	-55	-116	-214	-264	-249	-239	-197	-193	-188	-186	-182	-181
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4	-55	-116	-233	-257	-250	-250	-191	-185	-182	-179	-175	-175
5	-55	-116	-239	-265	-239	-228	-187	-183	-178	-183	-183	-176
6	-55	-116	-242	-265	-237	-225	-186	-183	-176	-185	-179	-173
7	-55	-115	-192	-263	-201	-217	-184	-186	-177	-182	-176	-168
8	-54	-110	-183	-235	-183	-196	-184	-186	-181	-173	-168	-161
9	-54	-109	-178	-229	-174	-187	-182	-182	-183	-165	-163	-157
10	-53	-106	-169	-217	-171	-176	-178	-179	-172	-153	-156	-152
11	-51	-103	-159	-192	-158	-161	-166	-166	-165	-141	-129	-146
12	-51	-102	-154	-183	-150	-157	-170	-161	-161	-136	-128	-142
13	-47	-95	-144	-168	-105	-138	-158	-160	-154	-128	-126	-124
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32	-10	8	6	3	-37	-50	-67	-67	-71	-63	-59	-42
33	-9	9	6	3	-33	-48	-67	-68	-71	-69	-61	-48
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36	-5	18	6	0	-23	-40	-63	-65	-72	-74	-77	-80
37	-4	21	4	-4	-22	-38	-64	-66	-73	-78	-79	-84
38	-3	22	-2	-4	-24	-41	-64	-66	-74	-80	-81	-89
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40	0	26	0	-4	-28	-47	-66	-68	-79	-90	-96	-103

RADIUS ID	S E N S O R N U M B E R											
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43	2	30	-3	-8	-42	-53	-60	-66	-84	-102	-114	-125
44	3	30	-2	-10	-41	-52	-59	-63	-81	-105	-115	-131
45	4	31	-2	-10	-40	-50	-58	-60	-80	-104	-116	-133
46	5	31	-1	-10	-34	-46	-58	-60	-78	-101	-116	-131
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48	7	31	0	-6	-22	-37	-55	-57	-74	-97	-115	-129
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51	9	33	4	1	-3	-21	-43	-46	-65	-92	-115	-137
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54	5	34	17	13	3	-9	-30	-35	-55	-80	-106	-134
55	7	34	24	15	5	-9	-26	-29	-51	-75	-100	-124
56	8	35	28	20	7	-7	-23	-26	-48	-72	-95	-118
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65	13	35	84	91	42	25	6	3	-17	-55	-72	-68
66	13	38	88	96	50	29	9	6	-17	-52	-69	-67
67	13	43	96	114	62	39	16	11	-13	-47	-66	-80
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73	13	62	149	163	129	102	23	18	-14	-42	-67	-89
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76	13	60	133	156	123	83	14	9	-22	-48	-72	-95
77	13	58	126	152	113	74	10	5	-27	-51	-75	-100
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80	12	49	109	124	74	43	8	4	-28	-59	-82	-104

RADIUS ID	S E N S O R N U M B E R											
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87	12	32	63	54	8	-5	-17	-20	-44	-80	-104	-127
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102	4	18	-1	-12	-35	-50	-69	-71	-92	-118	-139	-155
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119	-18	-4	-4	-18	-60	-80	-90	-90	-92	-81	-66	-53
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RADIUS ID	S E N S O R N U M B E R											
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126	-28	-32	-45	-62	-101	-105	-107	-107	-105	-100	-90	-71
127	-29	-44	-54	-72	-96	-107	-111	-111	-108	-104	-90	-77
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130	-33	-62	-85	-99	-107	-118	-127	-127	-125	-117	-107	-99
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135	-46	-92	-130	-154	-130	-147	-162	-163	-164	-150	-146	-137
136	-48	-97	-141	-170	-138	-157	-172	-173	-172	-152	-148	-145
137	-50	-102	-152	-181	-160	-171	-183	-176	-177	-154	-149	-161
138	-50	-104	-158	-191	-168	-177	-180	-180	-181	-159	-152	-166
139	-51	-107	-168	-210	-182	-189	-188	-188	-187	-168	-167	-171
140	-52	-110	-178	-226	-193	-202	-194	-194	-192	-179	-179	-174
141	-52	-111	-183	-234	-199	-208	-195	-195	-194	-184	-182	-175
142	-53	-113	-192	-248	-211	-223	-196	-199	-193	-192	-188	-180
143	-54	-115	-201	-259	-227	-227	-199	-197	-191	-193	-189	-183
144	-54	-115	-206	-264	-237	-232	-198	-195	-190	-191	-188	-183

BEST FIT PARABOLOID WITH MINIMUM PATH LENGTH IN LEAST SQUARES SENSE

12M SURF ADJ 90/50 === 1728 PTS

ORIGINAL FOCAL LENGTH = 200.0000 NO. POINTS IN ANALYSIS = 1728

INPUT DISTORTIONS OBTAINED ANALYTICALLY - OPTION 1

MINIMIZATION OF RMS WITH RESPECT TO RIGID BODY MOTION

RMS OF 1/2 LAMBDA WEIGHTED BY AREAS = 0.001736

DEVIATION OF THE MEAN - 1/2 LAMBDA = -0.00011

SUM-UNIT AREA*1/2 LAMBDA = -0.3742

SUM-UNIT AREAS = 1728.0000

X COORDINATE OF VERTEX = 0.00055

Y COORDINATE OF VERTEX = -0.15879

Z COORDINATE OF VERTEX = -0.00220

ROTATION ABOUT X AXIS = -0.0003443

ROTATION ABOUT Y AXIS = 0.0000011

MINIMIZATION OF RMS WITH RESPECT TO FOCAL LENGTH CHANGE

RMS OF 1/2 LAMBDA WEIGHTED BY AREAS = 0.001252

NEW FOCAL LENGTH = 200.0134

DEVIATION OF THE MEAN - 1/2 LAMBDA = -0.00000

SUM-UNIT AREA*1/2 LAMBDA = -0.0008

SUM-UNIT AREAS = 1728.0000

X COORDINATE OF VERTEX = 0.00082

Y COORDINATE OF VERTEX = -0.15889

Z COORDINATE OF VERTEX = -0.00062

ROTATION ABOUT X AXIS = -0.0003445

ROTATION ABOUT Y AXIS = 0.0000005

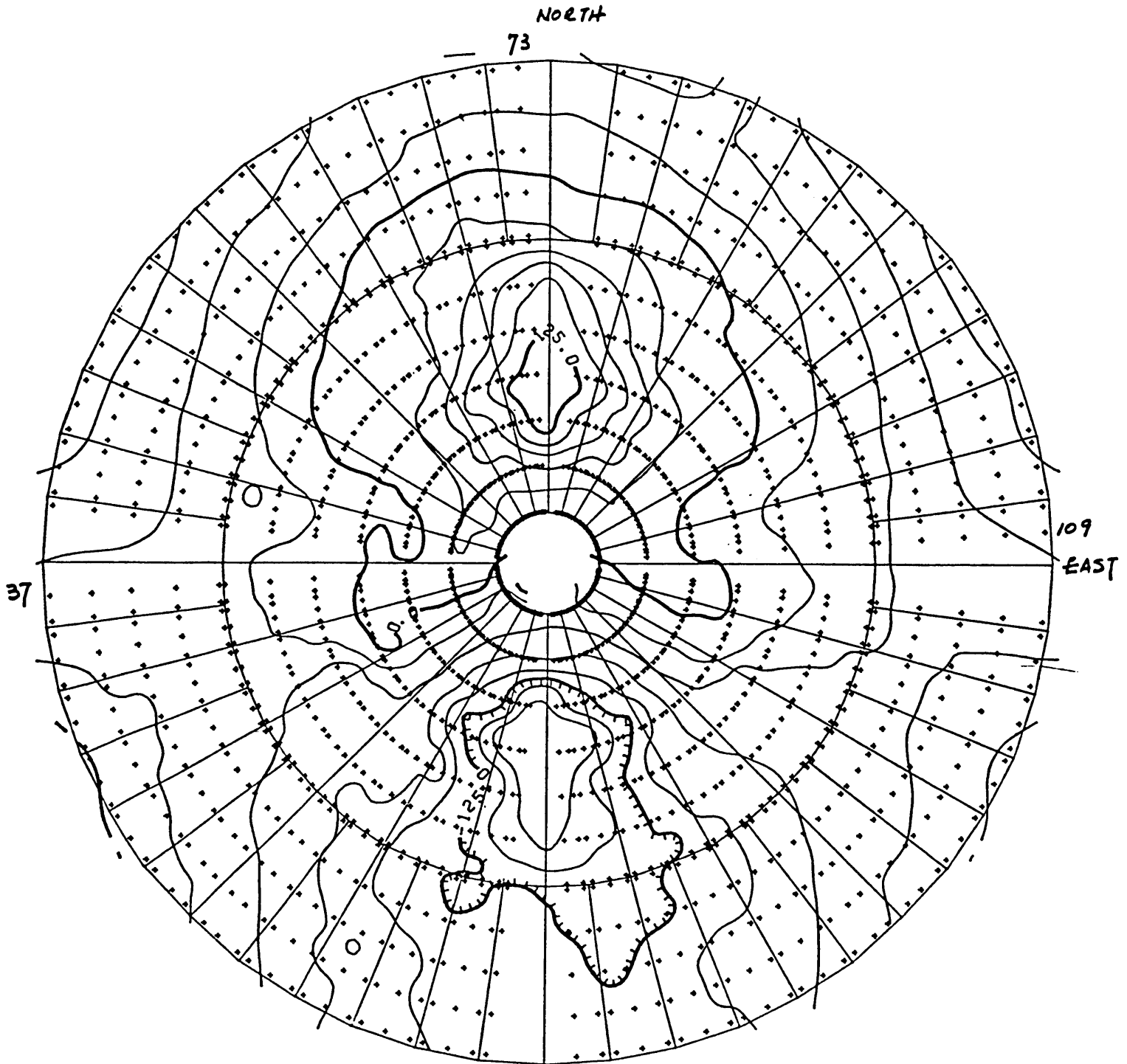
ALL LENGTH UNITS ARE CONSISTENT WITH INPUT

ROTATION UNITS ARE RADIANS

12M SURF ADJ --- 90WRT60

REF. ZA = 30°

CONTOUR Δ 25 μm



RADIUS ID	S E N S O R N U M B E R											
	1	2	3	4	5	6	7	8	9	10	11	12
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9	-37	-76	-131	-169	-123	-130	-124	-124	-122	-105	-102	-96
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11	-35	-72	-117	-140	-111	-111	-112	-111	-108	-88	-78	-89
12	-34	-71	-113	-134	-105	-107	-115	-108	-105	-84	-77	-87
13	-32	-67	-105	-122	-69	-92	-106	-107	-100	-78	-76	-73
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40	1	18	0	-1	-15	-25	-36	-37	-43	-49	-53	-57

RADIUS ID	S E N S O R N U M B E R											
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41	2	19	-2	-2	-20	-27	-36	-37	-46	-54	-60	-63
42	3	20	-2	-3	-21	-28	-36	-37	-46	-56	-62	-66
43	4	21	-2	-5	-23	-30	-32	-36	-46	-58	-66	-74
44	5	22	-1	-6	-22	-28	-31	-33	-45	-60	-68	-80
45	5	23	-1	-6	-22	-27	-30	-31	-44	-60	-69	-81
46	6	23	0	-6	-17	-23	-30	-31	-42	-59	-69	-81
47	7	24	0	-4	-12	-19	-28	-30	-40	-57	-70	-81
48	8	24	1	-2	-8	-16	-28	-28	-39	-57	-70	-81
49	9	24	3	0	2	-11	-24	-26	-37	-55	-70	-83
50	9	23	2	1	5	-6	-20	-22	-34	-53	-70	-85
51	10	27	5	3	7	-3	-18	-20	-33	-52	-69	-85
52	10	27	9	8	10	2	-16	-18	-30	-49	-66	-86
53	8	28	13	12	11	4	-12	-14	-27	-45	-63	-84
54	8	28	16	15	11	4	-9	-12	-26	-43	-61	-82
55	9	29	21	17	13	4	-6	-8	-23	-39	-57	-75
56	10	30	25	21	15	6	-3	-5	-21	-37	-54	-71
57	11	31	30	26	16	9	0	-1	-17	-35	-50	-67
58	12	32	34	28	17	9	2	0	-13	-34	-50	-66
59	13	30	41	36	11	11	5	3	-10	-32	-49	-63
60	13	30	44	39	14	8	7	5	-8	-31	-48	-61
61	13	31	50	46	20	14	11	10	-4	-27	-42	-58
62	14	31	55	53	20	17	15	14	0	-23	-39	-54
63	14	31	59	58	25	21	17	16	2	-22	-36	-51
64	14	33	65	74	33	24	19	16	4	-22	-33	-37
65	14	34	72	80	45	34	23	20	6	-20	-33	-29
66	14	36	75	84	51	37	25	23	7	-19	-31	-28
67	14	40	82	98	61	46	30	27	10	-13	-27	-36
68	15	43	86	105	71	52	33	31	14	-10	-27	-41
69	15	45	89	109	74	57	37	35	13	-8	-26	-41
70	15	52	96	125	86	69	37	34	13	-6	-24	-41
71	15	54	130	128	110	82	36	33	11	-6	-25	-42
72	15	55	128	129	110	82	39	35	10	-7	-25	-42
73	15	55	124	137	113	94	36	33	9	-9	-26	-41
74	15	55	120	135	111	89	35	31	7	-11	-28	-41
75	15	55	116	133	110	85	32	29	5	-13	-29	-43
76	15	54	111	131	108	80	29	26	3	-14	-30	-46
77	15	52	106	128	100	73	26	22	0	-15	-32	-49
78	15	51	103	124	93	69	26	22	0	-16	-33	-50
79	14	48	97	116	81	59	26	23	0	-18	-35	-52
80	14	45	92	106	70	49	24	22	0	-22	-38	-54

RADIUS ID	S E N S O R N U M B E R											
	1	2	3	4	5	6	7	8	9	10	11	12
81	14	43	89	101	65	45	23	20	-1	-23	-39	-54
82	14	40	82	91	54	36	18	16	-4	-27	-42	-49
83	14	37	76	80	43	28	13	11	-6	-33	-47	-46
84	13	35	72	75	38	25	10	8	-8	-34	-48	-48
85	13	32	65	66	27	18	8	6	-10	-36	-51	-60
86	13	30	58	55	20	12	4	2	-14	-39	-55	-71
87	13	30	55	50	17	9	2	0	-15	-40	-58	-75
88	13	31	49	42	13	4	-1	-3	-20	-44	-62	-80
89	13	31	43	37	11	2	-5	-7	-23	-47	-67	-83
90	12	30	39	34	10	1	-7	-9	-25	-49	-68	-85
91	12	29	33	27	10	0	-10	-12	-29	-51	-70	-88
92	11	27	29	23	9	-1	-12	-14	-32	-52	-72	-90
93	11	23	24	18	8	-2	-16	-18	-35	-55	-75	-95
94	10	21	20	15	7	-3	-16	-21	-37	-57	-78	-100
95	10	20	15	11	5	-5	-22	-24	-41	-61	-82	-106
96	9	20	13	9	4	-7	-24	-26	-42	-62	-83	-108
97	9	19	10	6	2	-9	-27	-29	-45	-66	-86	-108
98	8	19	6	3	0	-13	-31	-32	-48	-69	-89	-108
99	8	19	5	1	-2	-15	-32	-34	-49	-70	-89	-108
100	7	18	2	-2	-6	-20	-35	-37	-52	-71	-89	-106
101	6	16	0	-5	-14	-24	-38	-40	-54	-73	-89	-102
102	6	14	0	-7	-18	-27	-39	-41	-55	-73	-89	-101
103	5	12	-1	-9	-23	-31	-40	-42	-56	-74	-89	-103
104	4	11	-2	-10	-27	-34	-41	-43	-57	-74	-88	-103
105	3	10	-2	-10	-28	-35	-42	-43	-57	-74	-87	-102
106	2	9	-2	-10	-29	-36	-43	-45	-58	-74	-85	-96
107	1	8	-2	-9	-27	-37	-44	-46	-58	-72	-81	-89
108	1	8	-1	-8	-25	-36	-45	-46	-58	-70	-78	-85
109	0	7	0	-7	-22	-35	-45	-47	-57	-65	-72	-79
110	-1	7	0	-6	-22	-34	-46	-47	-56	-63	-68	-75
111	-1	7	1	-5	-20	-33	-47	-48	-56	-60	-64	-70
112	-3	7	2	-4	-19	-31	-47	-47	-55	-57	-60	-64
113	-4	6	4	-3	-18	-31	-46	-47	-53	-55	-57	-60
114	-5	6	4	-2	-17	-30	-47	-47	-52	-54	-54	-57
115	-6	5	4	-1	-20	-33	-47	-48	-52	-50	-49	-49
116	-7	0	5	-4	-20	-38	-48	-48	-52	-49	-45	-36
117	-8	0	5	-4	-26	-40	-50	-50	-53	-48	-44	-33
118	-10	-1	-1	-3	-29	-45	-52	-52	-54	-45	-39	-27
119	-11	-3	-2	-11	-37	-49	-54	-54	-53	-43	-32	-21
120	-12	-4	-3	-11	-40	-53	-55	-55	-54	-43	-33	-21

RADIUS ID	S E N S O R N U M B E R											
	1	2	3	4	5	6	7	8	9	10	11	12
121	-13	-9	-5	-12	-47	-60	-58	-58	-56	-45	-34	-22
122	-15	-12	-14	-26	-58	-62	-58	-58	-57	-49	-39	-26
123	-15	-14	-16	-28	-62	-66	-60	-59	-59	-51	-42	-28
124	-17	-18	-21	-33	-62	-68	-63	-63	-61	-54	-43	-30
125	-18	-21	-29	-41	-67	-72	-66	-66	-63	-57	-48	-32
126	-19	-23	-32	-43	-69	-70	-68	-68	-65	-58	-49	-33
127	-20	-31	-38	-51	-66	-71	-72	-71	-67	-61	-50	-38
128	-21	-35	-44	-57	-68	-74	-75	-74	-70	-63	-51	-43
129	-22	-40	-52	-65	-71	-77	-80	-80	-75	-67	-57	-50
130	-22	-44	-61	-70	-73	-79	-84	-83	-80	-71	-62	-55
131	-23	-48	-70	-79	-77	-81	-90	-89	-87	-78	-70	-62
132	-24	-50	-74	-84	-79	-81	-93	-93	-90	-82	-73	-66
133	-30	-55	-83	-94	-81	-84	-100	-100	-98	-88	-80	-73
134	-31	-59	-91	-106	-87	-96	-106	-106	-105	-93	-87	-79
135	-32	-65	-95	-112	-89	-100	-109	-109	-108	-95	-90	-82
136	-33	-69	-103	-124	-95	-108	-116	-117	-114	-97	-92	-88
137	-34	-71	-111	-131	-112	-118	-124	-119	-117	-98	-93	-101
138	-34	-73	-115	-139	-119	-123	-122	-122	-120	-102	-95	-104
139	-35	-75	-123	-154	-129	-132	-128	-128	-125	-108	-105	-108
140	-36	-77	-131	-166	-138	-142	-133	-132	-128	-115	-114	-108
141	-36	-78	-135	-173	-143	-147	-134	-134	-130	-119	-116	-109
142	-37	-79	-142	-183	-151	-158	-134	-136	-129	-125	-120	-112
143	-37	-80	-149	-192	-164	-161	-136	-134	-127	-125	-121	-114
144	-37	-80	-152	-196	-171	-165	-136	-133	-127	-124	-120	-114

BEST FIT PARABOLOID WITH MINIMUM PATH LENGTH IN LEAST SQUARES SENSE

12M SURF ADJ 90/60 === 1728 PTS

ORIGINAL FOCAL LENGTH = 200.0000 NO. POINTS IN ANALYSIS = 1728

INPUT DISTORTIONS OBTAINED ANALYTICALLY - OPTION 1

MINIMIZATION OF RMS WITH RESPECT TO RIGID BODY MCTION

RMS OF 1/2 LAMBDA WEIGHTED BY AREAS = 0.001165

DEVIATION OF THE MEAN - 1/2 LAMBDA = -0.00006

SUM-UNIT AREA*1/2 LAMBDA = -0.2152

SUM-UNIT AREAS = 1728.0000

X COORDINATE OF VERTEX = 0.00033

Y COORDINATE OF VERTEX = -0.12344

Z COORDINATE OF VERTEX = -0.00124

ROTATION ABOUT X AXIS = -0.0002676

ROTATION ABOUT Y AXIS = 0.0000011

MINIMIZATION OF RMS WITH RESPECT TO FOCAL LENGTH CHANGE

RMS OF 1/2 LAMBDA WEIGHTED BY AREAS = 0.000937

NEW FOCAL LENGTH = 200.0077

DEVIATION OF THE MEAN - 1/2 LAMBDA = -0.00000

SUM-UNIT AREA*1/2 LAMBDA = -0.0001

SUM-UNIT AREAS = 1728.0000

X COORDINATE OF VERTEX = 0.00048

Y COORDINATE OF VERTEX = -0.12350

Z COORDINATE OF VERTEX = -0.00034

ROTATION ABOUT X AXIS = -0.0002678

ROTATION ABOUT Y AXIS = 0.0000007

ALL LENGTH UNITS ARE CONSISTENT WITH INPUT----

ROTATION UNITS ARE RADIANS