PART V

SUPERSONIC CRUISE PERFORMANCE

List of Illustrations

List of Illustrations (Con't)

TURNING PERFORMANCE

Figure A5-1 presents generalized turning performance at constant Mach numbers for various ambient temperatures and bank angles. Turn radius, distance, and time are plotted for a selected range of Mach numbers, ambient temperatures, bank angles, and degrees of turn.

Example:

For a Mach 3.00 turn at a forecast ambient temperature of -56.5°C, 30° bank angle, and a planned 180° of turn, find the turn radius, distance, and time. As shown in the chart, enter figure A5-1 at Mach 3.00 and -56.5°C ambient temperature and note that true airspeed is 1720 knots. Proceed horizontally to 30° bank angle and read turn radius as 74.5 nautical miles. Proceed downward to 180° of turn and read turn distance as 235 nautical miles flown. Proceed horizontally to 1720 KTAS and read the turn time as 8.1 minutes.

SPECIFIC RANGE

Specific range charts are presented for speeds of Mach 3.20, 3.10, and 2.90 and for four ambient temperature conditions at each speed as shown by the list of illustrations. The data is computed from Flight Test and Operational Testing results with YJ-1 engines. Corrections for a range of bank angles are included on each chart to show the effect bank angle has on specific range and altitude capability while turning. Supplemental scales provide KEAS-altitude information and fuel flow conversions.

Example:

Refer to figure A5-13, Specific Range data for Mach 3.10 cruise at -56.5°C ambient temperature. Locate the Max Range cruise schedule line. At long range cruise power and 80,000 pounds gross weight the cruise climb altitude is 78,150 feet and the zero bank angle specific range is 61.0 nmi/1000 lb of fuel. For a turn at the same power setting, using a 30 degree bank angle, the specific range is 53.0 nmi/1000 lb of fuel and the altitude is 75,100 feet. The fuel flow per engine is 14,600 lb/hr at zero bank and 16,800 lb/hr at 30 degree bank for a -56.5°C ambient temperature day. At this temperature, Mach 3.1 corresponds to 1777 KTAS as listed in the chart.

LONG RANGE AND HIGH ALTITUDE CRUISE SUMMARIES

Long range cruise summaries are presented for Mach 3.20, 3.10, and 2.90. High altitude cruise summaries are presented for Mach 3.20 and 3.10. The high altitude profiles are based on the "90%" lines shown on the Specific Range charts, except that the performance shown conforms with the present 85,000 ft altitude restriction. These data are presented for both the 1956 ARDC Atmosphere and the "MEAN TROPIC" Atmosphere as shown in the list of illustrations. The climb and cruise data are computed from Flight Test and Operational Testing results with YJ-1 engines. Descent data is based on Flight Test and Operational testing at near standard temperatures. There are three sheets for each figure. The first sheet provides cruise summaries showing distance and time from end AR at 30,000 feet through the climb, cruise, and descent to 20,000 feet with either 5000 lbs or 7500 lbs of fuel reserve. The second sheet presents climb-cruise intercepts which are to be used in conjunction with sheet 3. The third sheet presents performance and flight planning data. The initial conditions shown are end AR at 30,000 feet, and brake release with either 64,000 lbs or 50,000 lbs fuel remaining using the normal climb schedule. The effect of various temperatures is shown for climb and cruise performance. The descent performance shown is based on operational testing and does not include the effect of temperature. Descent through a "Tropic" atmosphere may be approximated by increasing the presented descent data by the following increments:

Distance - 30 miles

Time - 1 minute

Fuel used - 100 pounds

Use of the chart is illustrated by the following example:

Example:

Refer to figure A5-7, sheet 2 of 3 and sheet 3 of 3.

Find the total distance capability and time required for a Mach 3.2 high altitude cruise with a forecast ambient temperature condition of -56.5°C at cruise. A profile is planned consisting of a heavyweight takeoff at sea level with standard day climb, cruise without turn, normal descent, and 7500 lb fuel reserve at 20,000 feet. Planned fuel load at brake release is 64,000 lb.

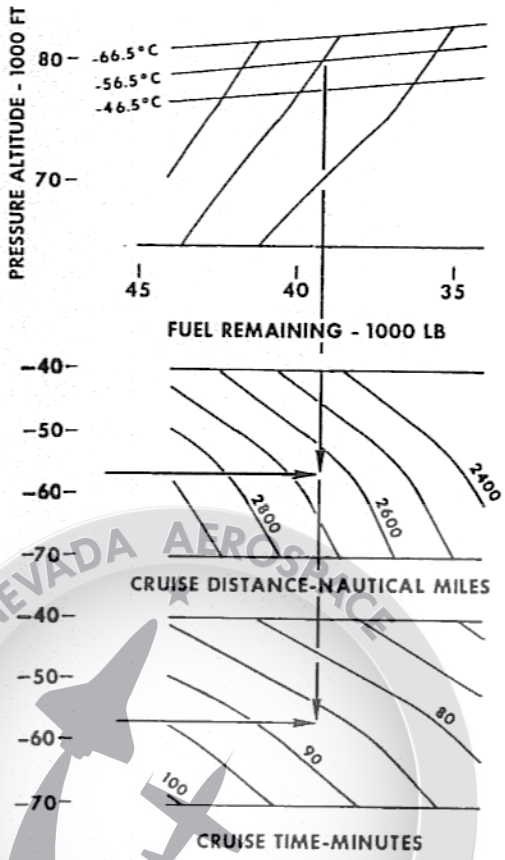
Enter figure A5-7, sheet 2 of 3, at 119,150 lb gross weight, sea level altitude, standard day climb temperature, and -56.5°C cruise temperature and read the cruise-climb intercept as 80,100 feet. Read climb distance as 345 miles, climb time as 20.1 minutes

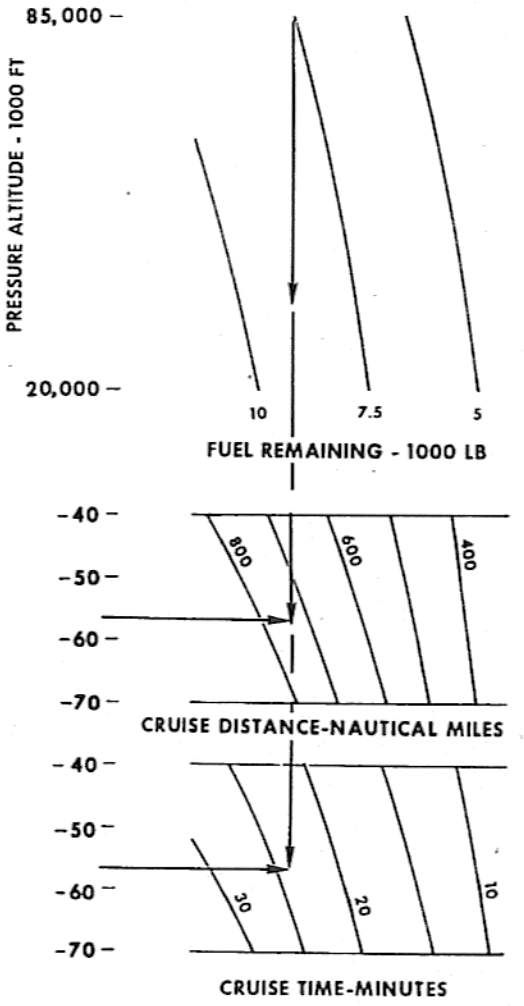
and fuel remaining as 39,250 lb. Referring to figure A5-7, sheet 3 of 3, the intercept of the standard day climb line and the -56.5°C cruise line is shown. The lower portion of sheet 3 of 3 shows cruise distance and cruise time to zero fuel remaining as a function of fuel remaining and cruise reference temperature. Entering the portion of the curve at the fuel remaining value of 39,250 lb and a cruise reference temperature of -56.5°C, read the cruise distance as 2655 miles and cruise time as 86.8 minutes. Then read on the cruise line (from beginning of the 7500 lb descent line) the fuel remaining as 8900 lb. Reading the distance and time to zero fuel remaining, the distance is 740 miles and the time is 24 minutes. This gives the incremental cruise distance as (2655 - 740) = 1915 miles and the cruise time as (86.8 - 24) = 62.8 minutes. The descent to 20,000 ft is 237 miles and 13.8 minutes as shown by the vertical scales at the right side of the profile portion of the chart.

Distance and time from brake release at sea level with 64,000 lb fuel to 20,000 feet with 7500 lb fuel remaining is:

Distance = (345 + 1915 + 237) = 2497 miles

Time = (20.1 + 62.8 + 13.8) = 96.7 minutes





MAXIMUM A/B CEILING CRUISE SUMMARIES

Maximum A/B Ceiling Cruise summaries are presented for Mach 3.20 and 3.10 as shown in the list of illustrations. The data were calculated from Flight Test and Operational Testing results with YJ-1 engines. There are two sheets for each figure. The first sheet presents cruise summaries showing distance and time from end AR at 32,000 feet through the climb, cruise, and descent to 20,000 feet with either 5000 lbs or 7500 lbs fuel reserve. The second sheet presents cruise summaries which are indexed at 10,000 lb fuel remaining at altitude (zero distance and time). The initial conditions shown are end AR at 30,000 feet and brake release with 64,000 lbs fuel remaining using the normal climb schedule. Distance and time allowances for reserves of 5000, 7500, and 10,000 lbs at 20,000 feet are shown in the charts. To obtain the total distance and time, add the two distances and times for the desired profile.

Example:

Refer to figure A5-18, sheet 2 of 2, and the example figure on the following page.

Find the total distance and time for a 3.10 Mach maximum A/B ceiling cruise at a forecast ambient temperature of -56.5°C at cruise. A profile is planned consisting of a heavyweight takeoff at sea level with standard day climb, cruise without turns, and 7500 lb reserve at 20,000 feet. Planned fuel load at brake release is 64,000 lb. Enter figure A5-18, sheet 2 of 2, at the climb line for the sea level 64,000 lb fuel remaining case and read distance and time as 1809 nmi, and 1 hr, 09.5 min. Reenter at the 7500 lb reserve descent line at 20,000 feet and read distance and time as 310 nmi and 16.7 min. Add the distances and times and obtain 2114 nmi and 1 hr, 26.2 min.

If forecast temperatures indicate standard day climb and cold day cruise, -64.5°C, the distance will be increased by two small increments. The cruise distance will be longer due to the colder temperature, and the climb distance will be longer due to the climb to higher altitude. Referring to the text illustration below, which is for 119,150 lb gross weight and 64,000 lb fuel remaining at brake release, the shaded triangles show where the standard day climb intercepts the four cruise lines. The cold day intercept shows a distance of 1635 nmi. Extend the climb curve to the altitude where the cold day cruise begins and read a distance of 1475 nmi. The difference between these distances (1635 - 1475 = 160) is the increase in range due to cold day cruise conditions. The corresponding time increment is 4.3 min. for the additional 160 nmi of cruise. This results in a total range and time of 2279 nmi and 1 hr, 30.5 min.

MISSION PLANNING FACTORS TABLE

A Mission Planning Factors Table is provided on figure A5-28 for quick reference in mission planning.

RAPID DEPLOYMENT TO ARCP

Figures A5-29 thru A5-32 present the data for a minimum time profile from brake release to ARCP.

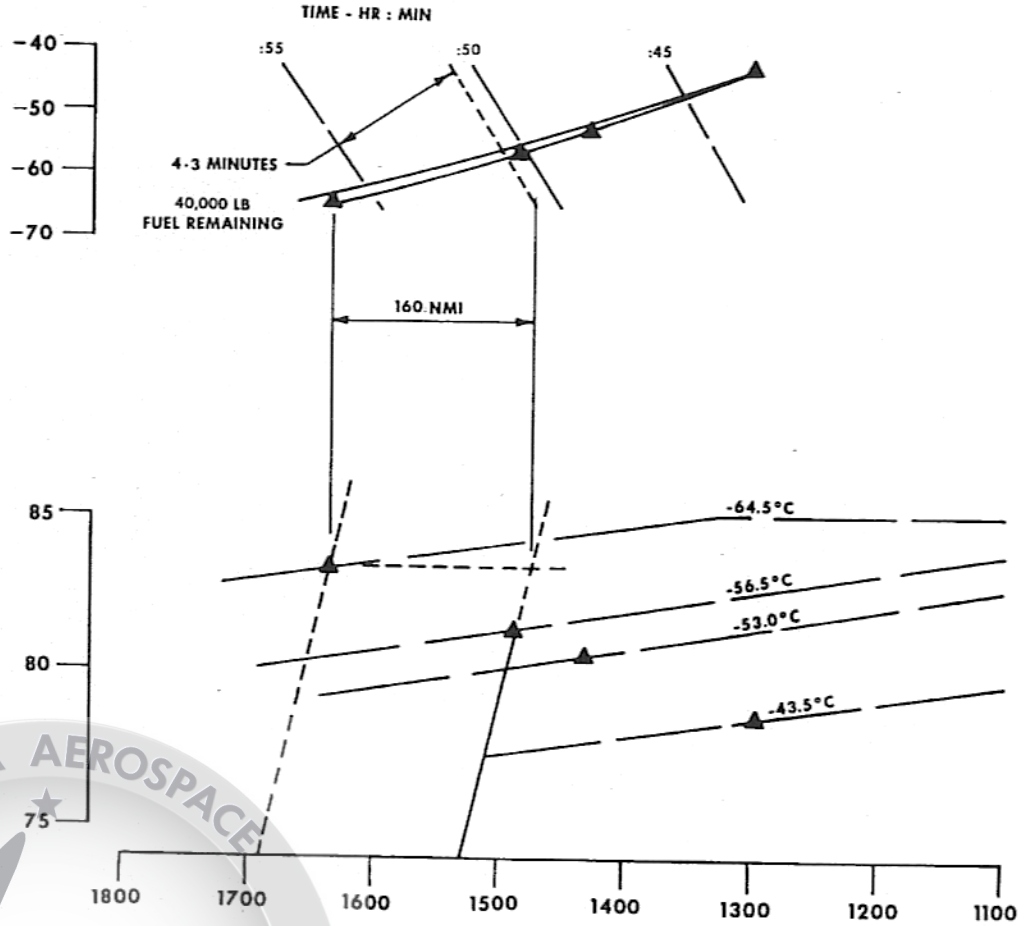
The profile is defined as:

1. 50,000 pounds fuel remaining at brake release.
2. Normal climb schedule to cruise Mach number.
3. Climb to cruise altitude at constant Mach number.
4. Cruise for two minutes at 82° PLA.
5. Normal deceleration to 300 KEAS.
6. Normal 300 KEAS descent to reach 29,000 ft at a point 20 miles from ARCP.

The data are presented for both the 1956 ARDC and Mean Tropic atmospheres.

EXAMPLE FIGURE

REFER TO FIGURE A5-18 SHEET 2 OF 2
AND PAGE A5-4 A



Figures A5-30 and A5-32 (sheet 1 of 2) show standard and tropic day mission profiles for five representative Mach numbers, and portray the climb, cruise and deceleration segments of the missions. Figures A5-30 and A5-32 (sheet 2 of 2) show the corresponding time and fuel remaining for the presented profiles.

Figures A5-29 and A5-31 give the necessary detail information for planning a flight of specific length. These curves present the overall mission time from brake release to ARCP, cruise Mach number, altitude to initiate constant Mach climb, cruise altitude and the DTG to start deceleration to arrive at 29,000 feet at a point 20 miles from the ARCP. Mach 1.25 is the minimum supersonic cruise Mach recommended, as this speed is the "break point" for minimum time between subsonic and supersonic flight plans. For a mission distance of less than 130 miles, the flight should be made at 0.91 Mach. Missions longer than 130 miles would be flown at the Mach number given by figures A5-29 and A5-31.

Example:

To select flight plan for minimum time to ARCP, with Mean Tropic day temperatures, and ARCP 300 miles from takeoff point.

Refer to figure A5-31, "Rapid Deployment to ARCP".

Mission time from brake release to ARCP is 23.5 minutes.

Cruise Mach = 2.31.

Start constant Mach climb = 55,300 feet.

Cruise altitude = 67,000 feet.

DTG at start decel = 117 miles.

Figure A5-6

PROFILE CHART: CLIMB - CRUISE INTERCEPT POINTS

1956 ARDC ATMOSPHERE

LONG RANGE CRUISE - MACH 3.20

INITIAL GR. WT. LB.	INITIAL ALTITUDE FT.	CLIMB TEMP °C	CRUISE TEMP. °C	CLIMB - CRUISE INTERCEPT			
				ALTITUDE FT.	DISTANCE N. MI.	TIME MIN.	FUEL REM. LB.
122,450	30,000	STD -10	-66.5	77,050	258	14.6	48,410
			-56.5	75,296	237	13.9	48,875
			-46.5	75,296	237	13.9	48,875
		STD	-66.5	77,500	326	17.4	45,620
			-56.5	75,500	302	16.6	46,150
			-46.5	75,296	299	16.5	46,205
		STD +10	-66.5	78,350	438	22.0	41,070
			-56.5	76,450	416	21.3	41,570
			-46.5	75,296	402	20.8	41,875
119,150	S.L.	STD -10	-66.5	78,200	267	16.9	42,130
			-56.5	76,200	244	16.1	42,665
			-46.5	75,296	233	15.8	42,905
		STD	-66.5	78,600	326	19.5	39,650
			-56.5	76,750	305	18.8	40,145
			-46.5	75,296	287	18.2	40,530
		STD +10	-66.5	79,350	421	23.6	36,075
			-56.5	77,400	398	22.8	36,595
			-46.5	75,800	379	22.1	37,020
105,150	S.L.	STD -10	-66.5	80,400	254	15.3	30,980
			-56.5	78,550	233	14.5	31,475
			-46.5	76,900	213	13.9	31,915
		STD	-66.5	80,800	301	17.3	28,915
			-56.5	79,050	281	16.6	29,380
			-46.5	76,400	249	15.5	30,085
		STD +10	-66.5	81,450	375	20.4	26,280
			-56.5	79,750	355	19.7	26,735
			-46.5	78,000	335	19.0	27,200

Figure A5-6
(Sheet 2 of 3)

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MACH 3.20
1956 ARDC ATMOSPHERE

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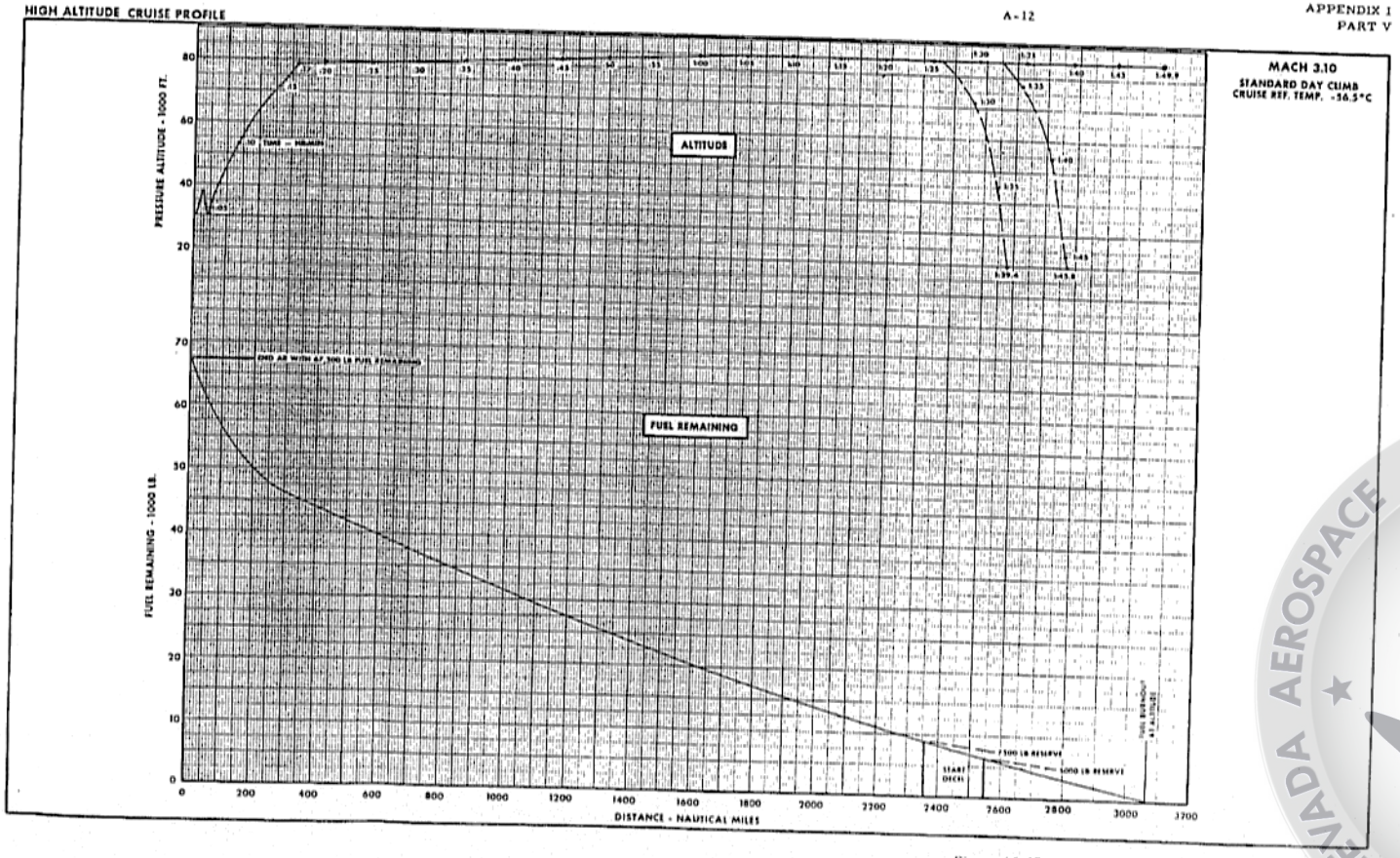
Figure A5-6
(Sheet 3 of 3)



Changed 15 June 1968

Figure A5-17
(Sheet 1 of 3)

PROFILE CHART: CLIMB - CRUISE INTERCEPT POINTS

1956 ARDC ATMOSPHERE

HIGH ALTITUDE CRUISE - MACH 3.20

INITIAL GR. WT. LB.	INITIAL ALTITUDE FT.	CLIMB TEMP. °C	CRUISE TEMP. °C	CLIMB - CRUISE INTERCEPT			
				ALTITUDE FT.	DISTANCE N. MI.	TIME MIN.	FUEL REM LB.
122,450	30,000	STD -10	-66.5	80,600	301	16.0	47,465
			-56.5	78,400	275	15.1	48,050
			-46.5	76,000	246	14.2	48,690
		STD	-66.5	81,150	369	18.8	44,645
			-56.5	78,900	343	17.9	45,245
			-46.5	76,450	314	17.0	45,900
		STD +10	-66.5	82,000	482	23.5	40,090
			-56.5	79,800	457	22.6	40,675
			-46.5	77,350	428	21.6	41,330
119,150	S.L.	STD -10	-66.5	81,800	310	18.4	41,175
			-56.5	79,600	285	17.5	41,760
			-46.5	77,150	256	16.5	42,410
		STD	-66.5	82,200	369	21.0	38,690
			-56.5	80,100	345	20.1	39,250
			-46.5	77,600	316	19.1	39,915
		STD +10	-66.5	83,050	465	25.0	35,090
			-56.5	80,800	439	24.1	35,690
			-46.5	78,400	411	23.2	36,330
105,150	S.L.	STD -10	-66.5	84,200	300	16.8	29,975
			-56.5	82,000	275	15.9	30,555
			-46.5	79,400	245	14.9	31,250
		STD	-66.5	84,700	348	18.9	27,875
			-56.5	82,450	323	18.0	28,475
			-46.5	79,850	292	16.9	29,080
		STD +10	-66.5	85,000	417	21.8	25,335
			-56.5	84,150	409	21.5	25,560
			-46.5	80,450	365	20.0	26,550

Figure A5-7
(Sheet 2 of 3)

HIGH ALTITUDE CRUISE PROFILE

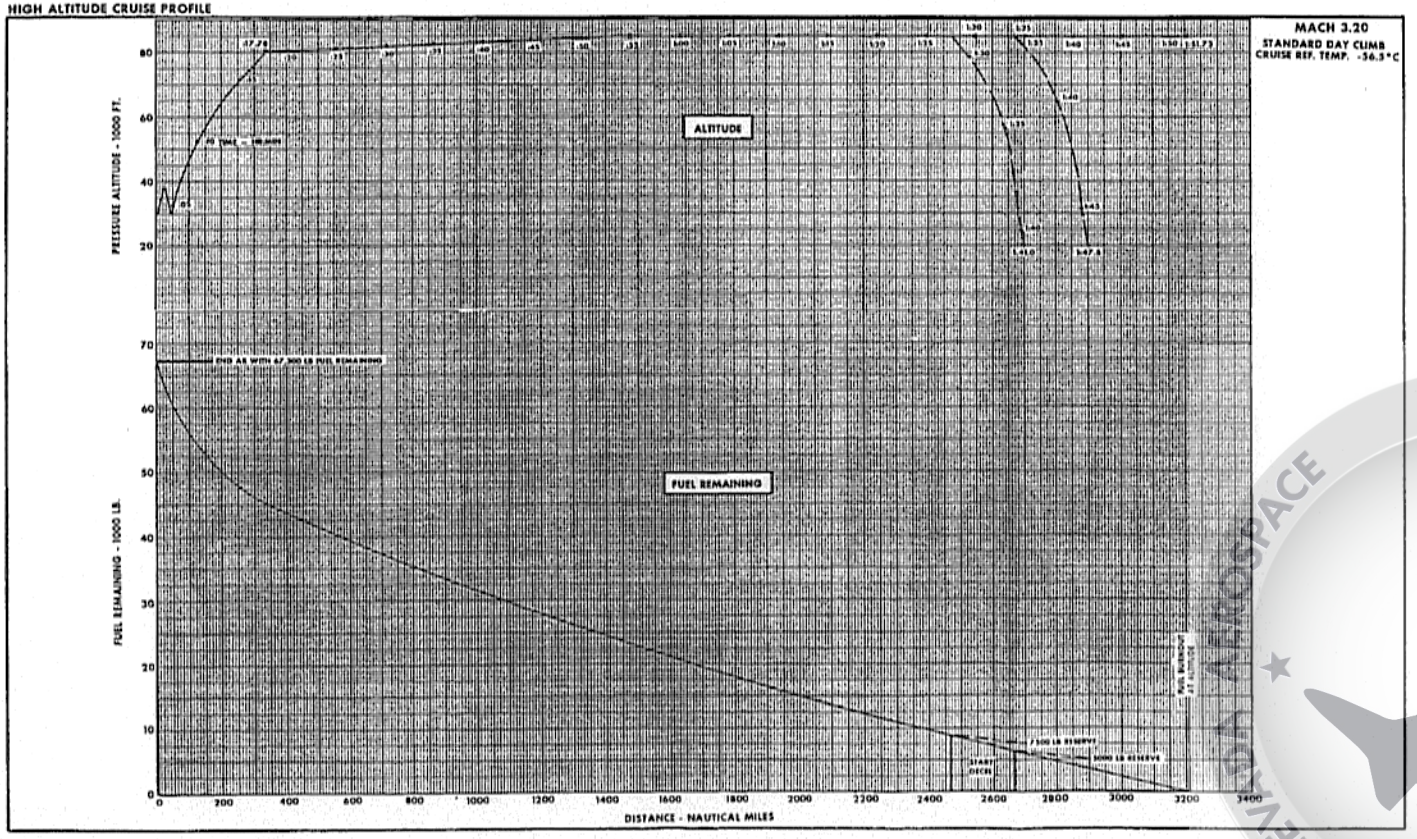


Figure A5-7

Figure A5-7
(Sheet 3 of 3)

LONG RANGE CRUISE PROFILE

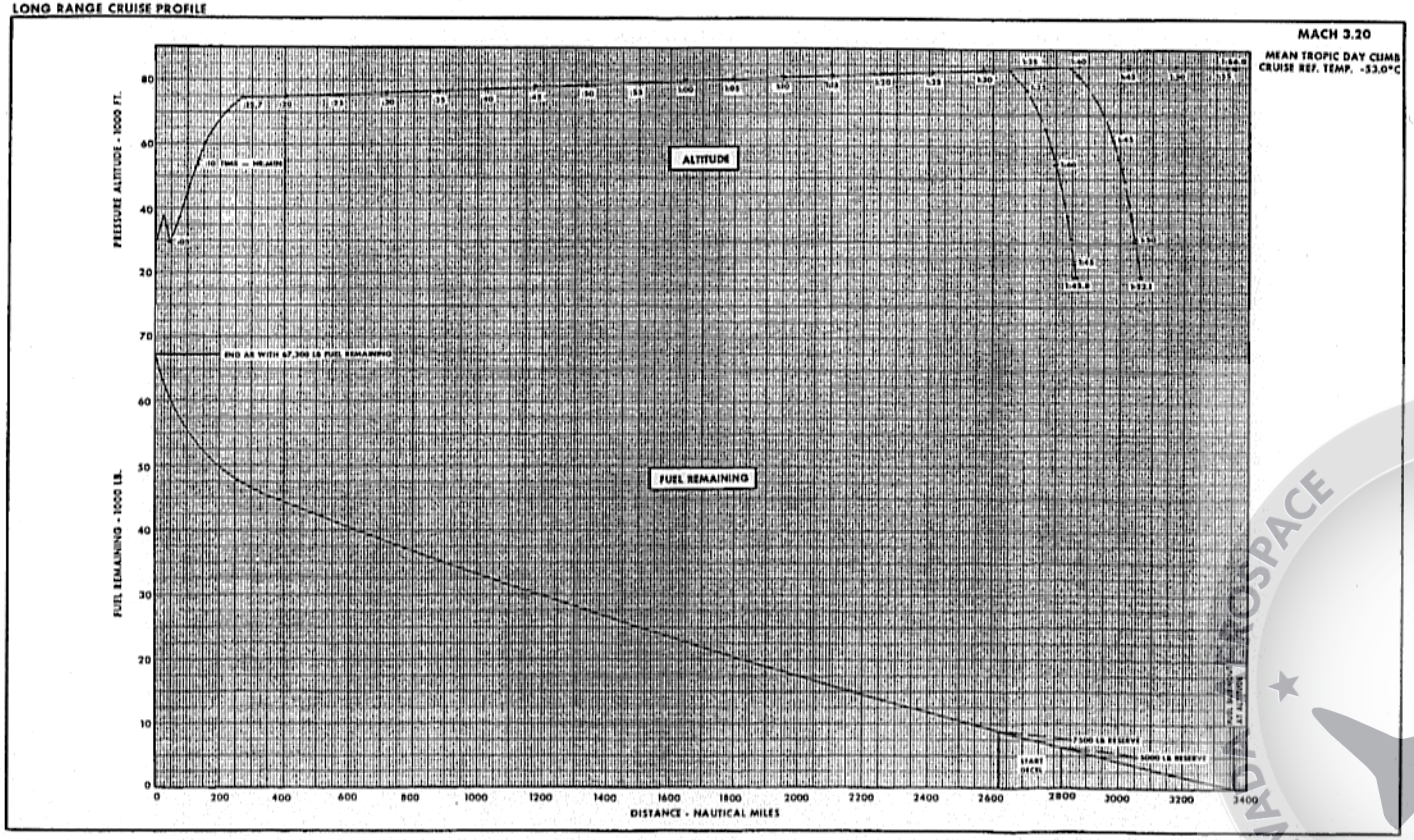


Figure A5-9

(Sheet 1 of 3)

Changed 15 June 1968

PROFILE CHART: CLIMB - CRUISE INTERCEPT POINTS

MEAN TROPIC ATMOSPHERE

LONG RANGE CRUISE - MACH 3.20

INITIAL GR. WT. LB.	INITIAL ALTITUDE FT.	CLIMB TEMP. °C	CRUISE TEMP. °C	CLIMB - CRUISE INTERCEPT			
				ALTITUDE FT.	DISTANCE N. MI.	TIME MIN.	FUEL REM. LB.
122,450	30,000	M.T. -10	-63.0	76,050	230	13.6	49,025
			-53.0	75,296	221	13.3	49,225
			-43.0	75,296	221	13.3	49,225
		M.T.	-63.0	76,600	290	16.2	46,395
			-53.0	75,296	274	15.7	46,740
			-43.0	75,296	274	15.7	46,740
		M.T. +10	-63.0	77,400	382	20.2	42,290
			-53.0	75,450	359	19.5	42,810
			-43.0	75,296	357	19.4	42,850
119,150	S.L.	M.T. -10	-63.0	77,200	229	15.6	43,645
			-53.0	75,296	206	14.9	44,150
			-43.0	75,296	206	14.9	44,150
		M.T.	-63.0	77,550	274	17.8	41,760
			-53.0	75,600	250	17.0	42,280
			-43.0	75,296	247	16.9	42,360
		M.T. +10	-63.0	78,150	340	20.7	38,860
			-53.0	76,150	316	19.9	39,395
			-43.0	75,296	306	19.5	39,620
105,150	S.L.	M.T. -10	-63.0	79,750	236	14.9	31,285
			-53.0	77,750	223	14.1	31,815
			-43.0	76,350	196	13.5	32,190
		M.T.	-63.0	80,150	277	16.7	29,660
			-53.0	78,150	254	15.9	30,190
			-43.0	76,750	237	15.4	30,565
		M.T. +10	-63.0	80,750	336	19.2	27,100
			-53.0	78,700	312	18.4	27,645
			-43.0	77,300	296	17.9	28,015

Figure A5-9
(Sheet 2 of 3)

Figure A5-7
(Sheet 3 of 3)

Changed 15 June 1968

A-12

APPENDIX
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A5-25/A5

HIGH ALTITUDE CRUISE PROFILE

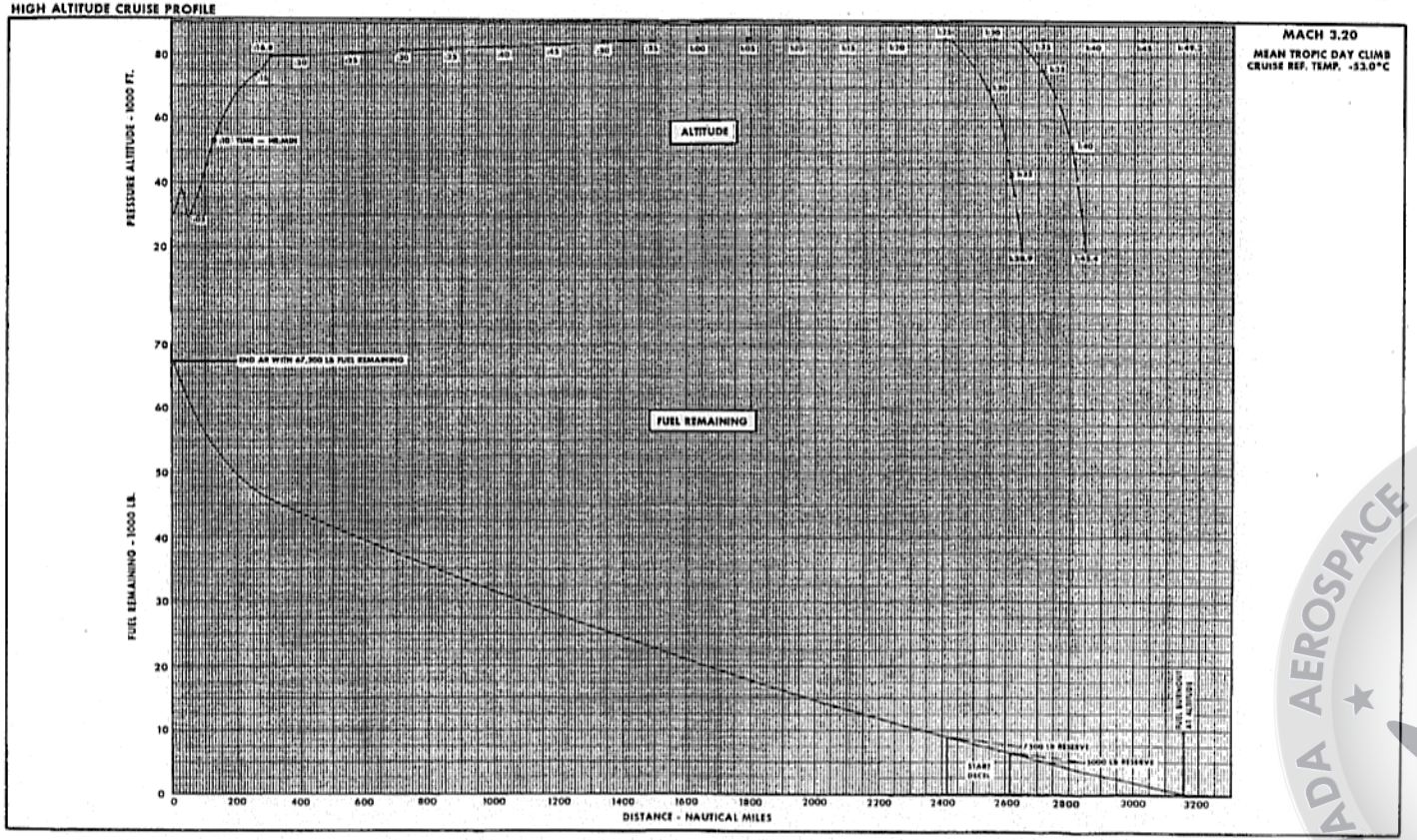

Figure A5-10

(Sheet 1 of 3)

PROFILE CHART: CLIMB - CRUISE INTERCEPT POINTS

MEAN TROPIC ATMOSPHERE

HIGH ALTITUDE CRUISE - MACH 3.20

INITIAL GR. WT. LB.	INITIAL ALTITUDE FT.	CLIMB TEMP. °C	CRUISE TEMP. °C	CLIMB - CRUISE INTERCEPT			
				ALTITUDE FT	DISTANCE N. MI.	TIME MIN.	FUEL REM. LB.
122,450	30,000	M.T. -10	-63.0	79,800	276	15.1	48,025
			-53.0	77,500	249	14.2	48,640
			-43.0	75,296	221	13.3	49,225
		M.T.	-63.0	80,250	334	17.7	45,420
			-53.0	78,000	307	16.8	46,020
			-43.0	75,500	277	15.8	46,685
		M.T. +10	-63.0	81,000	426	21.7	41,330
			-53.0	78,750	400	20.8	41,930
			-43.0	76,300	370	19.8	42,585
119,150	S.L.	M.T. -10	-63.0	80,800	272	17.1	42,685
			-53.0	78,500	246	16.2	43,295
			-43.0	76,000	215	15.2	43,965
		M.T.	-63.0	81,150	317	19.2	40,800
			-53.0	78,850	290	18.3	41,425
			-43.0	76,400	260	17.3	42,065
		M.T. +10	-63.0	81,650	381	22.0	37,955
			-53.0	79,400	356	21.2	38,530
			-43.0	77,000	327	20.2	39,165
105,150	S.L.	M.T. -10	-63.0	83,400	280	16.4	30,310
			-53.0	81,000	253	15.4	30,950
			-43.0	78,500	223	14.4	31,615
		M.T.	-63.0	83,800	321	18.2	28,690
			-53.0	81,400	294	17.2	29,325
			-43.0	78,850	264	16.2	30,005
		M. T. +10	-63.0	84,450	378	20.7	26,140
			-53.0	82,000	353	19.7	26,765
			-43.0	79,400	322	18.7	27,460

Figure A5-10
(Sheet 2 of 3)

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Figure A5-10
(Sheet 3 of 3)

A5-23/A

A-12

APPEN
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LONG RANGE CRUISE PROFILE

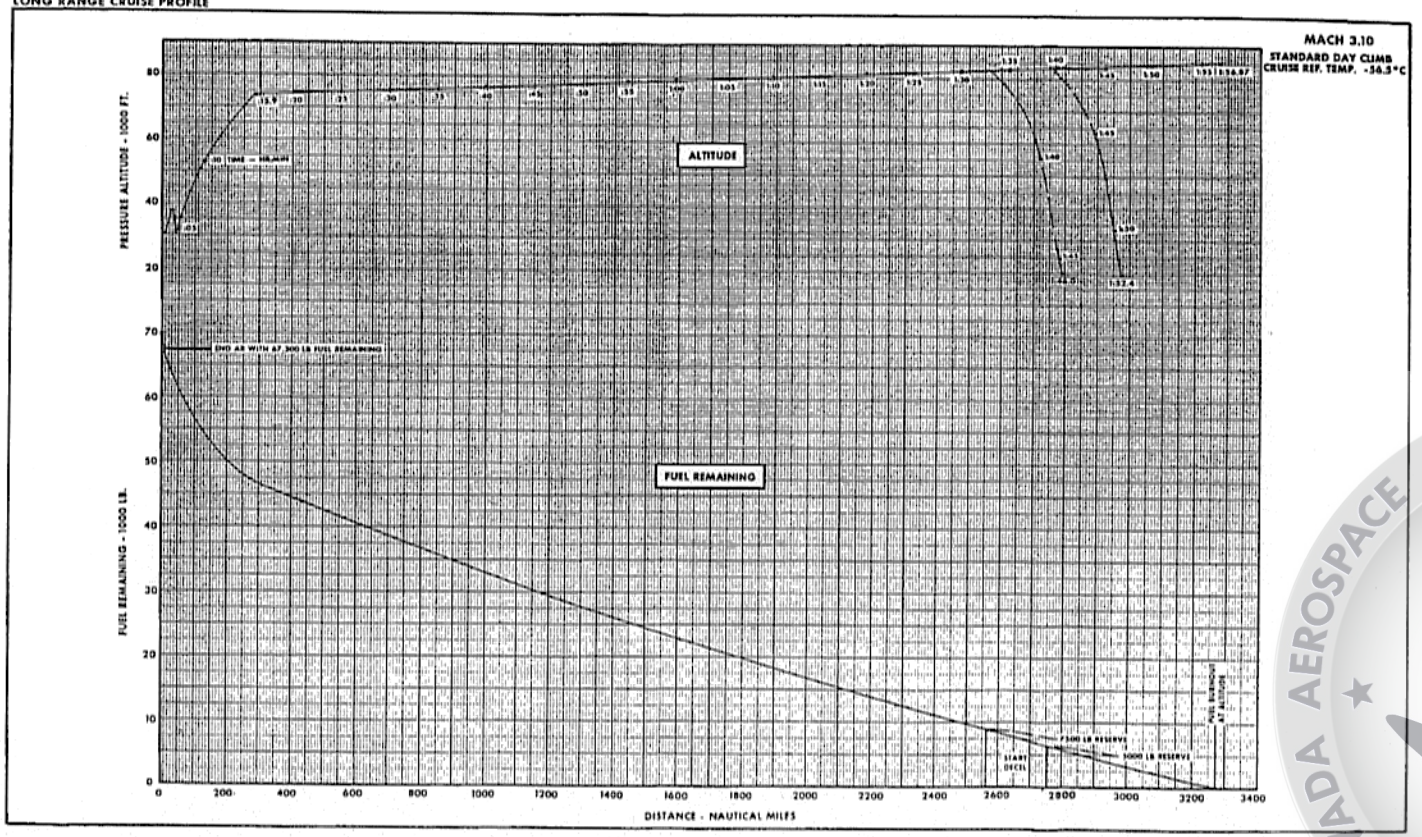


Figure A5-16
(Sheet 1 of 3)

Changed 15 June 1968

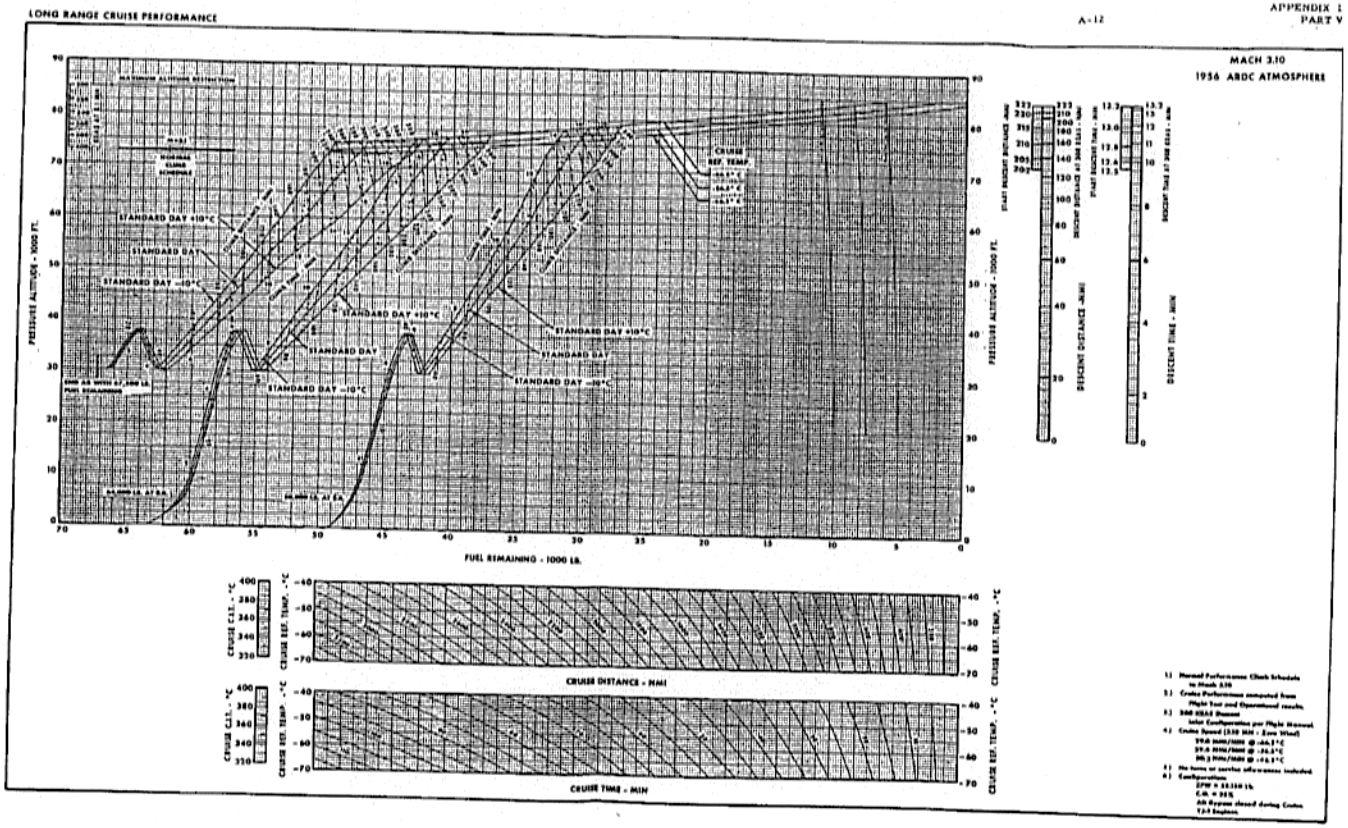
PROFILE CHART: CLIMB - CRUISE INTERCEPT POINTS

1956 ARDC ATMOSPHERE

LONG RANGE CRUISE - MACH 3.10

INITIAL GR. WT. LB.	INITIAL ALTITUDE FT.	CLIMB TEMP. °C	CRUISE TEMP. °C	CLIMB - CRUISE INTERCEPT			
				ALTITUDE FT.	DISTANCE N. MI.	TIME MIN.	FUEL REM. LB.
122,450	30,000	STD -10	-66.5	74,600	239	14.0	49,130
			-56.5	73,200	223	13.4	49,500
			-46.5	72,920	219	13.3	49,575
		STD	-66.5	75,050	296	16.4	46,565
			-56.5	73,700	281	15.9	46,900
			-46.5	72,920	272	15.6	47,105
		STD +10	-66.5	75,850	396	20.7	42,395
			-56.5	74,450	380	20.1	42,770
			-46.5	73,400	368	19.7	43,050
119,150	S.L.	STD -10	-66.5	75,800	251	16.4	42,840
			-56.5	74,400	235	15.8	43,210
			-46.5	73,300	222	15.4	43,505
		STD	-66.5	76,200	303	18.7	40,505
			-56.5	74,800	287	18.2	40,880
			-46.5	73,750	275	17.8	41,160
		STD +10	-66.5	76,850	319	22.4	37,160
			-56.5	75,450	303	21.9	37,530
			-46.5	74,350	291	21.4	37,825
105,150	S.L.	STD -10	-66.5	78,050	239	14.8	31,470
			-56.5	76,600	223	14.2	31,860
			-46.5	75,450	210	13.8	32,165
		STD	-66.5	78,450	281	16.7	29,610
			-56.5	77,000	266	16.1	29,990
			-46.5	75,850	253	15.7	30,300
		STD +10	-66.5	79,050	347	19.7	26,990
			-56.5	77,600	332	19.1	27,375
			-46.5	76,400	318	18.6	27,695

Figure A5-16
(Sheet 2 of 3)



Changed 15 June 1968

Figure A5-16
(Sheet 3 of 3)

PROFILE CHART: CLIMB - CRUISE INTERCEPT POINTS

1956 ARDC ATMOSPHERE

HIGH ALTITUDE CRUISE - MACH 3.10

INITIAL GR. WT. LB.	INITIAL ALTITUDE FT.	CLIMB TEMP. °C	CRUISE TEMP. °C	CLIMB - CRUISE INTERCEPT			
				ALTITUDE FT.	DISTANCE N. MI.	TIME MIN.	FUEL REM LB.
122,450	30,000	STD -10	-66.5	79,000	290	15.7	47,955
			-56.5	76,750	265	14.8	48,555
			-46.5	74,400	237	13.9	49,180
		STD	-66.5	79,550	349	18.3	45,335
			-56.5	77,200	323	17.3	45,965
			-46.5	74,800	295	16.4	46,605
		STD +10	-66.5	80,400	449	22.5	41,185
			-56.5	77,950	422	21.5	41,835
			-46.5	75,600	395	20.6	42,360
119,150	S.L.	STD -10	-66.5	80,250	303	18.2	41,655
			-56.5	77,800	276	17.2	42,305
			-46.5	75,250	246	16.2	42,985
		STD	-66.5	80,750	355	20.6	39,300
			-56.5	78,250	328	19.6	39,960
			-46.5	76,000	302	18.7	40,560
		STD +10	-66.5	81,400	371	24.2	35,945
			-56.5	78,900	344	23.1	36,615
			-46.5	76,600	318	22.3	37,225
105,150	S.L.	STD -10	-66.5	82,650	292	16.7	30,245
			-56.5	80,050	264	15.6	30,940
			-46.5	77,800	238	14.7	31,540
		STD	-66.5	83,100	335	18.6	28,370
			-56.5	80,500	307	17.5	29,060
			-46.5	78,200	281	16.6	29,670
		STD +10	-66.5	83,750	402	21.5	25,735
			-56.5	81,150	374	20.5	26,425
			-46.5	78,800	348	19.6	27,050

Figure A5-17
(Sheet 2 of 3)

Figure A5-17
(Sheet 1 of 3)

A5-45/A

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A-12

APPENDIX
FAIR

MAXIMUM A/B CEILING CRUISE PROFILE

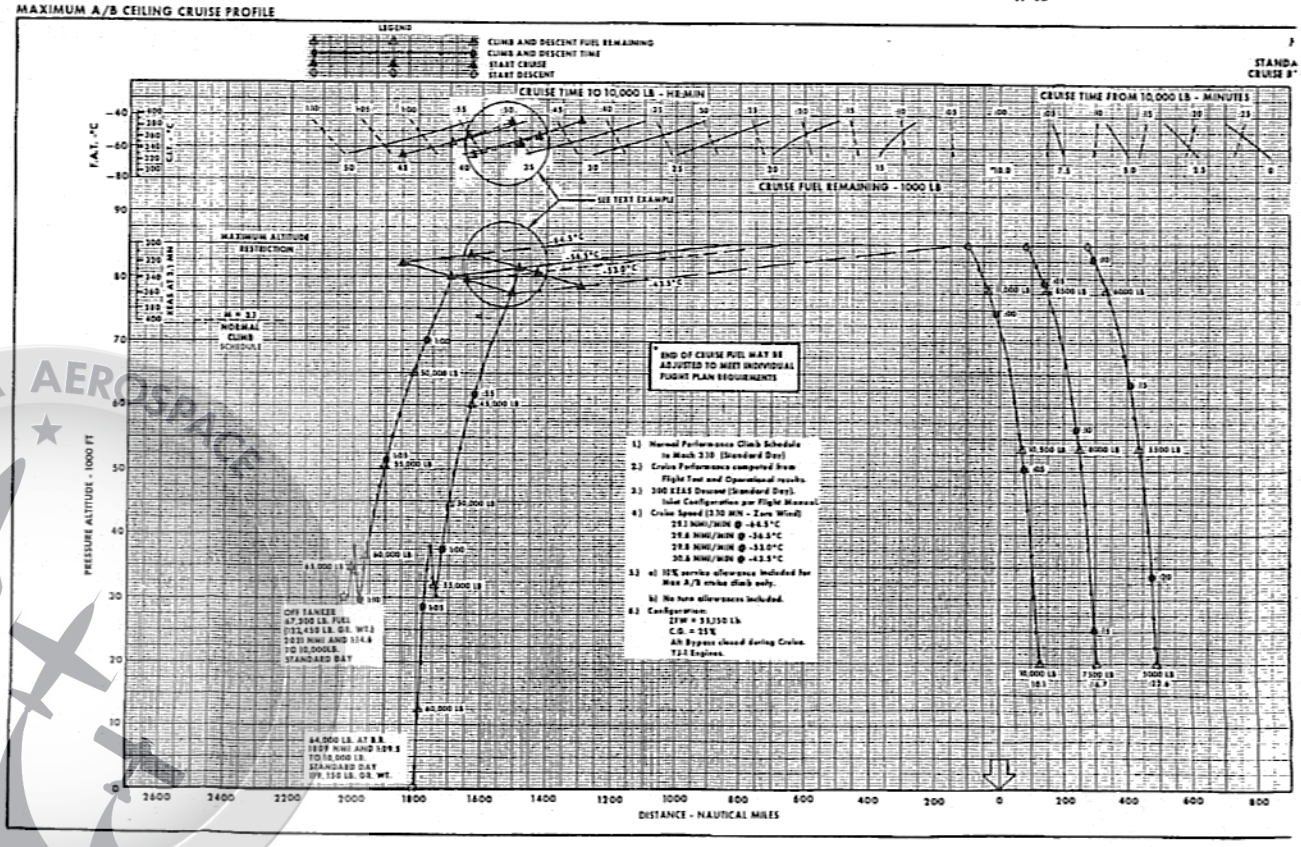

Figure A5-18

(Sheet 2 of 2)

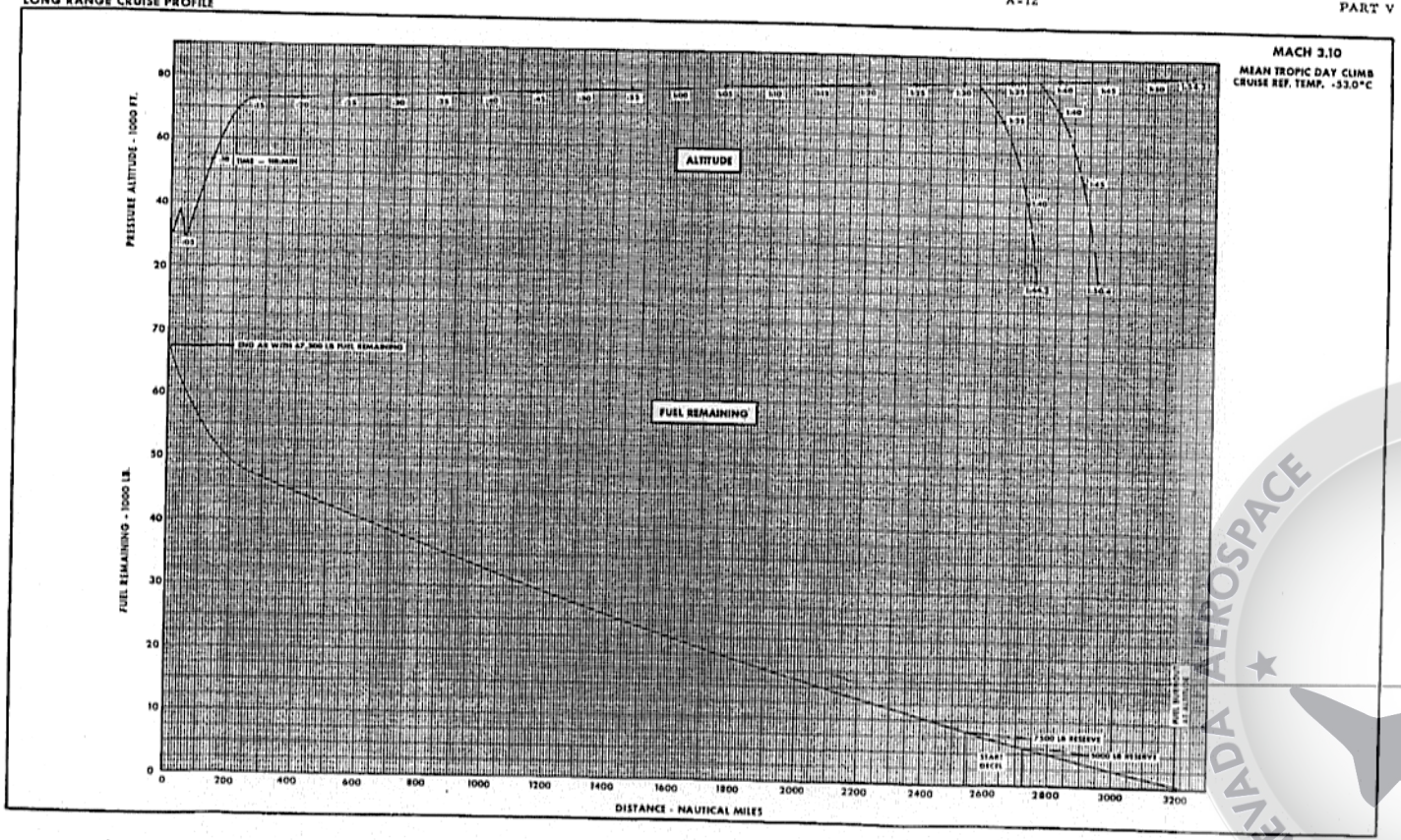

Figure A5-19
(Sheet 1 of 3)

Figure A5-19
(Sheet 3 of 3)

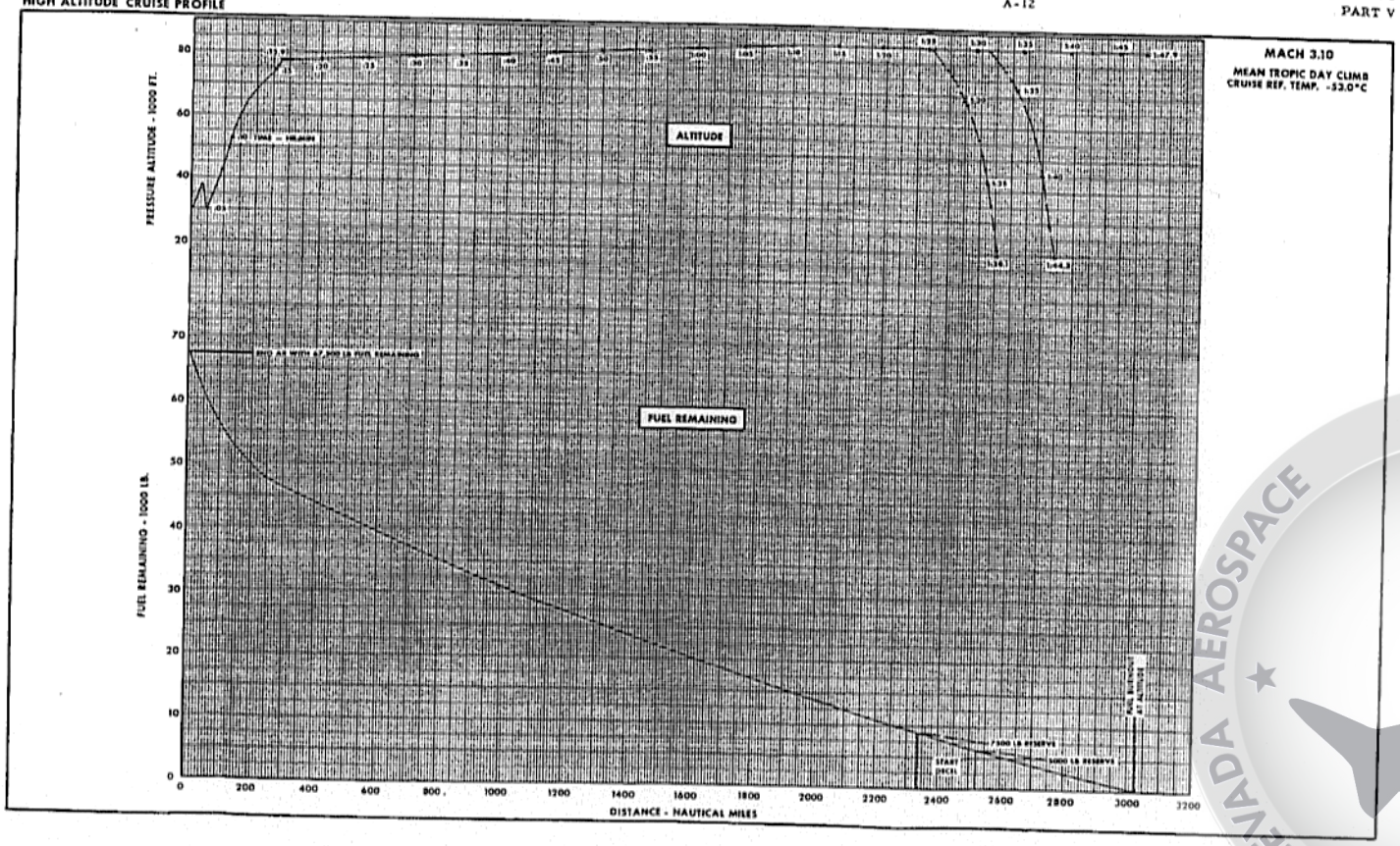

Figure A5-20

(Sheet 1 of 3)

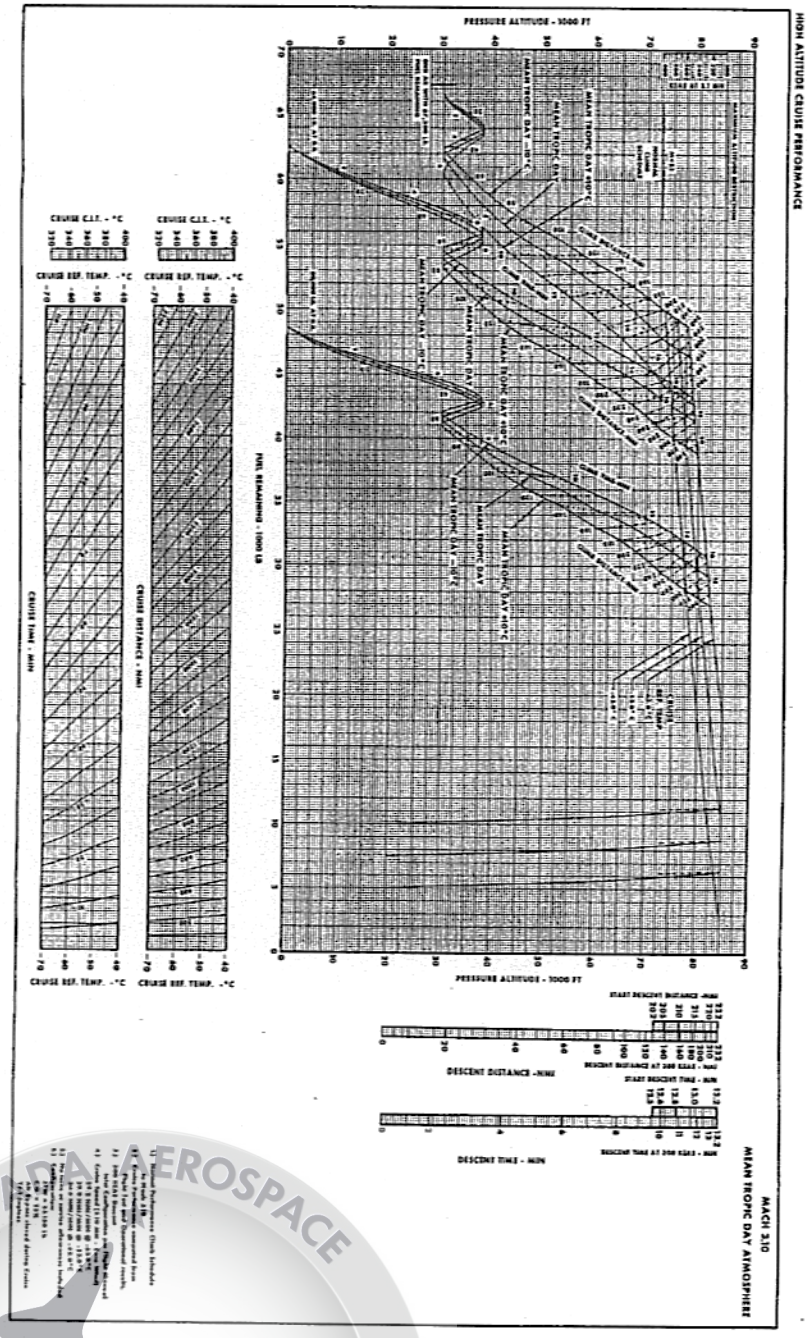

Figure A5-20
(Sheet 3 of 3)

A5-57/A5-58

LONG RANGE CRUISE PROFILE

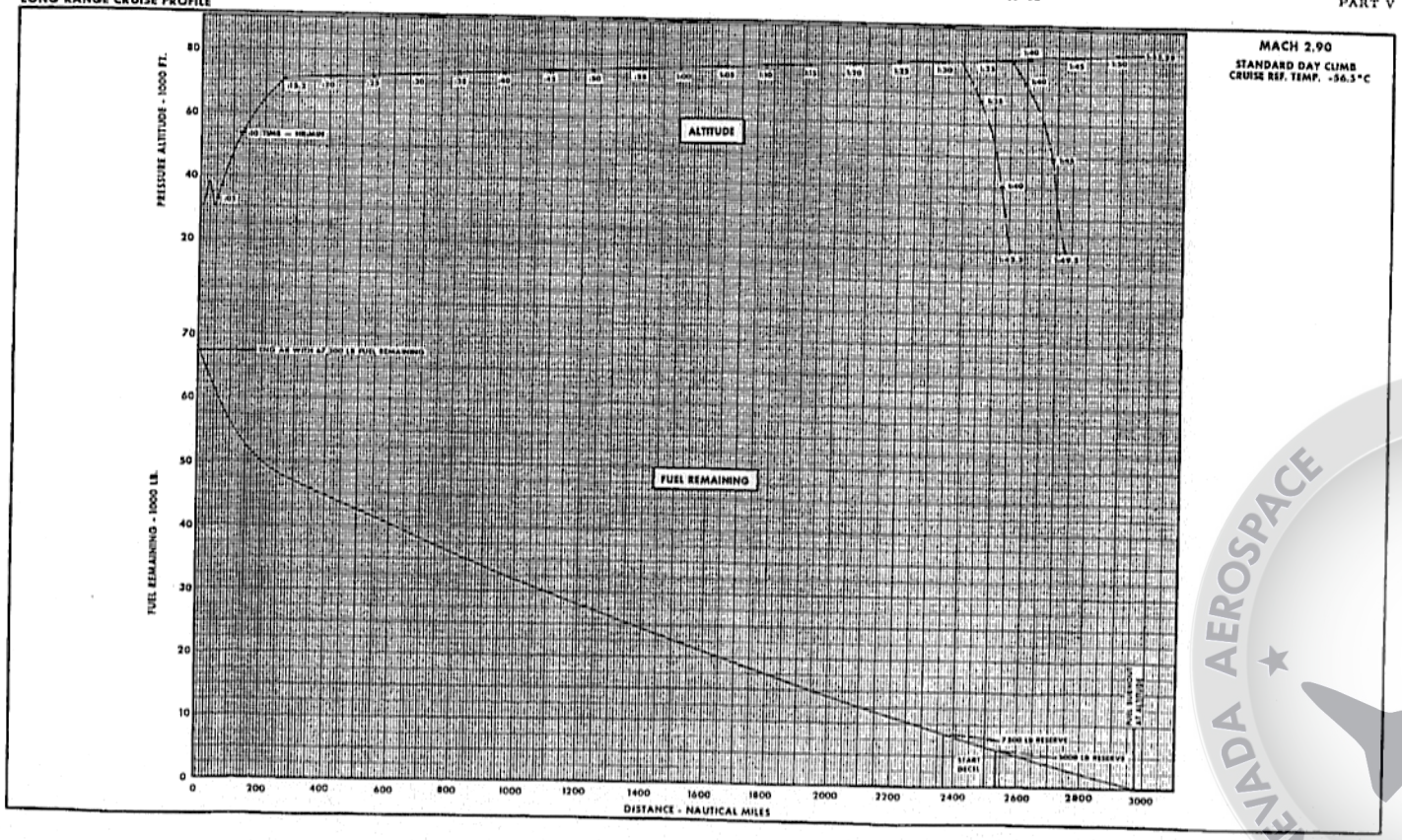

Figure A5-26
(Sheet 1 of 3)

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Figure A5-2A
(Sheet 1 of 3)

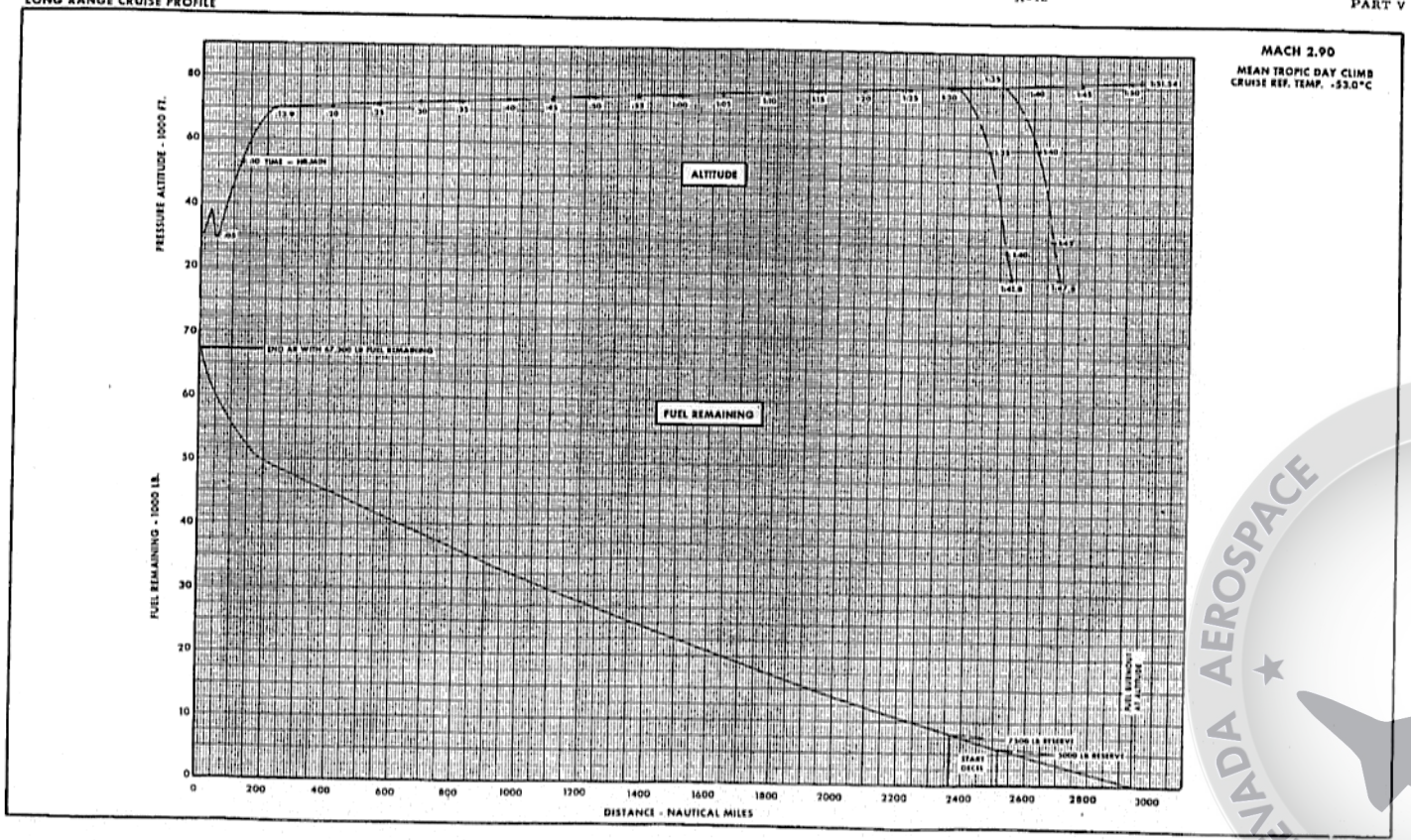

Figure A5-27
(Sheet 1 of 3)

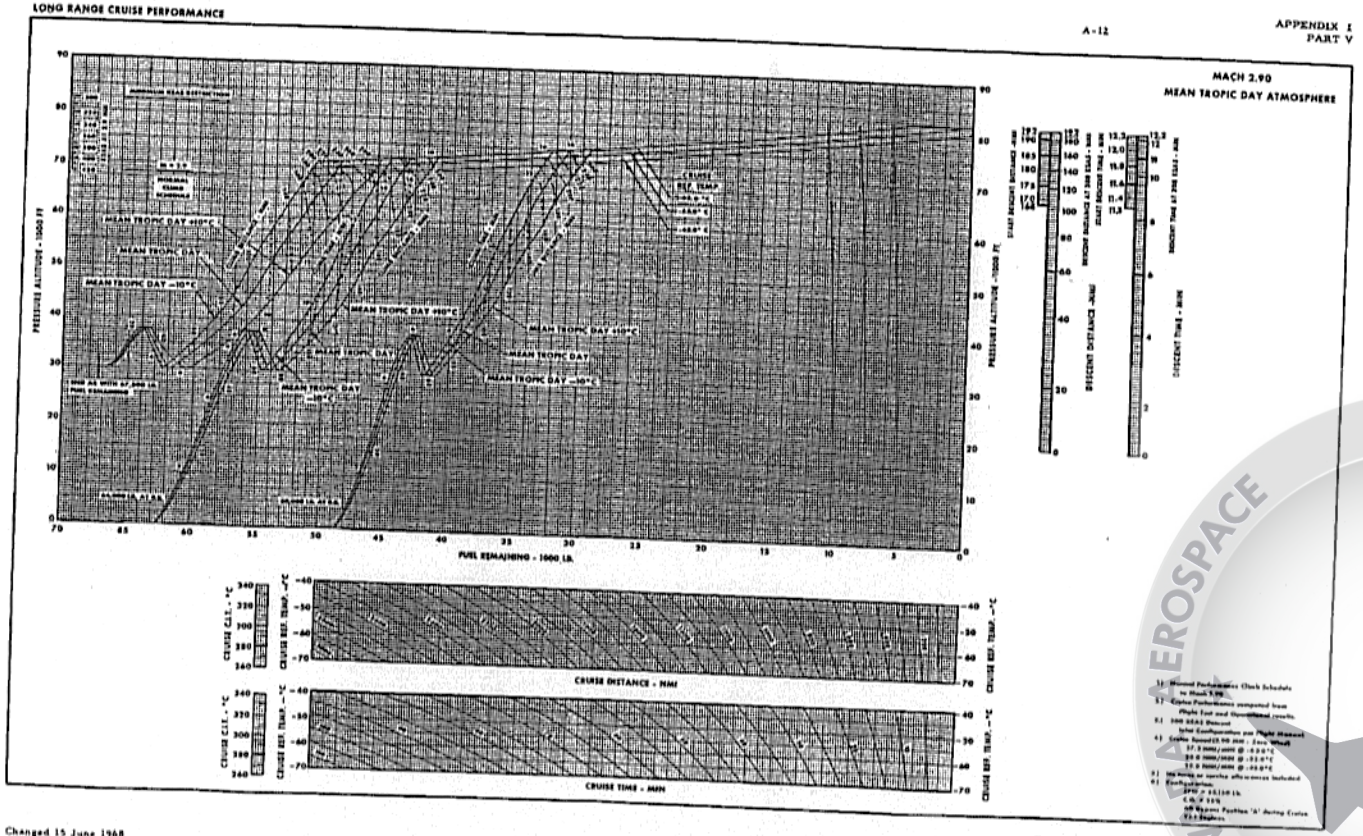

Figure A5-27
[Sheet 3 of 3]