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**MEASUREMENTS OF COSMIC RADIATION DOSE IN
SUBSONIC COMMERCIAL AIRCRAFT COMPARED
TO THE CITY-PAIR DOSE CALCULATION**

Roger Wallace

July 16, 1973

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INTRODUCTION

The work for this project was carried out in three phases, as MS projects by two students, and as a postdoctoral project by a visiting scientist. The first phase was completed by Michael F. Boyer¹ in 1969-70, and consisted entirely of measurements between San Francisco and London over the great circle route. The second phase was carried out in 1971-72 by Jon A. Kirby, over routes from San Francisco to Washington, D. C., Tokyo, Buenos Aires, and Rio de Janeiro. The City-Pair code, which originated at Boeing Aircraft Co., was reprogrammed to run on the computers at the Lawrence Berkeley Laboratory by Douglas C. Wallace, and the code was revised further by Kalina Mamont-Cieřla, guest physicist, who is visiting the Lawrence Berkeley Laboratory from the Central Laboratory of Radiological Protection, Warsaw, Poland.

In the first phase, photographic emulsions and thermoluminescent dosimeters were mailed by conventional registered air mail from Berkeley via San Francisco to Professor Jack Fowler at Hammersmith Hospital near London, who returned them to us. These detectors accumulated approximately 2100 hours of flight time at altitudes above 30,000 feet. In the second experimental phase, similar detectors were mailed round trip through diplomatic channels to Washington, D. C., and thence to Tokyo, Buenos Aires, and Rio de Janeiro for a total flight time above 30,000 feet in excess of 2900 hours. The dates of the flights are listed in Tables Ia and II, and of solar proton events in Table Ib. The

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measured results were then compared to the results of the "Boeing Code" which was originally programmed by Stanley Curtis and was originally described in the Boeing report.² This program, called the Galactic Radiation Exposure Program (GREP), calculates the dose in tissue in millirads for the great circle flight path between two cities. The agreement is seen to be reasonably good.

It is concluded that both experiments and theory show that the total doses received at present day conventional jet aircraft altitudes are considerably higher than those encountered in supersonic flights at much higher altitudes, even though the dose rate is lower at these lower altitudes, when the longer time of exposure at the lower altitudes is taken into consideration.

The Experiments

The dosimetric measurements were made with thermoluminescent dosimeters (TLD's) and with emulsions of three types sealed in plastic packets. These packets were sent by air mail back and forth from Berkeley, California to the five cities on the dates shown in Tables Ia and II. A dose sufficiently above background for a satisfactory measurement was accumulated by the TLD's on one round trip and by the emulsions on three round trips. Although there were some small variations in the contents of certain packets, all were basically the same. Pieces of polyvinyl-chloride (0.6 mm thick) were cut to the size of a regular business envelope (10 cm X 23 cm). The packet was compartmentized and sealed with a radio-frequency plastic welder. Packets sent to London contained β - γ films, NTA films, 600 μ emulsion, and CaF_2 thermoluminescent detectors (TLD). Packets sent to Washington, Tokyo, Rio de Janeiro, and Buenos Aires contained only β - γ emulsions and TLD's. Before sealing, each packet was flushed with dry nitrogen gas to reduce photographic fading of the latent image by decreasing the relative humidity and decreasing the atmospheric oxygen in contact with the emulsion.

Each packet contained four β - γ films. Two of these films were

unexposed; the third film was pre-exposed to 20 mr and the fourth film was pre-exposed to 100 mr of radium γ -rays. In those packets that contained nuclear track emulsions (NTA), one NTA film was pre-exposed to 20 mrem and the other to 100 mrem of PuBe neutrinos.

In evaluating the flight paths for the first part of this experiment from San Francisco to London, an air mail flight schedule was obtained from the Berkeley post office. When the total number of available flights is considered, it is reasonable to assume that at least 80% of the packets sent to London made the trip by the polar route, rather than landing in New York. Polar flights from San Francisco to London always go via Los Angeles. On the Los Angeles to London leg they have a flight profile approximately like that seen in Fig. 1. These flights usually go over the southern part of Hudson Bay, Baffin Island, and the southern third of Greenland. Each flight is flown over the predicted "least time" route based on the latest weather predictions. Some flights may go considerably south of Greenland, occasionally as far south as Atlanta, although this is rare. These variations probably don't have a large effect on the galactic cosmic ray dose since they take longer at a lower dose rate, which has a compensating effect on the integrated dose. The solar flare dose, if any, would be reduced by a larger factor at the lower magnetic latitudes. Since few solar flares occurred during this experiment, these relatively rare and self-compensating route variations have little effect on our results.

Calculations made with the GREP code² indicate that for the San Francisco to London route one should expect a total dose of about 5 mr/round trip. Since the lower limit of sensitivity for the film is approximately 10 mr, each packet to London was sent on about five round trips. Unfortunately, during this time there were no large flares and only one small flare. Three groups of packets completed five round trips to London. Six groups of packets completed round trips to Washington, Tokyo, and Buenos Aires. Five groups of packets completed round trips to Rio de Janeiro.

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Fig. 1. Flight profile of a typical flight between Los Angeles and London from TWA.

One packet was lost on this route.

The packets sent to Washington, Tokyo, Rio de Janeiro, and Buenos Aires actually followed the following routes, according to the U. S. Postal Service and the U. S. Department of State. The return route was the reverse of the outbound route in each case. In the calculations, each leg of these routes was assumed to be a great circle path between the two points at its end. The Washington route was direct from San Francisco to Washington. The Tokyo route was also direct from San Francisco to Tokyo non stop. The Rio de Janeiro route was from San Francisco to New York; to Charleston, South Carolina; to Caracas, Venezuela; to Rio de Janeiro, Brazil. The Buenos Aires route on the other hand, was from San Francisco to Washington, D. C.; to New York; to Buenos Aires, Argentina. The dates of the flights are shown in Table Ia and the dates of solar proton events are shown in Table Ib.

Background Radiation

Realizing that from the time the film is sealed until it is developed, it spends more time at sea level than at altitude, it is necessary to attempt to estimate the dose of ionizing radiation which is accumulated during the time not spent in the aircraft.

Duplicate dosimeters were stored in a low background cave at the Lawrence Berkeley Laboratory and in an unshielded area (Oakland) during the flight times. These dosimeters were processed with the dosimeters that had been mailed and the background readings were subtracted appropriately.

Analysis of β - γ Film Data

In interpreting the data there were two experimental factors which need special mention. First, these films, all from the same emulsion number, were packaged, exposed, and developed in different groups; and secondly, the time which elapsed from loading to development in the different groups was different, even though the time which each group spent in the air was essentially the same. The total dose gathered on

Table Ia. The TLD's each flew on one trip between the following dates

	1971				1972	
	#1	#2	#3	#4	#5	#6
Washington	7/28-8/8	8/28-9/2	9/28-10/12	11/17-12/3	1/13-1/20*	4/6-4/14
Tokyo	7/28-8/6	8/27-9/9	9/28-10/6	11/17-12/9	1/13-1/24*	4/6-4/17
Buenos Aires	7/28-8/18	8/27-9/16	9/28-10/19	11/17-12/6	1/13-2/1*	4/6-4/26
Rio de Janeiro	7/28-8/30	8/27-9/23	9/28-10/28	11/17-12/13	1/13-2/8 *	4/6-5/1
TLD Dates Between Start and Reading					1/13-2/16*	4/5-5/5

The films each flew three trips as follows:

<u>Set of Films</u>		<u>Trips</u>
Washington	# A	1, 2, 3
	# B	4, 5, 6
Tokyo	# A	1, 2, 3
	# B	4, 5, 6
Buenos Aires	# A	1, 2, 3
	# B	4, 5, 6
Rio de Janeiro	# A	1, 3, 4
	# B	2, 3, 4
	# C	4, 5, 6

* There was solar activity during these flights, See Table Ib.

Table Ib. Dates of Solar Proton Events

<u>Date</u>	<u>Strength</u> <u>(all events low energy)</u>	<u>Duration</u>
September 1, 1971	small	short
October 3, 1971	medium	day
December 2, 1971	small	short
December 14-21, 1971 peak December 17	medium to large	7 days
January 11, 1972	small	day
January 15-16, 1972	small	2 days
January 19-25, 1972 peak January 20-21	medium	6 days
April 17-18, 1972	small	6 hours

the London trips made by these films represents about 2052 hours of exposure at altitudes above 30,000 feet, as calculated from the flight profile in Fig. 1. The total time spent above 30,000 feet on the Washington, Tokyo, Rio de Janeiro, and Buenos Aires flights was 2897 hours.

Fading

The question of the change of the latent image during the 8 to 16 weeks between loading and development is poorly understood. The controls which were kept in the shielded cave showed an apparent fading in the last two groups and an increase of background in the first group. Many possible explanations for this were examined and discarded. We are forced to attribute this inconsistency in the background film exposures to unexplained but occasionally observed variations in β - γ film dosimetry. The film was all from one emulsion number and all films were treated the same. The assumption was made in the case of each group that, for the time period from loading into the packets until development, all films in the group underwent the same fading and background change. Therefore, the figures in Table II represent the dose readings in roentgens minus the actual dose reading from the appropriate control film which was kept in the low background cave.

In groups 2 and 3 the fading of the control films was more than might be expected, even though they were sealed in nitrogen and kept in the cave, which has a very constant environment. In some low dose films the fading was as much as 60 percent. This proved to be especially annoying in the case of the last group, where the average readings were higher than in groups 1 and 2. (See Table II)

The experience which has been gained over many years in reading β - γ film indicates that the data are reasonable. It may not be possible to attach dosimetric significance to the measurements of any one film, but, in view of the large total number of hours which the film spent in the air, the average is probably significant.

Many possible explanations of the wide variation in measured doses were examined. It is quite possible that packages 9 and 13 may have

Table II. Results from the β - γ films making flight San Francisco-London in the packets.

Group	Pkg.	Rd. trips	Hrs. in air [*]	Total dose in milliroentgen gained					mr/round trip			Group Average
				Zero	Zero	20	100	Ave.	Min.	Max.	Ave.	
1 (9 Dec. 69 to 9 Apr. 70)	1	6	108	23	26	30	6	21	1.0	5.0	3.5	4.7
	2	5	90	16	19	57	23	29	3.2	11.4	5.8	
	3	5	90	19	19	23	27	22	3.8	5.4	4.4	
	4	3	54	11	11	15	19	14	3.7	6.3	4.7	
	5	5	90	16	23	16	9	16	1.8	4.6	3.2	
	6	5	90	30	30	33	37	33	6.0	7.4	6.6	
	9	5	90	228	228	62	202	180	12.4	45.6	36.0	
	10	5	90	24	31	20	21	24	4.0	6.2	4.8	
	11	5	90	24	31	18	24	24	3.6	6.2	4.8	
2 (10 Mar. 70 to 29 Mar. 70)	12	5	90	28	28	17	33	26	3.4	6.6	5.2	10.6
	13	5	90	90	100	118	88	99	17.6	23.6	19.8	
	14	5	90	28	32	9	20	22	1.8	6.4	4.4	
	15	5	90	28	30	12	28	24	2.4	5.6	4.8	
	16	5	90	30	31	14	18	23	2.8	6.2	4.6	
	20	5	90	37	47	89	90	66	7.4	18.0	13.2	
	21	5	90	64	92	104	97	89	12.8	20.8	17.8	
	22	5	90	107	121	149	164	135	21.4	32.8	27.0	
	23	5	90	30	44	96	69	60	6.0	19.2	12.0	
3 (13 Mar. 70 to 14 Jul. 70)	24	5	90	89	160	186	193	157	17.8	38.6	31.4	19.7
	25	5	90	47	54	96	94	73	9.4	19.2	14.6	
	26	5	90	100	107	142	164	128	20.0	32.8	25.6	
	27	5	90	61	71	78	90	75	12.2	18.0	15.0	
	28	5	90	92	100	128	97	104	18.4	25.6	20.8	
								Ave.	Ave.	Ave.	Ave.	
Total Averages								62.8	8.3	16.1	12.5	

* Approximately 18 hours in air at altitude per round trip

been exposed to a source of radiation somewhere along their trips. To suggest that all of group 3 is higher from this type of cause seems very unreasonable. There is, however, experimental experience that for unknown reasons, probably connected with environmental conditions, as much as 50 mr per film might be due to activation of the silver grains by a so far unidentified process other than radiation. This phenomenon has been known to occur in the processing of large groups of films in which, for unknown reasons, most of the films which left the photoprocessing lab apparently gained an abnormally large amount of radiation, while the control films that did not leave the laboratory showed nothing abnormal.

Although no large solar flares occurred during the experiment, an attempt was made to correlate enhanced solar activity with those packets which showed a higher dose. This was only mildly successful. For example, June 13 and 14 were the most active days since the beginning of the year. There were large class X events. Packet 27 flew during this period and showed the highest dose of all packets for group 3. Packet 23 also flew during this time period and showed the lowest dose of group 3.

If the readings for the four days previous to the May 30, 1970 flare, made on the polar route to London, are averaged together using the amounts over the 4.0 mrad background, one gets an average of 1.93 mrad/round trip. We assume that half of this dose was accumulated during each flight direction, or that on a no-flare trip the extra amount of radiation from flying is about 1 mrad. There was thus an increase of about 50% per round trip due to this flare.

Analysis of TLD Data

The TLD's (thermoluminescent dosimeters) were CaF_2 . Each reading is actually an average of three separate dosimeters contained in a small plastic disk. All readings and calibration of these dosimeters was done at the Lawrence Livermore Laboratory under the direction of D. E. Jones, R. E. McMillan, and G. L. Seibel, Hazards Control Group,

and are listed in Table III.

Due to their greater sensitivity (down to 0.1 mrad) TLD dosimeters were sent on only one round trip before being read. Of special interest is the TLD sent on the 30th of May, 1970. It was in the air when the first proton event in 45 days occurred. Unfortunately, on this particular day a TLD was not sent via JFK airport, and so no comparison could be made between the polar and lower magnetic latitude routes. However, the measurement during the flare* was clearly above the other measurements. There was at most a 50% increase in dose for the flight during this class M flare.

Experimental Results

The experimental results from the first phase of the experiment are listed in Table II. The average additional dose from cosmic rays on flights to London from December, 1969 to July, 1970 was 12.5 ± 4 mrad/round trip with a lower limit of 8.3 mrad/trip and an upper limit of 16.1 mrad/round trip. The results from the second phase of the experiment, including both the beta-gamma films and the TLD dosimeters, are summarized in Tables III to VI.

Measured Cosmic Ray Neutron Spectrum

One of the 600 μ emulsions was scanned for proton recoils, and these in turn converted to the neutron spectrum in Fig. 2.

* A description of the flare of May 30, 1970, as given by ESSA, is as follows:

"The proton event was associated with an imp IN, a Class M flare at 30/0240Z, (IN-A size and intensity evaluation. In this case, area 2.1 — 5.1 sq. deg with normal intensity.) again in region 760. The 1-8 A x-ray burst associated with this flare had a peak flux of only 0.04 erg per sq cm per cm per sec, but a total duration of 6 hours. Protons were first detected by the ATS-1 satellite at about 30/0800 Z and were of the order of 350 and 16 particles per sq cm per sec in the 5-21 and 21-70 MeV channels respectively. Associated riometer absorption at 30 MHz was 1 Db or less."

Table III. CaF_2 TLD's (^{60}Co mrad)

Destination	#1	#2	#3	#4	#5	#6
Washington	8.23	6.25	9.74	12.76	5.77	1.31
	<u>8.34</u>	<u>6.28</u>	<u>7.98</u>	<u>12.47</u>	<u>5.74</u>	<u>1.29</u>
Average	8.29	6.27	9.86	12.62	5.76	1.30
Tokyo	7.45	8.38	10.26	14.20	6.80	2.28
	<u>7.69</u>	<u>8.54</u>	<u>10.37</u>	<u>14.28</u>	<u>6.78</u>	<u>2.32</u>
Average	7.57	8.46	10.32	14.24	6.79	2.30
Buenos Aires	8.18	7.41	11.77	15.01	7.82	2.79
	<u>8.63</u>	<u>7.71</u>	<u>12.05</u>	<u>15.35</u>	<u>7.86</u>	<u>2.92</u>
Average	8.41	7.56	11.91	15.18	7.84	2.86
Rio de Janeiro	lost	10.68	12.27	16.00	10.38	7.92
	lost	<u>10.85</u>	<u>12.86</u>	<u>17.71</u>	<u>10.58</u>	<u>7.87</u>
Average		10.77	12.57	16.86	10.48	7.90
Cave Control	2.28	2.11	2.71	2.37	2.07	0.25
	—	<u>2.13</u>	<u>2.75</u>	<u>2.31</u>	<u>2.15</u>	<u>0.21</u>
Average	2.28	2.12	2.73	2.34	2.11	0.26
Home Control (Oakland, Ca)	3.95	4.45	6.32	8.07	4.22	1.44
	—	<u>4.52</u>	<u>7.53</u>	<u>7.15</u>	<u>lost</u>	<u>1.47</u>
Average	3.95	4.49	6.93	7.61	4.22	1.46

Table IV. β - γ Films (^{226}Ra mr)

The doses shown are the excess dose above the pre-irradiated dose per individual film. Each film has been on three round trips. It should be noted that the averages were taken after excluding the 100 mr exposed films, which apparently had experienced fading.

		<u>0</u>	<u>0</u>	<u>20</u>	<u>40</u>	<u>100</u>	<u>Average/trip</u> **
Washington	#A	29	30	30	30	17	10.0
	#B	40		36	31	—	11.8
Tokyo	#A	30	29	26	30	13	9.8
	#B	41		38	32		12.3
Buenos Aires	#A	31	32	30	31	17	10.3
	#B	43		39	35		13.0
Rio de Janeiro	#A	39	36	31	30	8	11.3
	#B	36		30	26		10.2
	#C	54		50	40		16.0
Cave Control	#A	3.5	3.5	4.5	9	-13	1.7
	#B	4		2	0		0.7
	#C	12		13	0		2.8
Home Controls							
	#A (cold)	11.0	11.5	14.5	20.5	- 1	
	#A (shelf)	<u>24.0</u>	<u>24.0</u>	<u>19.0</u>	<u>22.0</u>	<u>13</u>	
	Average	17.5	17.8	16.8	21.3	7	6.0
	#B (cold)	30		29	26		
	#B (shelf)	<u>30</u>		<u>26</u>	<u>22</u>		
	Average	30		27.5	24		9.1

* Control for Rio de Janeiro flight #B

** The 100 mr column is not included in the average.

Table V(A). Average dose/trip

The doses shown are the average doses/trip above the background at Oakland, California. The values are secured, except as noted in the post note, by subtracting the Oakland, California values from the flight values shown in Table I.

Destination	TLD's (in Rad)						Net/Ave.
	#1	#2	#3	#4	#5*	#6*	
Washington	4.34	1.78	2.93	5.01	3.22 (7/34)	0.72 (8/30)	3.00
Tokyo	3.62	3.97	3.39	6.63	4.00 (11/34)	1.60 (11/30)	3.87
Buenos Aires	4.46	3.07	4.98	7.57	4.55 (19/34)	1.60 (20/30)	4.37
Rio de Janeiro	—	6.28	5.64	9.25	6.76 (26/34)	6.64 (25/30)	6.91

* These sets of TLD's were handled differently from the first four sets. These TLD's were kept in the cave except when in the mail. The TLD's were 34 (#5) and 30 (#6) days between preparation and reading. The numerator of the fraction in parentheses in the number of days it was out of the cave. The dose above background for these sets is found by:

$$\text{Dose} = \text{reported exposed dose} - \text{cave dose} \\ - \text{minus (fraction) (home dose-cave dose)}$$

This process takes into account the time the packets were in the cave.

Table V (B). Average dose/trip

	<u>β - γ Films (mr)</u>		<u>Net/Ave.</u>
	<u>#A</u>	<u>#B</u>	
Washington	4.0	2.7	3.4
Tokyo	3.8	3.2	3.5
Buenos Aires	4.3	3.9	4.1
Rio de Janeiro [*]	2.2	7.2	6.9

* Trip # A: Since these three trips took 46 days longer than the others, 140/94 times the home control dose was used to find the exposure over background.

Trip # B: These three trips had their own cave control, so a factor of 0.7/1.7 times the home control dose was used to find the exposure over background.

Table VI. Experimental and calculated equivalent doses received per round trip in conventional jet aircraft during average solar conditions between San Francisco and several cities.

San Francisco to:	Calculated Solar Average Conditions			Experimental	
	Charged Particles	Neutrons	Total	β - γ Film	TLD
London *	5.58	1.64	7.22	8.5	2.00
Washington	2.39	0.68	3.06	3.4	3.00
Tokyo	2.48	0.83	3.31	3.5	3.87
Buenos Aires	6.98	1.74	8.72	4.1	4.37
Rio de Janeiro	5.10	1.30	6.40	5.4	6.91

* There was at most an increase of 50% during a class M solar flare which occurred on May 30, 1970, between San Francisco and London.

The proton recoil emulsion was read using the random-walk method. Using this method, 1150 proton recoil tracks were measured in the emulsion, which is approximately 2 cm X 2 cm X 600 μ in size. These data were then introduced into a computer program which determines the track-length energy. The number of tracks per energy interval $\Delta N/(P, \Delta E)$ was then plotted versus energy. From this a smooth proton spectrum was drawn.

The two peaks at the low end of the proton spectrum are produced by systematic effects. They are caused by nitrogen in the emulsion (a n α h, p reaction on nitrogen) and alphas from thorium and radium impurities.

Points from the smooth proton spectrum are then introduced into another program which determines the neutron spectrum. (See Fig. 2.) A second plot of this neutron spectrum was made with a linear scale. (See Fig. 3.) Then, using the relations shown below

<u>Analytic expressions for dose equivalent vs neutron energy</u>	
<u>Energy range</u> <u>(MeV)</u>	<u>n-cm⁻²-sec⁻¹ equivalent to</u> <u>1 mrem-h⁻¹</u>
<10 ⁻²	232
10 ⁻² - 10 ⁰	7.20 E ^{-3/4}
10 ⁰ - 10 ¹	7.20
>10 ¹	12.8 E ^{-1/4}

An integral rem dose was calculated for each energy interval. This rem spectrum was then plotted with the linear neutron spectrum for comparison. (See Fig. 3.)

Calculations

The calculations² were made by a code GREP originally programmed at the Boeing Aircraft Company by Stanley Curtis (now at the Lawrence Berkeley Laboratory) and modified by Douglas Wallace and Kalina Mamont-Cieřla for this work. This code calculates tissue doses due to galactic

Figure 3

cosmic radiation during subsonic and supersonic flight for times of minimum solar activity and times of average solar activity.

In this calculation the input to the code, which is listed in the appendix, is the geographical coordinates of the cities, altitude-distance flight profiles, and block times. The program then changes the instantaneous geographic latitude and longitude of the plane to geomagnetic latitude and longitude and pressure altitude as it follows the aircraft on a great circle route. At 0.1 hour intervals, the ionization density, caused by charged particles in the atmosphere from basic cosmic ray data ion pairs formed in a cm^3 per sec of standard air, is converted to an equivalent tissue dose rate in mrad per hour with all the appropriate conditions taken into account. The ion pair data are entered in a table from which values are interpolated as needed. This dose rate is then integrated and accumulated over the entire flight.

Results

In particular, note in Table VII that the direct Los Angeles - Paris flight is 3.70 mrad/round trip for an SST under average solar conditions and that the same trip made by way of New York is 3.66 mrad/round trip. ($1.28 + 2.38 = 3.66$.) In general, while more southerly routes have lower hourly dose rates, the flight routes are longer and thus more time is spent in these lower dose rate regions (due to the larger area of the earth in the equatorial and temperate zones). Thus, there is a compensating effect which tends to make doses on polar flights almost the same as those on lower latitude flights.

There is a similar compensating effect of altitude which takes place as altitude is varied. Subsonic flight at 35,000 feet takes about three times as long as supersonic flight over the same route at 65,000 feet. Since the dose rate is about three times higher at 65,000 feet relative to 35,000 feet, these effects roughly cancel. As an example,

Table VII. Comparison of the subsonic and supersonic round trip doses computed by the GREP code. The dose is given in mrem obtained when flying between various city pairs under average solar conditions.

City Pair	Subsonic Flight - 35,000 ft. altitude	
	Block Time*	mrad/round trip
	(BT) hrs	
Paris-Anchorage	9.45	4.07
Los Angeles-Paris	11.15	4.79
Anchorage-Hamburg	8.95	3.84
Chicago-Paris	8.35	3.56
New York-Paris	7.45	3.13
Montreal-Paris	7.05	2.94
New York-London	7.05	2.94
San Francisco-New York	5.45	2.07
Los Angeles-New York	5.25	1.92
Los Angeles-Washington	4.95	1.75
Los Angeles-Chicago	3.95	1.34
Sydney-Acapulco**	17.45	4.40

City Pair	Supersonic Flight 60-65,000 ft. altitude	
	Block Time	mrad/round trip
	(BT) hrs	
Paris-Anchorage	3.25	3.16
Los Angeles-Paris	3.85	3.70
Anchorage-Hamburg	3.05	2.92
Chicago-Paris	2.85	2.64
New York-Paris	2.65	2.38
Montreal-Paris	2.45	2.17
New York-London	2.45	2.17
San Francisco-New York	2.05	1.44
Los Angeles-New York	1.95	1.28
Los Angeles-Washington	1.85	1.16
Los Angeles-Chicago	1.55	0.89
Sydney-Acapulco**	6.25	2.08

*Time in the air

**Two stopovers

note that the Los Angeles to Paris SST dose is 3.70 mrad and the subsonic dose is 4.79 mrad. In fact, the total doses for subsonic 35,000 feet flights are between 25 and 100% higher than for flights at 65,000 feet, the supersonic altitude range. These increased doses in subsonic flight will undoubtedly be experienced by far more people than will experience the reduced doses associated with supersonic flights.

References

1. Michael Boyer, A Measurement of Cosmic Radiation Dose: Jet Aircraft to Polar Route, San Francisco to London, August, 1970. (M.S. Thesis.) Lawrence Berkeley Laboratory report, UCRL-20052.
2. City Pair Dose Calculations, Boeing Document D6 A11467-1.


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C****
C****
C****
PROGRAM ACRE(INPUT,OUTPUT,TAP5=INPUT,TAP6=OUTPUT) 1
C****
C**** ACRE--AIR CRAFT RADIATION EXPOSURE 2
C****
DIMENSION ALTTAB(300),DTAB(300),LTAB(11),TALTAB(15), 4
1 INTTAB(18),FTAB(18),IPTAB(11,15),SOLRAT(11,15),NFTAB(11,15), 5
2 LAMBDA(300),X(300,3), TALT(300), IDOSE(300,2), 6
3 XD0SE(300,4), SPEED(3),ND0SE(300,2),XND0SE(300,4),ID0SE(300,2), 7
4 ALAT(2), PRDN(2,2),AIRPORT( 800,8),ALONG(2),TXD0SE(300,4) 7A
5 RFAL 1,AT2,LONG1,LONG2,LAT,LNTALT,ID0SE,IPAIRS,FLUXN,ND0SE, 8
6 LAMBDA,LONG 9
7 INTEGER CDPRNM, IREPORT ( 800,8), DIFER 9A
8 EQUIVALENCE (IREPORT,AIRPORT) 9B
C****
C**** READ IN FIXED DATA TABLES. THESE ARE THE SAME FOR ALL PROBLEMS. 10
C**** IPTAB (11,15) ARRAY OF ION PAIRS/CM**3/SEC AS A FUNCTION OF GEOMAG- 10A
C**** NETIC LATITUDE AND AIR DEPTH 10B
C**** SOLRAT(11,15) ARRAY OF ADJUSTMENT RATIOS AS A FUNCTION OF GEOMAG- 10C
C**** NETIC LATITUDE AND AIR DEPTH. THESE FACTORS CORRECT FROM SOLAR MINI- 10D
C**** MUM TO SOLAR AVERAGE CONDITIONS. 10E
C**** NFTAB (11,15) ARRAY OF NEUTRON FLUXES AS A FUNCTION OF GEOMAG- 10F
C**** NETIC LATITUDE AND AIR DEPTH 10G
22 READ 1000,((IPTAB(I,J),J=1,15),I=1,11) 11
42 READ 1000,((SOLRAT(I,J),J=1,15),I=1,11) 12
READ 1000,((NFTAB(I,J),J=1,15),I=1,11) 12A
1000 FORMAT (13F6.0,2X) 13
C****
C**** TALTAB(15) ARRAY OF AIR DEPTH VALUES (GM/CM**2) 13A
C**** LTAB (11) ARRAY OF GEOMAGNETIC LATITUDES 13B
C**** LNTTAB(18) ARRAY OF LOGARITHMS OF THE MASS OF AIR OVERHEAD AT A- 13C
C**** GIVEN ALTITUDE IN FTAB 13D
C**** FTAB (18) ARRAY OF ALTITUDES IN FEET 13E
62 READ 1010,(TALTAB(J),J=1,15) 14
70 READ 1010, (LTAB(J),J=1,11) 15
76 READ 1010, (LNTTAB(I),I=1,18) 16
104 READ 1010, (FTAB(J),J=1,18) 17
1010 FORMAT(8F10.0) 18
C****
C**** END OF FIXED DATA TABLES FOR COSMIC RAY FLUXES AND AIR PROPERTIES.
C**** PRINT OUT THESE FIXED DATA TABLES.
112 PRINT 1110, (TALTAB(J),J=1,15) 19
1110 FORMAT(1H1,/,55X,34H AIR DEPTH TABLE (GM/CM**2) TALTAB,/, 20
2,24X,(15F7.0)) 21
C****
120 PRINT 1090, ((LTAB(I), (IPTAB(I,J),J=1,15)),I=1,11) 22
1090 FORMAT(//6X,*GEOMAGNETIC*,38X,46H ION PAIR DATA (ION PAIRS / CM**3 23
1/ SEC) IPTAB,/, 24
2,6X,*LATITUDE*// 25
3(6X,F5.0,13X,15F7.1//)) 26
C****
144 PRINT 1111, (TALTAB(J),J=1,15) 26A
1111 FORMAT(1H1,/,55X,34H AIR DEPTH TABLE (GM/CM**2) TALTAB,/, 26B
2,24X,(15F7.0)) 26C

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APPENDIX

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LBL-1505

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****
C****
152 PRINT 1100, ((LTAB(I), (SOLRAT(I,J), J=1, 15)), I=1, 11) 27
1100 FORMAT(/, 6X, *GEOMAGNETIC*, 18X, 62HSOLAR AVERAGE ATMOSPHERIC CORRE 28
2CTION FACTOR (GM/CM**2) SOLRAT,/ 29
3, 6X, *LATITUDE*// 30
4(6X, F5.0, 13X, 15F7.3//) 31
176 PRINT 1130, (LNTTAB(J), J=1, 18) 32
1130 FORMAT(/, 36X, *LOG OF AIR DEPTH VALUES LNTTAB, */(9F14.5//) 33
C****
204 PRINT 1140, (FTAB(J), J=1, 18) 34
1140 FORMAT(/, 36X, *ALTITUDE IN FEET FTAB, */(9F14.0//) 35
C****
212 PRINT 1110, (TALTAB(J), J=1, 15) 35A
C****
220 PRINT 1091, ((LTAB(I), (NFTAB(I,J), J=1, 15)), I=1, 11) 35B
1091 FORMAT(/, 6X, *GEOMAGNETIC*, 38X, 38HNEUTRON FLUX DATA (N/CM**2/SEC) 35C
2NFTAB,/ 35D
3, 6X, *LATITUDE*// 35E
4(6X, F5.0, 13X, 15F7.2//) 35F
C****
C**** READ IN ALL AIRPORT DATA(4 ITEMS FOR EACH AIRPORT* CODE NAME, LAT, 36
C**** LONG, FULL NAME) AND STORE IT IN MATRIX AIRPORT(K,M) 36A
C**** READ IN K=NUMBER OF AIRPORTS 36B
C**** READ IN IND, THIS VARIABLE HAS A VALUE ZERO IF WE DO NOT WANT THE 36C
C**** LIST OF AIRPORTS TO BE PRINTED AND VALUE 1 IF WE DO 36D
244 READ 3010, K, IND 37
3010 FORMAT (2I5) 37A
254 IF (IND-1) 305, 306, 306 38
257 306 CONTINUE C306 38A
257 WRITE (6, 3005) 39
3005 FORMAT(1H1, //, 35X, 16HLIST OF AIRPORTS, //, 4X, 20HCODE NAME OF AIRPO 40
2RT, 5X, 8HLATITUDE, 5X, 9HLONGITUDE, 9X, 7HAIRPORT, //) 40A
263 305 CONTINUE 41
C**** THE GEOGRAPHIC LOCATION OF THE AIRPORTS IS ENTERED WITH THE WEATHER
C**** STATION AIRPORT CODE OF THREE LETTERS IN THE FIRST THREE COLUMNS.
C**** THE LATITUDE AND THE LONGITUDE EXPRESSED TO THE NEAREST DECIMAL HUNDREDTH
C**** OF A DEGREE ARE ENTERED IN COLUMNS 11 - 20 AND 21 - 30 RESPECTIVELY. THIS
C**** IS THEN FOLLOWED IN COLUMNS 31 - 80 BY THE NAME OF THE CITY AND THE
C**** AIRPORT.
263 DO 300 IK=1, K D 30042
265 READ 3020, (AIRPORT (IK, IM), IM=1, 8) 43
3020 FORMAT ( A10, 2F10.2 , 5A10) 43A
301 IF (IND-1) 300, 310, 310 43B
304 310 PRINT 3030, (AIRPORT (IK, IM), IM=1, 8) 44
3030 FORMAT( 11X, A6, 13X, F7.2, 7X, F7.2, 8X, 5A10) 44A
321 300 CONTINUE 44B
C****
C****
C**** INITIALIZE CONSTANTS 45
324 1 CONTINUE C 1 45A
324 SNZT= SIN(11.5/57.2958) 45B
326 CNZT= COS(11.5/57.2958) 45C
331 XN = 1./14.1 45D
332 XK=.001924 46
C**** RESET FLIGHT DOSAGE VALUES 46A
333 SOLMIN=0. 46B

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****
334 SOLAVF = 0. 46C
335 IFLR=0 46D
336 SOLMINN = 0. 46E
336 SOLAVEN = 0. 46F
C****
C**** RESET COUNTER OF READ IN CODE NAMES IN .IT WILL HAVE A VALUE 1 OR 2 47
IN=0 47A
C****READ IN MESSAGE ON THE FLIGHT 47E
337 READ 1021,SPEED 47F
1021 FORMAT (3A10) 47G
C**** CHECK TO SEE IF ALL PROBLEMS HAVE BEEN DONE. IF SO --EXIT. IF NOT 47H
C**** CONTINUE 47I
C****
345 IF (EOF,5) 999,2 8999/248
350 2 CONTINUE C 2 48A
C**** READ IN 2 PROBLEM DATA CARDS CDPNRM=CODE PROBLEM NAME AND FIND 49
C**** THEIR LAT, LONG AND FULL NAMES IN THE LIBRARY OF AIRPORTS 49A
350 330 IN=IN+1 50
352 READ 3040, CDPNRM 51
3040 FORMAT (A6) 52
C**** RESET INDEX LACK. LACK BECOMES 1 IF A PROBLEM CODE NAME HAS BEEN 52A
C**** FOUND IN THE LIBRARY OF AIRPORTS AND LEAVES ZERO IF NOT 52B
357 LACK = 0 52C
360 DO 401 IK=1,K 53
362 IF (CDPNRM.NE. IPORT(IK,1)) GO TO 401 D401 53A
365 ALAT (IN)= AIRPORT(IK,2) 53B
366 ALONG (IN)= AIRPORT(IK,3) 53C
370 PPRNM (IN,1)=AIRPORT(IK,4) 53D
372 PPRNM (IN,2)=AIRPORT(IK,5) 53E
373 LACK=1 53F
374 GO TO 340 G340 53G
375 401 CONTINUE C401 53H
C****
C****
400 340 IF ( LACK-1 ) 402,345,345 54
403 402 PRINT 1081, CDPNRM 54A
1081 FORMAT( 1H1,/,10X,A6, 37HIS MISSING IN THE LIBRARY OF AIRPORTS) 54B
411 IF (IN-2) 403,404,1 54C
414 403 READ 3040, CDPNRM 54D
422 IN = 3 54E
423 404 READ 1020, BLKTM,RTCLIMB,CRSALT,RTDSCNT, STARTRT, RTHRZTL,ENDRT 55
445 IF ( IN .EQ. 3) GO TO 3 55A
447 GO TO 1 55B
450 345 IF ( IN - 2 ) 330, 405, 1 55C
453 405 PRINT 1080 , (PRBNM (1,J),J=1,2) ,(PRBNM(2,J),J=1,2),SPEED 55D
1080 FORMAT(1H1,/, 5A10,X, 2HTO, X,5A10,3A10,/) 55E
C****
C****
500 LAT1=ALAT(1) 56
501 LAT2=ALAT(2) 56A
502 LONG1=ALONG(1) 56B
503 LONG2=ALONG(2) 56C
C****
C**** CALCULATE COURSE IN SPHERICAL GEOGRAPHIC GEOMETRY 56D
505 XLAT1=LAT1 56E
506 XLAT2=LAT2 57

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507 LAT1=90.-LAT1
510 LAT2=90.-LAT2
511 SNLAT1 = SIN(LAT1/57.2958)
515 CNLAT1= COS(LAT1/57.2958)
521 SNLAT2 = SIN(LAT2/57.2958)
525 CNLAT2 = COS(LAT2/57.2958)
531 CNLGDF = COS(ABS(LONG2- LONG1)/57.2958)
537 COSA =CNLAT1*CNLAT2+SNLAT1*SNLAT2*CNLGDF
543 DIST = 3956.*ATAN1((1.-COSA *COSA) **.5)/COSA
556 SINC =SNLAT2*(1.-CNLGDF*CNLGDF)**.5/((1.-COSA *COSA)**.5)
570 COSC =CNLAT2-CNSA *CNLAT1/((1.-COSA*COSA) **.5*SNLAT1)
577 CPSANG =57.2958*ATAN2(SINC ,COSC )

602 C**** IF(LONG2-LONG1)/112.53,53
605 12 CRSANG=360-CRSANG
610 53 CONTINUE

C**** GENERATE FLIGHT PROFILE ALTITUDE ARRAY ALTTAB(NDPS) AND DISTANCE
C**** ARRAY DTAB(NDPS). NOTE NDPS ≤ 300.
C**** READ 1020, BLKTM,RTCLTMB,CRSALT,RTDSCNT,STARTRT,RTHRZTL,ENDRT
610 1020 FORMAT ( 7 F10.0)

C****
C**** BLKTM=THE BLOCK TIME IN THE AIR ON ONE WAY TRIP
C**** RTCLTMB=RATE OF CLIMB IN FEET/MIN
C**** CRSALT=CRUISING ALTITUDE IN FEET
C**** RTDSCNT=RATE OF DESCENT IN FEET/MIN
C**** STARTRT=CLIMBING GROUND SPEED IN MILES/HOUR
C**** RTHRZTL=CRUISING SPEED IN MILES/HOUR
C**** ENDRT= DESCENDING GROUND SPEED IN MILES/HOUR

C****
632 RLDATA = BLKTM*10.
634 NDPS = IFTXRLDATA+ 0.000011
636 104 CONTINUE
636 RLDATA=RLDATA-CRSALT/RTDSCNT/6.
641 LUATAOS= IFTXRLDATA/5.001
643 ALTTAB(1)=6.*RTCLTMB
645 DTAB(1) = STARTRT/10.

C****
647 DO 2040 I=2,NDPS
651 IF(ALTTAB(I)-11+.01 )-CRSALT1 2010,2020,2030
655 2010 IF (1-LUATAOS)2025,2025,2030
661 2025 ALTTAB(I)=6.*RTCLTMB + ALTTAB(I-1)
664 DTAB(I) = STARTRT/10.
666 GO TO 2040
670 ALTTAB(I)=ALTTAB(I-1)-6.*RTCLTMB
673 DTAB(I) = ENDRT /10.
675 GO TO 2040
676 2020 IF (1-LUATAOS) 2026,2026,2030
702 2026 ALTTAB(I)=CRSALT
703 DTAB(I) = RTHRZTL/10.
706 2040 CONTINUE
711 ALTTAB(NDPS) =0.

C****
712 PDIST =0.
713 DO 10 M=1,NDPS
720 PDIST =PDIST+ DTAB(M)
721 10 CONTINUE

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C****
C**** COMPARE THE GREAT CIRCLE DISTANCE DIST WITH THE DISTANCE PDIST CAL- 66
C**** CUMATED AS A SUM OF GENERATED DISTANCES TRAVELLED PER 0.1 HOUR 66A
C**** INCREMENT AND CORRECT THE READ IN SCHEDULE VALUE OF BLKTM TO BLK 66B
C**** IF NECESSARY. 66C
722 DIF = (DIST - PDIST) / (RTHRZTL / 10.) 66D
726 IF (ABS(DIF) .LT. 1.) GO TO 102 66E
731 DIFER = IFIX ( DIF ) 66F
732 IF ( DIFER - 0 ) 101, 102, 103 66G
735 101 NDPS = NDPS + DIFER 67
736 RLODATA = FLOAT ( NDPS ) 67A
737 GO TO 104 G 104 67B
741 103 NDPS = NDPS - DIFER 67C
742 RLODATA = FLOAT ( NDPS ) 67D
743 GO TO 104 67E
744 102 CONTINUE 68
744 PRINT 1180, BLKTM,RTCLIMB,CRSALT,RTDSCNT,STARTRT,RTHRZTL,ENDRT 68A
1180 FORMAT (1H0,47X,36H SCHEDULE BLOCK TIME ON ONE WAY(HRS)=,F10.1// 68B
224H RATE OF CLIMB( FEET/MIN)=,F10.3,9X,24H CRUISING ALTITUDE( FEET)=, 68C
3 F10.0, 4X,26H RATE OF DESCENT( FEET/MIN)=,F10.3//34H CLIMBING GROUND 68D
4 SPEED(MILES/HOUR)=,F6.2, 3X,27H CRUISING SPEED(MILES/HOUR)=,F7.2,4X 68E
7 H8X PG PG) : 11 4 (NONE UNP) (D-NP UT: QWZ) S=F8.1 #TT) 68F
C****
766 PRINT 1150, (ALTAB(I),I=1,NDPS) 69
1150 FORMAT (35X, 62H FLIGHT ALTITUDE AND DISTANCE PROFILE IN 1/10 HOUR 70
INCREMENTS. // 4X, 71
2 RH ALTITUDE //( 9F10.0 ) 72
775 PRINT 1160, (DTAB(I),I=1,NDPS) 73
1160 FORMAT (1H0, 3X, 80H DISTANCE / / 1 8F10.2 ) 74
1004 RIK = RLODATA / 10. 75
1006 PRINT 1170, PDIST , BLK 76
1170 FORMAT (1H0, 3X, 30H TOTAL INPUT PROFILE DISTANCE = ,F10.2, 77
12X,13H STATUTE MILES // 4X, 19H FLIGHT PROFILE TIME, 10X, 1H, F10.2 78
2,2X, 16H HOURS IN THE AIR ) 79
C**** PRINT OUT GREAT CIRCLE PATH VALUES. 103
1016 PRINT 1050, DIST,CRSANG,XLAT1, XLAT2, LONG2 104
1050 FORMAT (1H1,2X,37H COMPUTED GREAT CIRCLE LEG DISTANCE = ,F10.1,5X, 105
127H THE INITIAL COURSE ANGLE = ,F10.3// 106
23X,21H LEG START LATITUDE = ,F7.2,5X,22H LEG START LONGITUDE = , 107
3F7.2//3X,18H LEG END LATITUDE = ,3X, 108
4 F7.2,5X,19H LEG END LONGITUDE =,3X,F7.2 ) 109
C****
1036 SUMX=0.0 110
1037 DO 100 I = 1 , NDPS D 100 112
1041 IFLR = IFLR+1 113
C**** CALCULATE LAT.+LONG. OF FLIGHT PATH INCREMENTS IN GEOGRAPHIC COORDS 114
C**** NOTE THAT THE MIDPOINT OF THE 0.1 HOUR INTERVAL IS USED TO COMPUTE 115
C**** POSITION AND DISE. 116
1042 IF (IFLR .GT. 1) GO TO 15 B 15 117
1045 X= 0.5 *DTAB(IFLR) 118
1047 GO TO 20 G 20 119
1047 15 X= 0.5*(DTAB(IFLR)+DTAB(IFLR-1)) 120
1053 20 CONTINUE C 20 121
1053 SUMX=SUMX+X 122
C**** THE RADIUS OF THE EARTH IS 3956 STATUTE MILES. 122A
1055 COSL2 =COS(SUMX/3956.)*CNLAT1+SIN(SUMX/3956.)*SNLAT1*COSC 123

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1070 SINA =SIN(SIUMX/3956.)*SINC /((1.-COSL2 *COSL2 )**.5) 124
1103 COSNA =(COS(SIUMX/3956.1-CNLAT1+COSL2) /((SNLAT1*(1.-COSL2 *COSL2
11**5) 126
-----
C**** DETERMINE DIRECTION OF TRAVEL IN ORDER TO GET NEW LONGITUDE. 127
IF (LONG2 - LONG1) 30,35,35 B 303535
1120 30 CONTINUE C 30 129
1123 LONG = LONG1 - ATAN2(SINA ,COSNA) *57.2958 130
1130 GO TO 40 G 40 131
1131 35 CONTINUE C 35 132
1131 LONG = LONG1 + ATAN2(SINA ,COSNA )*57.2958 133
1136 40 CONTINUE C 40 134
1136 LAT = ATAN2((1. - COSL2 *COSL2 )**.5,COSL2 )*57.2958 135
1147 LAT = 90. - LAT 136
C**** COMPUTE THE NEW PRESENT POSITION COURSE ANGLE. THE DESTINATION FOR 136A
C**** EACH CALCULATION IS STILL THE AIRPORT AT LAT2 AND LONG2 READ BY 136B
C**** CARD NO. 86. THE CURRENT POSITION LATITUDES, LONGITUDES AND COURSE 136C
C**** ANGLES ARE STORED IN THE XI(300,3) MATRIX. 136D
1151 LAT1 = LAT 136E
1151 LAT2 = LAT2 136F
1153 SNLAT11= SIN(LAT1/57.2958) 136G
1156 CNLAT11= COS(LAT1/57.2958) 136H
1162 SNLAT22=SIN(LAT2/57.2958) 136I
1166 CNLAT22= COS(LAT2/57.2958) 136J
1172 CNLGDIFF= COS(ARS(LONG2- LONG1)/57.2958) 136K
1200 COSAA =CNLAT11*CNLAT22+SNLAT11*SNLAT22*CNLGDIFF 136L
1204 DISTT = 3956.*ATAN(((1.-COSAA *COSAA) **.5)/COSAA) 136M
1217 SINCC=SNLAT22*(1.-CNLGDIFF*CNLGDIFF)**.5/((1.-COSAA*COSAA)**.5) 136N
1231 COSCC=(CNLAT22-COSAA*CNLAT11)/((1.-COSAA*COSAA)**.5*SNLAT11) 136O
1240 CRSANG =57.2958*ATAN2(SINCC ,COSCC ) 136P
1243 IF(LONG2-LONG1<43,43 136P1
1246 42 CRSANG=360-CRSANG 136P2
C**** COMPUTE ABSOLUTE VALUE OF THE GEOMAGNETIC LATITUDE. THIS ASSUMES 136Q
C**** THE SOUTH MAGNETIC POLE IS LOCATED IN THE NORTHERN HEMISPHERE NEAR THE 137
C**** NORTH GEOGRAPHIC POLE AT LATITUDE 78.5 NORTH AND LONGITUDE 68.9 WEST. 137A
C**** THE SOUTHERN GEOMAGNETIC HEMISPHERES IS SYMMETRICAL TO THE NORTHERN GEO-138
C**** MAGNETIC HEMISPHERE. 139
1251 43 Z = COS(LAT/57.2958)*SNZT+COS((LONG + 68.9)/57.2958) + SIN(LAT/ 140
1 57.2958)*CNZT 141
1272 LAMBDA(I) = 57.2958*ARS(ATAN(Z/((1. - Z*Z)**.5))) 142
1305 XI(I,1) = LAT 143
1307 XI(I,2) = LONG 144
1310 XI(I,3) = CRSANG 144A
C**** CONVERT FLIGHT PATH ALTITUDE FOR THIS INCREMENT TO MASS OF AIR OVERHEAD.
1312 IF (IFLB .GT. 1) GO TO 45 B 45 146
1315 ALT = 0.5*ALTTAB(IFLB) 147
1317 GO TO 50 148
1317 45 ALT = 0.5*(ALTTAB(IFLB) + ALTTAB(IFLB-1)) 149
1323 50 CONTINUE C 50 150
1323 LNTALT = TAB(I,ALT, FTAB, LNTTAB, 1, 18) 151
1327 TALT(I) = EXP(LNTALT) 152
C**** LOOK UP THE NO. OF ION PAIRS FOR THIS GEOMAG. LAT. + ALTITUDE. 153
1333 IPAIRS = TAB(I2(LAMBDA(I),TALT(I),LTAB,TALTAB,IPTAB,1,1,11,15,11,15 154
1) 155
C**** LOOK UP THE NEUTRON FLUX FOR THIS GEOMAG. LAT. + ALTITUDE. 155A
1346 FLUXN = TAB(I2(LAMBDA(I),TALT(I),LTAB,TALTAB,NFTAB,1,1,11,15,11,15 155B
1) 155C

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C**** CONVERT TO MILLIRADS/HOUR                      156
C**** IDOSE(NDPS,K) ARRAY OF INCREMENTAL DOSE RATES FROM CHARGED PAR- 156A
C**** TICLES AND GAMMA RAY                          156B
C**** NDOSE(NDPS,K) ARRAY OF INCREMENTAL DOSE RATES FROM NEUTRONS 156C
C**** TDOSF(NDPS,K) ARRAY OF INCREMENTAL TOTAL DOSE RATES          156D
C**** K=1 CORRESPONDS TO THE SOLAR MINIMUM CONDITION              156F
C**** K=2 CORRESPONDS TO THE SOLAR AVERAGE CONDITION             156F
1364 IDOSE(I,1) = IPATRS*XX                      157
1365 NDOSE(I,1) = FLUXN*XX                      157A
1367 TDOSF(I,1) = IDOSE(I,1) + NDOSE(I,1)        157B
C**** COMPUTE INCREMENT AND CUMULATIVE DOSE IN MILLIRADS IN ARRAYS- 158
C**** XDOSF(NDPS,J) FOR CHARGED PARTICLES AND GAMMA RAYS          158A
C**** XDOSF(NDPS,J) FOR NEUTRONS                                158B
C**** TXDOSF(NDPS,J) FOR TOTAL                                    158C
C**** J=1 CORRESPONDS TO INCREMENTAL DOSE FOR THE SOLAR MINIMUM CONDITION 158D
C**** J=2 CORRESPONDS TO CUMULATIVE DOSE FOR THE SOLAR MINIM. CONDITION 158E
C**** J=3 CORRESPONDS TO INCREMENTAL DOSE FOR THE SOLAR AVER. CONDITION 158F
C**** J=4 CORRESPONDS TO CUMULATIVE DOSE FOR THE SOLAR AVER. CONDITION 158G
1371 XDOSF(I,1) = IDOSE(I,1)*0.1                159
1372 XDOSF(I,1) = XDOSF(I,1) * 0.1              159A
1374 TXDOSF(I,1) = XDOSF(I,1) + XDOSF(I,1)      159B
1376 IF (I.GT.1) GO TO 80                        B 80 160
1402 XDOSF(I,2) = XDOSF(I,1)                    161
1403 XDOSF(I,2) = XDOSF(I,1)                    161A
1404 TXDOSF(I,2) = TXDOSF(I,1)                  161B
1406 GO TO 85                                    G 85 162
1407 80 CONTINUE                                C 80 163
1411 XDOSF(I,2) = XDOSF(I,1) + XDOSF(I-1,2)    164
1412 XDOSF(I,2) = XDOSF(I,2) + XDOSF(I-1,2)    164A
1415 TXDOSF(I,2) = TXDOSF(I,2) + XDOSF(I,2)    164B
1417 85 CONTINUE                                C 85 165
C**** COMPUTE SOLAR AVERAGE MILLIRAD/HOUR DOSE 166
1417 RATIO=TBLUZ(LAMBDA(I),TALT(I),LTAB,TALTB,SOLRAT,1,1,11,15,11,15) 167
1435 IDOSF(I,2) = IDOSF(I,1)*RATIO              168
1436 NDOSE(I,2) = NDOSE(I,1)*RATIO              168A
1440 TDOSF(I,2) = TDOSF(I,1)*RATIO              168B
C**** COMPUTE INCREMENT AND CUMULATIVE DOSE IN MILLIRADS 169
1441 XDOSF(I,3) = IDOSF(I,2)*0.1                180
1443 XDOSF(I,3) = XDOSF(I,2)*0.1                180A
1445 TXDOSF(I,3) = XDOSF(I,3) + XDOSF(I,3)      180B
1447 IF (I.GT.1) GO TO 90                        B 90 181
1454 XDOSF(I,4) = XDOSF(I,3)                    182
1455 XDOSF(I,4) = XDOSF(I,3)                    182A
1457 TXDOSF(I,4) = XDOSF(I,4) + XDOSF(I,4)      182B
1461 GO TO 95                                    G 95 183
1461 90 CONTINUE                                C 90 184
1463 XDOSF(I,4) = XDOSF(I,3) + XDOSF(I-1,4)    185
1464 XDOSF(I,4) = XDOSF(I,4) + XDOSF(I-1,4)    185A
1467 TXDOSF(I,4) = XDOSF(I,4) + XDOSF(I,4)    185B
1471 95 CONTINUE                                C 95 186
1471 100 CONTINUE                               C 100 187
C****
C**** PRINT OUT LEG INCREMENT RESULTS                      188
C****
C****
1474 PRINT 1060, ((XI(I,1),XI(I,2),XI(I,3),LAMBDA(I),TALT(I),

```

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11DOSE(1,1),1DOSE(1,2),NDDOSE(1,1),NDDOSE(1,2),TDOSE(1,1),
2TDOSE(1,2),I=1,NDPS)
1060 FORMAT(1H0,2X,4HLAT.,4X,5HLONG.,3X,6HCDIRSF,3X,7HGEOMAG.,3X,
16H4THOS.,3X,27HCHARGED PARTICLES AND GAMMA,11X,8HNEUTRONS,17X,
215HTOTAL DOSE RATE,/,19X,5HANGLE,6X,4HLAT.,4X,5HDEPTH,7X,20HDOSE R
3ATE (MREMS/HR),9X,20HDOSE RATE (MREMS/HR),9X,20HDOSE RATE (MREMS/HR
4R1,/,38X,6HGR/SQ.,3X,10HSOLAR MIN.,5X,10HSOLAR AVG.,5X,10HSOLAR M
5IN.,5X,
6 10HSOLAR AVG.,4X,10HSOLAR MIN.,4X,10HSOLAR AVG.,/,40X,3HCM.,//
7(11X,51F7.2,2X),6(F8.6,7X))
C**** ACCUMULATE FLIGHT DOSE
C**** SOLMIN,SOLMINN,SOLMINT - FLIGHT DOSE FROM CHARGED PARTICLES AND
C**** GAMMA RAYS, NEUTRONS, BOTH FOR SOLAR MINIMUM CONDITIONS
C**** SOLAVE, SOLAVEN, SOLAVET - THE SAME FOR SOLAR AVERAGE CONDITIONS
1551 SOLMIN = SOLMIN + XDOS (NDPS,2)
1552 SOLAVE = SOLAVE + XDOS (NDPS,4)
1554 SOLMINN = SOLMINN + XDOS(NDPS,2)
1555 SOLAVEN = SOLAVEN + XDOS(NDPS,4)
1557 SOLMINT = SOLMINN + SOLMIN
1560 SOLAVET = SOLAVEN + SOLAVE
1562 400 CONTINUE
C**** CALCULATE THE AVERAGE DOSE PER FLIGHT PROFILE HOUR
C**** ADFFH, ADFFHN, ADFFMT - AVERAGE DOSE PER FLIGHT PROFILE HOUR FROM
C**** CHARGED PARTICLES AND GAMMA RAYS, NEUTRONS, BOTH FOR SOLAR MINI-
C**** MUM CONDITIONS
C**** ALFFH, ADFFHN, ADFFAT - THE SAME FOR SOLAR AVERAGE CONDITIONS
1564 ADFFH = SOLMIN/BLK
1565 ADFFH = SOLAVE/BLK
1567 ADFFHN = SOLMINN/BLK
1570 ADFFHN = SOLAVEN/BLK
1572 ADFFMT = ACFHM + ADFFHM
1573 ADFFAT = ADFFH + ADFFHN
C**** CALCULATE THE AVERAGE DOSE PER FLIGHT BLOCK TIME FOR 300 HRS.
C**** ADRTM, ADRTMN, ADRTMT - AVERAGE DOSE PER BLOCK TIME HOUR FROM CHARGED
C**** PARTICLES AND GAMMA RAYS, NEUTRONS, BOTH FOR SOLAR MINIMUM
C**** CONDITIONS
C**** ADRTA, ADRTAN, ADRTAT - THE SAME FOR SOLAR AVERAGE CONDITIONS
1575 ADRTM = SOLMIN/(BLK + 0.25)
1577 ADRTA = SOLAVE/(BLK + 0.25)
1601 ADRTMN = SOLMINN/(BLK + 0.25)
1602 ADRTAN = SOLAVEN/(BLK + 0.25)
1604 ADRTMT = ADRTM + ADRTMN
1605 ADRTAT = ADRTA + ADRTAN
C****
1610 PRINT 1070, SOLMIN,SOLMINN,SOLMINT, SOLAVE,SOLAVEN,SOLAVET,
2ADFFH,ADFFHN,ADFFMT, ADFFH,ADFFHN,ADFFAT, ADRTM,ADRTMN,ADRTMT,
3ADRTA,ADRTAN,ADRTAT
1070 FORMAT(1H1,/,49X,13HCHARGED PART.,5X,8HNEUTRONS,8X,5HTOTAL,/,
249X,9HGAMMA RAY,/,
3 1X,48HTOTAL FLIGHT DOSE FOR SOLAR MINIMUM CONDITIONS =, 3
AF13.5, 30H MILLIREMS PER FLIGHT PROFILE // 49H TOTAL FLIGHT DOS
RE FOR SOLAR AVERAGE CONDITIONS =,3F13.5, 30H MILLIREM
GS PER FLIGHT PROFILE // 49H AVG. DOSE / FLIGHT PROFILE HOUR (SOLA
DR MIN.) =,3F13.5, 20H MILLIREMS PER HOUR // 49H AVG. DOSE / FL
EIGHT PROFILE HOUR (SOLAR AVG.) =,3F13.5, 20H MILLIREMS PER HOUR
FR // 49H AVG. DOSE / BLOCK TIME HOUR (SOLAR MINIMUM) =,3F13.5,

```

G31H MILLIREMS / (BLOCK TIME) HOUR // 49H AVG. DOSE / BLOCK TIME H 222
 HOUR (SOLAR AVERAGE) = ,3F13.5,32H MILLIREMS / (BLOCK TIME) HOUR 223
 IR, //IX, 42H EG BLOCK TIME = PROFILE TIME + 0.25 HOURS) 224

C****
 C**** SEE IF THERE IS ANOTHER PROBLEM. IF SO --PROCEED. IF NOT EXIT. 231
 1657 GO TO 1 G 1 232
 1660 999 CALL EXIT E 999233
 1661 END 234

PROGRAM LENGTH INCLUDING I/O BUFFERS

40227

STATEMENT FUNCTION REFERENCES

LOCATION GEN TAG SYM TAG REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000325	L00137	1	000414 000450 000453 001660
000351	L00160	2	000453
000360	L00164	3	000447
000606	L00267	12	NONE
001050	L00377	15	001044
001054	L00400	20	001047
001124	L00413	30	NONE
001132	L00416	35	001123
001137	L00420	40	001131
001247	L00454	42	NONE
001252	L00455	43	001246
001320	L00474	45	001314
001324	L00475	50	001317
000611	L00770	53	000605
001410	L00522	80	001400
001420	L00525	85	001407
001462	L00544	90	001452
001472	L00547	95	001461
001472	L00547	100	001461
000735	L00337	101	NONE
000745	L00345	102	000731 000733
000741	L00342	103	000734
000637	L00275	104	000740 000744
000322	L00135	300	000304
000264	L00117	305	000257
000260	L00114	306	000256
000305	L00130	310	000303
000351	L00160	330	000453
000401	L00202	340	000375
000451	L00221	345	000402 000403
001563	L00564	400	NONE
000376	L00200	401	000364
000404	L00203	402	NONE
000415	L00207	403	NONE

****	C****				
	C****				
	C****				
	C****				
	C****				
		FUNCTION TBLU2(X1,Y1,X,Y,F2,NDUM1,NDUM2,NX,NY,MX,MY)		235	
	C****				
	C****	LINEAR INTERPOLATION SUBROUTINE FOR 2 DIMENSIONAL NON-EQUALLY/		236.	
	C****	SPACED INTERVALS. USES BINARY SEARCH SUBROUTINE BAINS.		237	
		DIMENSION X(1),Y(1),F2(MX,MY)		238	
	C****	OBTAIN NEAREST POINTS IN TABLE TO (X1,Y1).		239	
		CALL BAINS(X,NX,X1,KX,K1X)	G	240	
21		CALL BAINS(Y,NY,Y1,KY,K1Y)	G	241	
31		TBLU2= -0.		242	
32		IF(KX .EQ. 0) GO TO 98	B 98	243	
37		IF(KY .EQ. 0) GO TO 98	B 98	244	
40		IF(K1X .NE. 0) GO TO 10	B 10	245	
41		FX1= F2(KX,KY)		246	
45		IF(K1Y .EQ. 0) GO TO 60	B 60	247	
47		FX2= F2(KX,K1Y)		248	
52		GO TO 50		249	
53	10	CONTINUE	C 10	250	
53		FX1= F2(KX,KY)+(X1-X(KX))*(F2(K1X,KY)-F2(KX,KY))/		251	
		(X(K1X)-X(KX))		252	
74		IF(K1Y .EQ. 0) GO TO 60	B 60	253	
75		FX2= F2(KX,K1Y)+(X1-X(KX))*(F2(K1X,K1Y)-F2(KX,K1Y))/		254	
		(X(K1X)-X(KX))		255	
116	50	CONTINUE	C 50	256	
116		TBLU2= FX1+(Y1-Y(KY))*(FX2-FX1)/(Y(K1Y)-Y(KY))		257	
126		RETURN	R	258	
127	60	CONTINUE	C 60	259	
127		TBLU2= FX1		260	
131		RETURN	R	261	
131	98	CONTINUE	C 98	262	
	C****				
131		PRINT 998, X1,Y1		263	
	998	FORMAT(*0\$\$\$ ERROR EXIT FROM TBLU2, THE POINT (* F6.2, *,*,		264	
		\$ F6.2, *)*, 2X, *DOES NOT LIE WITHIN TABLE LIMITS*)		265	
	C****				
146		RETURN	R	266	
147		END	E	267	

SUBPROGRAM LENGTH

00226

STATEMENT FUNCTION REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
----------	---------	---------	------------

STATEMENT NUMBER REFERENCES

LOCATION	GFN TAG	SYM TAG	REFERENCES
000054	L00037	10	000041

C****

C****

FUNCTION TRLUI(X,XTAB,FTB,NDUM,NX)

268

C****

LINEAR INTERPOLATION SUBROUTINE FOR 1-DIMENSIONAL NON-UNIFORM INTERVALS.

DIMENSION XTAB(1),FTB(1)

270

C****

OBTAIN VALUE CLOSEST TO X BY BINARY SEARCH.

271

CALL BAINS(XTAB,NX,X,K,K1)

G

272

C****

IF POINT OUTSIDE TABLE, TAKE ERROR EXIT.

273

12

TRLUI= -0.

274

13

IF(K.EQ. 0) GO TO 99

B

99 275

20

IF(K1.NE. 0) GO TO 10

B

10 276

C****

POINT IS A TABLE VALUE.

278

21

TRLUI= FTB(K)

278

22

RETURN

R

280

23

10 CONTINUE

C

10 281

23

TRLUI= FTB(K)+(X-XTAB(K))*(FTB(K1)-FTB(K))/
(XTAB(K1)-XTAB(K))

282

34

RETURN

R

284

34

99 CONTINUE

C

99 285

C****

34

PRINT 999 , X

286

999 FORMAT('0\$\$\$ \$ ERROR EXIT FROM TRLUI, THE POINT X= *, F6.2,

287

\$ *DOES NOT LIE WITHIN TABLE LIMITS*)

288

C****

45

RETURN

R

289

47

END

290

SUBPROGRAM LENGTH

00105

STATEMENT FUNCTION REFERENCES

LOCATION GEN TAG SYM TAG REFERENCES

STATEMENT NUMBER REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000024	L00022	10	000021
000035	L00024	99	000020
000056	C00004	999	000035

BLOCK NAMES AND LENGTHS

VARIABLE REFERENCES

LOCATION	GEN TAG	SYM TAG	REFERENCES
000103	V00007	K	000010 000017 000024
000104	V00010	K1	000011 000020 000025
000102	V00006	TRLUI	000017 000022 000034 000046

START OF CONSTANTS-000052

TEMPS--000071

INDIRECTS-000101

C****
C****

SUBROUTINE BAINS(SLIST, MM, Z, K, K1)

291

C****

DIMENSION SLIST(1)

292

C**** SLIST=TABLE, WHICH MUST BE MONOTONICALLY INCREASING

293

C**** OR MONOTONICALLY DECREASING

294

C**** M= NUMBER OF ENTRIES IN SLIST

295

C**** Z=VALUE TO BE FOUND IN TABLE

296

C**** K=SUBSCRIPT OF VALUE IN TABLE NEAREST TO Z

297

C**** PROGRAM RETURNS K = 0 IF Z IF OFF TABLE.

298

M=MM

299

7

K1=

0

300

10

L1=1

301

11

L2=M

302

12

K=1

303

C**** CHECK IF MONOTONICALLY DECREASING. IF SO, GO TO 50

304

13

IF(SLIST(1) .GT. SLIST(2)) GO TO 50

B 50 305

17

IF(Z-SLIST(1)) 1,15,3

R 1,15,3

21

3 K=M

307

22

IF(SLIST(M)-Z) 1,15,9

B 1,15,9

25

9 K=M/2

309

26

IF(Z-SLIST(K)) 20, 15, 29

B 201529

31

20 L2=K

312

32

GO TO 23

G 23 313

33

29 L1=K

314

34

IF(L2-L1-1) 1,14,25

R1,14,25

37

25 M=L1+L2

316

41

GO TO 9

G 9 317

42

14 CONTINUE

C 14 318

42

K=

L1

319

43

IF(2.*Z .GT. (SLIST(L1) + SLIST(L2))) K=L2

B 320

51

K1=

L2

321

52

IF(K .EQ. L2)

K1=L1

B 322

54

GO TO 15

G 15 323

55

1 K = 0

333

56

15 RETURN

R 334

C**** PROCEDURE FOR MONOTONICALLY DECREASING SEQUENCE.

335

57

50 CONTINUE

C 50 336

57

IF(Z-SLIST(1)) 55,15,1

R55,15,1

61

55 CONTINUE

C 55 338

61

K=

M

339

62

IF(SLIST(M)-Z) 60,15,1

B701565

65

60 CONTINUE

C60 341

65

K=

M/2

342

66

IF(Z-SLIST(K)) 70,15,65

B701565

71

65 CONTINUE

C65 344

71

L2=

K

345

72

GO TO 80

G 80 346

73

70 CONTINUE

C 70 347

73

L1=K

348

74

80 CONTINUE

C80 349

74

IF(L2-L1-1) 1,90,85

B1,90,85

77

85 CONTINUE

C 85 351

77

M=

L1+L2

352

101

GO TO 60

G 60 353

AIR DEPTH TABLE (GM/CM**2) TALTAB.

	30	40	50	59	60	70	80	90	100	120	140	200	245	300	1034
GEOMAGNETIC LATITUDE	ION PAIR DATA (ION PAIRS / CM**3 / SEC) IPTAB														
88	445.0	430.0	414.0	401.5	399.0	383.0	366.0	349.0	332.0	298.0	266.0	181.0	136.0	95.0	11.4
81	445.0	430.0	414.0	401.5	399.0	383.0	366.0	349.0	332.0	298.0	266.0	181.0	136.0	95.0	11.4
65	444.0	430.0	414.0	401.5	399.0	383.0	368.0	349.0	332.0	298.0	266.0	181.0	136.0	95.0	11.3
56	411.8	404.3	394.4	384.0	382.0	369.0	354.8	339.4	325.0	292.3	261.5	181.0	136.0	95.0	11.2
53	325.0	333.0	340.0	335.8	335.0	330.0	312.5	308.0	300.0	285.0	264.0	181.0	134.0	95.0	11.1
50	300.0	305.0	310.0	306.0	305.0	300.0	290.0	285.0	280.0	255.0	230.0	173.0	126.0	95.0	11.0
40	185.0	195.0	208.0	208.0	208.0	208.0	208.0	208.0	208.0	195.0	185.0	135.0	103.0	75.0	10.6
30	127.6	137.0	145.0	149.0	150.2	153.8	155.8	156.0	154.6	149.7	142.2	111.3	87.0	66.6	10.4
20	85.0	92.0	98.0	99.0	100.0	102.0	105.0	107.0	110.0	108.0	105.0	80.0	77.0	60.0	10.0
10	70.0	75.0	82.0	84.0	85.0	89.0	93.6	95.0	100.0	98.0	95.0	60.0	68.8	50.0	10.0
0	66.3	73.8	80.0	83.5	84.8	88.5	91.1	92.6	93.5	93.4	90.5	75.0	62.3	48.0	10.0

AIR DEPTH TABLE (GM/CM**2) TALTAB.

30 40 50 59 60 70 80 90 100 120 140 200 245 300 1034

GEOMAGNETIC SOLAR AVERAGE ATMOSPHERIC CORRECTION FACTOR (GM/CM**2) SOLRAT.

LATITUDE

88	.750	.765	.780	.788	.790	.800	.810	.820	.830	.840	.850	.880	.895	.910	1.000
81	.751	.766	.782	.789	.790	.800	.810	.820	.830	.840	.850	.880	.895	.910	1.000
65	.755	.770	.785	.793	.794	.801	.811	.820	.830	.840	.851	.881	.896	.910	1.000
56	.774	.783	.795	.800	.801	.807	.816	.824	.832	.842	.852	.881	.897	.911	1.000
53	.786	.793	.803	.806	.807	.812	.820	.826	.834	.842	.853	.881	.897	.911	1.000
50	.801	.807	.815	.817	.817	.819	.826	.831	.838	.845	.855	.884	.898	.911	1.000
40	.897	.900	.904	.906	.906	.907	.910	.912	.914	.914	.916	.920	.926	.931	1.000
30	.936	.938	.941	.943	.943	.944	.946	.946	.948	.948	.949	.951	.951	.951	1.000
20	.959	.961	.962	.963	.963	.964	.966	.967	.968	.968	.968	.968	.968	.968	1.000
10	.969	.971	.972	.973	.973	.973	.975	.976	.976	.977	.978	.979	.979	.979	1.000
0	.974	.976	.977	.978	.978	.979	.980	.981	.982	.982	.983	.984	.984	.984	1.000

LOG OF AIR DEPTH VALUES LNTTAB.

6.94022	6.69827	6.44572	6.17794	5.89990	5.60212	5.29330	4.97673	4.67283
4.35157	4.03777	3.72810	3.41773	3.11352	2.81541	2.51770	2.21485	1.92279

ALTITUDE IN FEET FTAB.

0	6560	13100	19700	26200	32800	39400	45900	52500
59100	65600	72200	78700	85300	91900	98400	105000	112000

AIR DEPTH TABLE (GM/CM**2) TALTAB.

30	40	50	59	60	70	80	90	100	120	140	200	245	300	1034
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GEOMAGNETIC
LATITUDE

NEUTRON FLUX DATA (N/CM**2/SEC) NFTAB

88	5.66	4.65	4.06	3.68	3.63	3.30	3.04	2.79	2.54	2.28	2.03	1.44	1.10	.80	0.00
81	5.66	4.65	4.06	3.68	3.63	3.30	3.04	2.79	2.54	2.28	2.03	1.44	1.10	.80	0.00
65	5.66	4.65	4.06	3.68	3.63	3.30	3.04	2.79	2.54	2.28	2.03	1.44	1.10	.80	0.00
56	5.55	4.56	3.98	3.61	3.56	3.23	2.98	2.73	2.49	2.23	1.99	1.41	1.08	.78	0.00
53	5.38	4.42	3.86	3.50	3.45	3.13	2.89	2.65	2.41	2.17	1.93	1.37	1.05	.76	0.00
50	5.26	4.32	3.78	3.42	3.38	3.07	2.83	2.59	2.36	2.19	1.89	1.34	1.02	.74	0.00
40	4.02	3.30	2.88	2.61	2.58	2.34	2.16	1.98	1.80	1.62	1.44	1.02	.78	.57	0.00
30	2.66	2.19	1.91	1.73	1.71	1.55	1.43	1.31	1.19	1.07	.95	.68	.52	.38	0.00
20	1.92	1.58	1.38	1.25	1.23	1.12	1.03	.95	.86	.78	.69	.49	.37	.27	0.00
10	1.70	1.39	1.22	1.10	1.09	.99	.91	.84	.76	.68	.61	.43	.33	.24	0.00
0	1.53	1.26	1.10	.99	.98	.89	.82	.75	.69	.62	.55	.39	.30	.22	0.00

1
3
1

LIST OF AIRPORTS

CODE	NAME OF AIRPORT	LATITUDE	LONGITUDE	AIRPORT
ABD		30.20	48.16	ABADAN, IRAN
ABQ		35.05	-106.40	ALBUQUERQUE, N. M., USA
ACA		16.51	-99.55	ACAPULCO, MEXICO
ACC		5.33	-1.13	ACCRA, GHANA
ACF		28.57	-13.32	ARRECIFE, CANARY IS.
ADD		9.00	38.50	ADDIS ABABA, ETHIOPIA
ADL		-34.58	138.32	ADELAIDE, S. AUSTRALIA
AGA		30.26	-9.36	AGADIR, MOROCCO
AGP		34.43	-4.25	MALAGA, SPAIN
AGR		27.12	77.59	AGRA, INDIA
AJA		41.55	8.44	AJACCIO, CORSICA
AKL		-36.53	174.45	AUCKLAND, NEW ZEALAND
ALA		43.15	76.57	ALMA-ATA, USSR
ALG		36.42	3.08	ALGERS, ALGERIA
AMA		35.13	-101.49	AMARILLO, TEXAS, USA
AMM		31.57	35.56	AMMAN, JORDAN
AMS		52.17	4.40	AMSTERDAM, NETHERLANDS
ANC		61.13	-149.53	ANCHORAGE, ALASKA, USA.
APW		-13.50	-171.44	APIA, W. SAMOA
ASU		-25.16	-57.40	ASUNCION, PARAGUAY
ATH		37.98	23.43	ATHENS, GREECE
ATL		33.45	-84.23	ATLANTA, GA., USA
AUH		23.37	58.35	ABU DHABI, TRUCIAL OMAN (MUSCAT, MUSQAT)
AUS		30.16	-97.45	AUSTIN, TEX., USA
BAH		26.00	50.30	BAHRAIN IS., ARABIAN GULF
BAK		40.23	49.51	BAKU, USSR
BAL		39.11	-76.40	BALTIMORE, MD., USA
BCN		41.23	2.11	BARCELONA, SPAIN
BDA		32.20	-64.45	BERMUDA, ATLANTIC OCEAN
BDR		13.10	-59.32	BARRADOS, WEST INDIES
BEG		44.50	20.30	BELGRADE, YUGOSLAVIA
BER		52.31	13.24	BERLIN, GER. FED. REP.
BEY		33.49	35.30	BEIRUT, LEBANON
BGH		33.20	44.26	BAGHDAD, IRAQ
BHX		52.30	-1.50	BIRMINGHAM, ENGLAND
BHZ		-19.55	-43.56	BELO HORIZONTE, BRAZIL
BJD		47.30	19.05	BUDAPEST, HUNGARY
BMA		59.21	17.55	STOCKHOLM, SWEDEN-BROMMA ARPT
BNE		-27.27	153.11	BRISBANE-EAGLE FARM ARPT, QUEENSL., AUSTRALIA
BOR		-16.30	-151.45	BORA-BORA, POLYNESIA
BOT		33.28	-95.13	BOGOTA, COLOMBIA
BOM		19.05	72.52	BOMBAY, INDIA-SANTA CRUZ ARPT
BOS		42.21	-71.04	BOSTON, MASS., USA
BPL		40.26	30.31	KIEV, USSR
BRH		50.54	4.30	BRUSSELS, BELGIUM
BRS		51.27	-2.35	BRISTOL, ENGLAND
BSE		47.33	7.25	BASEL, SWITZERLAND (BALE)
BTH		13.26	-16.39	BATHURST, GAMBIA
BTS		48.10	17.10	BRATISLAVA, CZECHOSLOVAKIA
BUE		-34.49	-58.32	BUENOS AIRES-EZEIZA AEROPORTO, ARGENTINA
BUF		42.52	-76.43	BUFFALO, N.Y., USA
BUR		44.24	26.06	BUCHAREST, ROMANIA
BUR		34.12	-118.18	BURBANK, CALIF., USA
BZV		-4.14	15.14	BRAZZAVILLE, CONGO REP.

CAI	30.08	31.24	CAIRO-INT. ARPT. ARAB REP. OF EGYPT
CAN	23.06	113.16	CANTON, CHINA (GUANGZHOU, ZHG)
CAS	33.39	-7.35	CASARLANCA, MOROCCO
CCU	44.50	-7.34	CALCUTTA, INDIA
CHR	-41.42	172.38	CHRISTCHURCH, N.Z.
CIA	41.48	12.36	ROME-CIAMPINI ARPT, ITALY
CIT	34.08	-118.08	CALTECH
CMB	6.56	79.51	COLOMBO, CEYLON
CNS	-16.51	145.43	CAIRNS, QUEENS. AUSTRALIA
COK	9.58	76.15	COCHIN, INDIA
CPH	55.40	12.35	COPENHAGEN
CPY	55.40	12.35	COPENHAGEN, DENMARK
CPT	-14.02	18.28	CAPTOWN-MAIAN ARPT, REP. S. AFRICA
CSD	-34.52	-56.02	MONTEVIDEO-CARRASCO AEROPUERTO, URUGUAY
CIH	53.35	-64.27	CHURCHILL FALLS, N.F.E., CANADA
CVG	39.06	84.31	CINCINNATI, OHIO, USA
CVQ	-24.53	113.40	CARNARVON, W. AUSTRALIA
DAC	23.43	90.25	DACCA, BANGLADESH
DSM	33.30	36.19	DAMASCUS-MEZZE ARPT, ARAB REP. OF SYRIA
DAR	12.23	130.44	DAR ES SALAAM, TANZANIA
DCA	42.19	-81.25	WASHINGTON DC-NATIONAL ARPT, USA
DEL	28.35	77.07	DELHI-PALAM INT. ARPT, INDIA
OCN	39.43	-105.01	DENVER, COLO., USA
DET	42.20	-83.03	DETROIT, MICH., USA
DHA	26.18	50.08	DHAHRAN, SAUDI ARABIA (AZ-ZAHARAN)
DKR	14.40	-17.26	DAKAR, SENEGAL
DLA	4.03	9.42	DMBIALA, CAMEROON
DME	55.25	37.35	MOSCOW, USSR-DOMODEDOVO ARPT
DNI	25.17	51.32	Doha (AD-DAWHAH) QATAR, ARABIA
DRW	-12.28	130.50	DARWIN, NT, AUSTRALIA
DTT	42.13	-83.22	DETROIT-METROPOLITAN WAYNE CO. ARPT., MICH., USA
DTW	42.25	-83.01	DETROIT, MICH-METROPOLITAN APT
DUR	-19.55	30.56	DURBAN, REP OF S. AFRICA
DUR	25.18	55.18	DURAI (DURAYNI), TRUCIAL OMAN
FOR	-19	32.25	KAMPALA, UGANDA (ENTERDE)
FLD	61.14	-149.54	ELMENDORF, AFB, ALASKA, USA
ESR	39.56	32.52	ANKARA-ESENROGA ARPT, TURKEY
EWN	40.10	44.31	EREVAN, ARMENIA, USSR (YFREYAN)
EZE	-34.49	-58.32	BUENOS AIRES-EZEIZA AEROPUERTO, ARGENTINA
FAT	64.51	-147.43	FATIRANKS, ALASKA, USA
FCO	41.46	12.13	ROME-LEONARDO DA VINCI DI FIUMICINO ARPT, ITALY
FIN	-6.35	147.50	FINSCHHAFEN, NEW GUINEA
FNC	32.38	-16.54	FINCHAL, MADEIRA IS.
FNG	39.00	125.47	PYONGYANG, N. KOREA
FRA	50.02	8.33	FRANKFURT, GERMAN FEDERAL REP.
KUL	3.09	101.43	KUALA LUMPUR, MALAYSIA
KWA	9.05	167.20	KWAJALEIN, MARSHALL IS.
KWI	29.30	47.45	KUWAIT, KUWAIT
LAD	-8.48	13.14	LIJANDA, ANGOLA
LAP	24.10	-117.10	LAPAZ, MEXICO
LAS	36.11	-115.08	LAS VEGAS, NEV., USA
LAX	33.56	-118.24	LOS ANGELES-INTERNATIONAL ARPT, CALIF., USA
LBB	33.35	-101.51	LIMBOCK, TEXAS, USA
LNG	48.56	2.26	PARIS, FRANCE-LE BOURGET ARPT
LRZ	-29.55	30.56	DURBAN, REP. S. AFRICA
LGH	51.09	-21	LONDON, ENGLAND-GATWICK ARPT
LHR	51.27	-28	LONDON, ENGLAND-HEATHROW ARPT
LID	60.01	30.17	LENINGRAD, USSR (KOLON'AGI APT)
LHM	21.59	-159.21	LITHIE, KAHAI HAWAII, USA
LIM	-12.03	-77.03	LIMA, PERU
LIN	45.27	9.16	MILAN, ITALY-FORLANINI-LINATE

LIS	30.43	-9.08	LISBON, PORTUGAL
LJU	46.33	14.31	LJUBLJANA, YUGOSLAVIA
LON	51.40	.15	LONDON
LPS	6.37	3.16	LAGOS-IKFJA ARPT, NIGERIA
LPA	28.06	15.24	LAS PALMAS, CANARY IS
LPB	-16.30	-60.09	LA PAZ, BOLIVIA
LPQ	19.52	102.08	LUANG PRABANG, LAOS
LUX	49.37	6.10	LUXEMBOURG, LUXEMBOURG (FINDL)
MAA	11.00	78.15	MADRAS, INDIA
MAD	40.28	-3.34	MADRID, SPAIN (BARAJAS)
MBA	-4.03	39.40	MOMBASA, KENYA
MRJ	18.30	-77.55	MONTGO RAY, JAMAICA
MCT	23.37	58.35	MUSCAT, OMAN (HASQAT)
MOL	22.00	96.05	MADALAY, BIRMA
NDY	28.13	-177.26	MIDWAY ISLAND, PACIFIC OCEAN
NEL	-37.49	144.58	MELBOURNE-TULLAMARINE ARPT, VIC., AUSTRALIA
NLV	6.18	-10.47	MONROVIA, LIBERIA
MMH	-77.50	166.25	MC MURDO, ANTARCTICA
MNL	14.34	121.01	MANILA-INT. ARPT, PHILIPPINES
NDW	55.45	37.42	MOSCOW
MSY	29.58	-90.07	NEW ORLEANS, LA., USA
MVD	-34.53	-56.11	MONTVIDEO, URUGUAY
MHI	-22.16	166.27	MUMBAI, NEW CAL-MAGENTA ARPT
MRP	45.38	8.44	MILAN, ITALY-MAPENSA ARPT
MZT	25.13	-106.25	MAZATLAN, MEXICO
NAN	-17.48	177.25	NANDI, FIJI IS.
NAP	40.51	14.17	NAPLES, ITALY-NAPOLI
NAS	25.05	-77.21	NASSAU, BAHAMAS
NAT	-5.47	-35.13	NATAL, BRAZIL
NRO	-1.17	36.49	NAIROBI, KENYA (ENTERRE)
NCE	43.40	7.14	NICE, FRANCE (COTE D'AZUR)
NLK	-29.03	167.56	NORFOLK, IS. PACIFIC OCEAN
OAK	37.47	-122.13	OAKLAND, CALIF., USA
ODS	46.28	30.44	ODESSA, USSR
GHV	69.15	-53.33	ODHAVN, GREENLAND
GTG	-22.50	-43.15	RIO DE JANEIRO, BRAZIL (AEROPORTO DO GALEAO)
GUM	13.29	144.48	GUAM, MARIANAS (AGANA NAS)
GVA	46.13	6.09	GENEVA-HEYRIN
HAN	21.02	105.51	HANOI, N. VIETNAM
HAV	23.08	-82.22	HAVANA, CUBA
HBA	-42.51	147.19	HOBART-TASMANIA
HEL	60.10	24.58	HELSINKI, FINLAND
HGS	8.30	-13.15	FREETOWN, SIERRA LEONE
HTR	-9.27	159.57	HONTARA, GUADALCANAL, SOLOMON
HKG	22.20	114.12	HONG KONG, BR CROWN COLONY
HLZ	-37.47	175.17	HAMILTON, NEW ZEALAND
HNL	21.20	-157.55	HONOLULU, OAHU HAWAII, USA
HRK	50.00	36.15	KHARKOV, USSR
IAD	38.57	-77.27	WASHINGTON DC-DULLES INTERNATIONAL AIRPORT, USA
IAH	39.59	-95.27	HOUSTON (INTERCONTINENTAL APT) TEXAS, USA
IBZ	38.54	1.26	IBIZA, SPAIN
ICO	34.11	33.23	NICOSIA, CYPRUS
IEV	50.26	30.31	KIEV, USSR
IKT	52.16	104.20	IRKUTSK, USSR
IND	39.46	-86.09	INDIANAPOLIS, IND., USA
IPC	-27.08	-109.23	EASTER ISLAND, PACIFIC OCEAN
ISP	40.44	-73.13	ISLIP, N.Y., USA
IST	40.58	-8.49	ISTANBUL, TURKEY (HAVA ALANI)
ITO	19.43	-155.05	HILO, HAWAII, USA
IXM	9.56	78.08	MADURAI, INDIA
IYK	35.39	-117.49	INYOKERN, CALIF., USA
IZM	38.25	27.09	IZMIR, TURKEY

JRK	37.57	-122.28	BERKELEY, CALIF., USA
JFD	24.30	46.43	RIYADH, SAUDI ARABIA, AR-RIYAD
JFK	40.38	-73.47	NEW YORK, NY-KENNEDY INT ARPT.
JKT	-6.10	106.48	JAKARTA, JAVA, INDONESIA
JLX	50.20	30.31	KIEV, USSR-JULIANI ARPT.
JUN	58.20	-134.27	JUNEAU, ALASKA, USA
KBL	34.30	69.10	KABUL, AFGHANISTAN
KDH	31.32	65.30	KANDAHAR, AFGHANISTAN
KDI	-3.57	122.35	KENDARI, CELEBES, INDONESIA
KEF	64.02	-22.36	REYKJAVIK, ICE. KEFLAVIK ARPT.
KHI	24.51	67.02	KARACHI, W. PAKISTAN
KIE	-6.13	155.38	KIETA, BOUGAINVILLE SOLOMON IS
KIM	-29.43	24.46	KIMBERLEY, REP OF S AFRICA
KIN	18.00	-76.50	KINGSTON, JAMAICA
KNI	26.28	80.20	KANPUR, INDIA
KOA	21.24	-157.44	KONA, KAILUA, HAWAII, USA
KOI	58.59	-2.58	KIRKALL, ORKNEY IS. SCOTLAND
KAK	50.03	19.58	KRAKO, POLAND
KKN	67.51	20.16	KIRUNA, SWEDEN
KRT	15.36	32.32	KHARTOUM, SUDAN
KTM	17.42	85.20	KATHMANDU, NEPAL
QGG	20.54	-156.26	KAHULUI, MAUI HAWAII, USA
OKA	26.22	127.45	OKINAWA, RYUKYU IS. (KADENAI)
OKC	35.29	-97.32	OKLAHOMA CITY, OKLA., USA
OKD	43.30	141.21	SAPPORO, JAPAN (OKADANA ARPT)
OMA	41.16	-95.57	OMAHA, NEB., USA
OME	64.30	-165.24	OME, ALASKA, USA
OMS	55.00	73.24	OMSK, USSR
OPD	41.11	-8.36	OPORTO, PORTUGAL
ORD	41.59	-87.54	CHICAGO, ILL-MARE ARPT, USA
ORY	48.45	2.24	PARIS, FRANCE-ORLY ARPT
OSA	34.47	135.26	OSAKA, JAPAN (KOKUSAI-KUKO)
OSL	59.55	10.45	OSLO, NORWAY
DTP	44.24	26.06	BUCHAREST, ROU-OTOPENI ARPT
OTZ	66.53	-162.39	KUTZEBUE, ALASKA, USA
OVB	55.02	82.55	NOVOSIBIRSK, USSR
PAP	18.32	-72.20	PORT AU PRINCE, HAITI
PAR	48.45	2.24	PARIS-ORLY ARPT, FRANCE
PPX	45.33	-122.36	PORTLAND, ORE., USA
PEK	38.47	116.23	PEKING, PEIPING, CHINA (NANYANGCHANG)
PEK	-31.57	115.58	PERTH, W AUSTRALIA
PHL	39.53	-75.14	PHILADELPHIA, PA., USA
PHX	33.27	-112.05	PHOENIX, ARIZ., USA
PIK	55.30	-4.36	GLASGOW, SCOT-PRESTHICK ARPT
PLZ	-33.58	25.40	PORT ELIZABETH, REP. S. AFRICA
PNI	6.58	158.13	PONAPE, CAROLINES, PAC. OCEAN
POM	-9.20	147.10	PORT MORESBY, PAPUA, N GUINEA
PUN	6.58	158.13	PONAPE, CAROLINES
PQS	10.39	-61.11	PORT OF SPAIN, TRINIDAD
PPG	-14.16	-170.42	PAGO PAGO, SAMOA
PPT	-17.32	-149.34	PAPEETE, TAHITI, FR POLYNESIA
PRG	50.05	14.24	PRAGUE, CZECHOSLOVAKIA
PSA	43.41	10.23	PISA, ITALY
RAB	-4.13	152.11	RABAT, NEW BRITAIN, N. GUINEA
RAK	31.49	-8.30	MARRAKECH, MOROCCO
RAR	-31.14	-159.46	RAROTONGA, COOK IS. S PACIFIC
RBA	34.02	-6.51	RABAT, MOROCCO
RFK	64.02	-22.36	REYKJAVIK, ICELAND
RGN	16.47	96.10	RANGOON, BURMA
RIO	-22.55	-43.10	RIO DE JANEIRO, BRAZIL (SANTOS DUMONT ARPT)
RNL	6.56	79.51	COLOMBO, CEYLON-RATHALANA
RND	-26.08	29.14	JOHANNESBURG, R S AFRICA (JAN SMITS)

RND	39.31	-119.40	RENO, NEV., USA
ROM	41.46	12.13	ROME, ITALY
RAF	35.42	-106.57	SANTA FE, N.M., USA
SAN	32.43	-117.09	SAN DIEGO, CALIF., USA
SAD	21.32	-46.37	SAO PAULO, BRAZIL
SAY	-17.50	31.03	SALISBURY, RHODESIA
SCL	-33.30	-70.40	SANTIAGO, CHILE
SDU	-22.55	-47.10	RIO DE JANEIRO, BRAZIL (SANTOS DUMONT ARPT)
SEA	47.27	-122.18	SEATTLE-TACOMA INT. ARPT, WASHINGTON, USA
SFL	37.32	126.56	SEOUL, REP OF KOREA
SEZ	-4.35	55.40	SEYCHELLES IS., INDIAN OCEAN
SFJ	67.00	-50.59	SNDRE STROMFJORD, GREENLAND
SFO	37.37	-122.23	SAN FRANCISCO, CALIF., USA
SGN	10.49	106.40	SAIGON, S VIETNAM (TAN SON NHUT)
SHA	31.12	121.23	SHANGHAI, CHINA
SHN	1.21	103.54	SINGAPORE, SINGAPORE (PAYA-LEBAR)
SJI	18.28	-66.07	SAN JUAN, PUERTO RICO
SJO	37.40	66.57	SAHARANO, USSR
SLC	40.46	-111.53	SALT LAKE CITY, UTAH, USA
SNW	52.30	-9.53	SHANNON, IRELAND (LIMERICK)
SOF	42.40	23.18	SOFIA, BULGARIA (SOFIYA)
SPK	43.03	141.21	SAPPORO, JAPAN
SPN	15.10	145.45	SAIPAN, MARTANA IS
STD	59.37	17.55	STOCKHOLM, SWEDEN (ARLANDA)
STT	18.21	-64.59	ST. THOMAS (HARRY TRUMAN APT) VIRGIN IS, USA
SVO	55.45	37.35	MOSCOW, RS (MOSKVA-SHEREMETYEVO ARPT) USSR
SVO	37.23	5.59	SEVILLE, SPAIN
SYD	-33.52	151.13	SYDNEY-KINGSFORD SMITH ARPT, NEW SOUTH WALES, AUS.
SZG	47.48	13.02	SALZBURG, AUSTRIA
TAR	11.15	-60.40	TOBAGO, TRINIDAD AND TOBAGO
TAS	41.20	69.18	TASHKENT, USSR
TWF	52.29	13.25	BERLIN-TEMPERHOF (ZENTRALFLUGHAFEN) GER. FED. REP.
THH	-21.17	-175.08	TONGA, TONGATAPU (FUAAHOTU ARPT) NEW HEBRIDES
THR	35.40	51.26	TEHRAN, IRAN (TEHRAN)
TIJ	32.32	-117.01	TIJUANA, MEXICO
TIP	32.58	13.12	TRIPOLI, ARAB REP. OF LIBYA
TKE	39.20	-120.11	TRUCKEE, CALIFORNIA, USA
TKK	7.23	151.43	TRUK, CAROLINES, PAC. OCEAN
TLS	43.35	1.26	TOULOUSE, FRANCE
TLV	32.07	34.45	TEL AVIV, ISRAEL
TNN	23.00	120.11	TAINAN, REP OF CHINA (TAIWAN)
TNR	-18.55	47.31	TANANARIVE, MALAGASY REP. (ANTANANARIVO)
TOM	16.46	3.01	TOMROUCTOU, MALI
TPE	25.03	121.30	TAIPEI, REP. OF CHINA (TAIWAN)
TPJ	18.00	-75.50	KINGSTON, JAMAICA-TINSON PEN
TRN	45.03	7.40	TURIN, ITALY (TORINO)
TRR	8.34	81.14	TRINCOMALEE, CEYLON
TRV	8.28	76.57	TRIVANDRUM, INDIA
TRW	1.25	173.00	TARAWA, GILBERT IS., PACIFIC OCEAN
TRZ	17.43	83.19	TRICHINOPOLY, INDIA (TRICHUCHIR)
TIM	30.10	-85.41	PANAMA CITY, PAN-TOCUMEN ARPT
TUN	36.48	10.11	TUNIS, TUNISTIA
TUS	32.13	-110.58	TUCSON, ARIZ., USA
TWL	38.54	-120.00	LAKE TAHOE, CALIF., USA (SN. LAKE TAHOE ARPT)
TWF	42.34	-114.28	TWIN FALLS, IDAHO, USA
TYO	35.33	139.46	TOKYO-KOKUSAI-KUKO ARPT. JAPAN
TZA	17.30	-88.12	BELIZE, BR. HONOURAS-HUN ARPT (BELICE)
ULN	47.55	106.53	ULAN BATOR, MONGOLIA (ULANBAATAR)
UMR	-31.31	137.10	WOMERA, S. AUSTRALIA
VCL	48.45	2.10	PARIS-VILLACOURLAY AERODROME, FRANCE
VCP	23.00	47.08	SAO PAULO, BRAZIL-VIRACOPOS AEROPORTO
VIE	48.13	16.20	VIENNA, AUSTRIA (WIEN, VIENNE)

VKD	55.37	37.17	MOSCOW-VNIUKOVO APT., USSR
VLC	38.28	.22	VALENCIA, SPAIN (VALENCE)
VLD	30.29	86.30	COLIN A.F. BASE F.A., USA
VTE	16.17	102.36	VIETIANE, LAOS
VAK	17.17	116.37	WAKE AIRPORT, WAKE ISLAND, PACIFIC OCEAN
WAL	47.28	-115.24	WASH DC, WASHINGTON, USA
WAR	52.15	21.00	WARSAWA, POLAND
WAW	32.15	21.00	WARSAWA, POLAND (WARSAWA)
WKE	19.17	166.36	WAKE ISLAND, PACIFIC OCEAN
WLG	-41.18	174.46	WELLINGTON, N.Z.
WLS	-13.18	-173.10	HALLIS ILES, S. PACIFIC OCEAN
WAP	9.34	138.09	YAP, CAROLINES, PAC. OCEAN
WDA	64.04	-139.25	DAYTON CITY, Y.T. CANADA
WDR	55.46	-120.14	DAYSON CREEK, N.C. CANADA
WEG	55.25	-75.42	OTTAWA, ONTARIO, CANADA
WEL	53.35	-113.58	EDMONTON-INTERNATIONAL APT., CANADA
WFB	54.46	-108.52	EDMONTON-SHERBAY, N.W.T. CANADA
WFI	54.46	-108.52	EDMONTON-SHERBAY, N.W.T. CANADA
WJT	48.33	-50.35	STERNBERG, ILE, N.W.T. CANADA
WQB	46.47	-71.23	QUEBEC, QUE. CANADA
WHL	45.28	-73.45	MONTREAL, QUE. CANADA
WVG	49.11	-123.10	VANCOUVER-INTERNATIONAL APT., B.C., CANADA
WYD	49.53	-97.09	WINNIPEG, MAN., CANADA
WYD	53.33	-113.28	EDMONTON, ALTA., CANADA
WYU	42.59	-81.14	LONDON, ONT., CANADA
WYJ	48.25	-123.22	VICTORIA, B.C., CANADA
WYF	43.11	-79.38	TORONTO-INT. APT., QUE., CANADA
WZF	45.11	-114.21	YELKINITE, N.W.T., CANADA
ZAG	45.48	132.05	ZAGREB, YUGOSLAVIA
ZAM	6.54	122.05	ZAMBONGA, PHILIPPINE IS
ZNI	6.10	39.11	ZANZIBAR, TANZANIA
ZRH	47.27	8.33	ZURICH-Kloten FLUGHAFEN, SWITZERLAND
ZRI	30.20	48.16	ABADAN, IRAN
ADH	23.37	58.35	ADU DAHADI, TRUCIAL DMAN (MUSCAT)
ACA	16.51	-99.55	ACAPULCO, MEXICO
ACC	5.33	-13	ACCRA, GHANA
ADD	9.00	38.50	ADDIS ABABA, ETHIOPIA
AGL	34.58	138.32	ADELATOE, S. AUSTRALIA
AGL	20.16	79.26	AGADIR, MOROCCO
AGR	41.55	75.22	AGRA, INDIA
AJA	35.05	8.44	ALGERIA, ALGERIA
ARQ	36.42	-104.40	ALBUQUERQUE, N.M., USA
ALG	43.15	3.08	ALGERIA, ALGERIA
ALA	35.13	-101.49	ALMA-ATA, USSR
AMA	31.57	35.56	AMARILLO, TEXAS, USA
AMM	33.20	44.26	AMMAN, JORDAN
AMS	52.17	4.40	AMSTERDAM, NETHERLANDS
ANC	61.13	-149.53	ANCHORAGE, ALASKA, USA
ESR	39.56	32.52	ANKARA-ESKIHOGA APT., TURKEY
ACE	-13.50	-171.44	APIA, W. SAMOA
ASH	23.57	-13.32	ARRIFICE, CANARY IS.
ASH	23.57	-13.32	ASUNCION, PARAGUAY
ATH	37.59	-57.00	ATHENS, GREECE
ATL	33.48	-83.42	ATLANTA, GA., USA
ATL	-36.53	174.45	AUCKLAND, NEW ZEALAND
AUS	30.16	-97.45	AUSTIN, TEXAS, USA
RGW	33.20	44.26	BAGHDAD, IRAQ
BAH	26.00	50.30	BAHRAIN IS., ARABIAN GULF
BAK	46.23	49.51	BAKU, USSR
BAL	39.11	-76.40	BALTIMORE, MD., USA
RDI	13.10	-59.32	BARBADOS, WEST INDIES
BCN	41.23	2.11	BARCELONA, SPAIN

ASL	47.33	7.25	BASEL, SWITZERLAND (BALE)
BTH	13.26	-16.39	BATHURST, GAMBIA
BEY	33.49	35.30	BETHLEHEM, JERUSALEM
BGR	44.50	20.10	BELGRADE, YUGOSLAVIA
BYA	17.30	-88.12	BELTZE, PR. HONDURAS-MUN. ARPT (BELICE)
BHZ	-19.55	-43.56	BELO HORIZONTE, BRAZIL
BOK	37.57	-122.28	BERKELEY, CALIF., USA
BER	52.31	13.24	BERLIN, GER. FED. REP.
THF	52.29	13.25	BERLIN-TEMPERHOF (ZENTRALFLUGHAFEN) GER. FED. REP.
BDA	22.20	-64.45	BERNINA, ATLANTIC OCEAN
BHX	52.30	-1.50	BIRMINGHAM, ENGLAND
BGG	33.28	-95.13	BOGOTA, COLOMBIA
BOM	19.05	72.52	BOMBAY, INDIA-SANTA CRUZ ARPT
BOS	-16.30	-151.45	BORA-BORA, POLYNESIA
BOS	42.21	-71.04	BOSTON, MASS., USA
BTS	48.10	17.10	BRATISLAVA, CZECHOSLOVAKIA
BZV	-4.14	15.14	BRAZZAVILLE, CONGO REP.
BNE	-27.27	153.11	BRISBANE-EAGLE FARM ARPT, QUEENSL., AUSTRALIA
BRS	51.27	-2.35	BRIGHTON, ENGLAND
BRH	50.54	4.30	BRUSSELS, BELGIUM
BHM	44.26	26.06	BUCHAREST, ROMANIA
BTP	44.26	26.06	BUCHAREST, ROMANIA-OTOPENI ARPT
BID	47.30	19.05	BUDAPEST, HUNGARY
BUE	-34.49	-58.32	BUENOS AIRES-EZEIZA AEROPUERTO, ARGENTINA
EZE	-34.49	-58.32	BUENOS AIRES-EZEIZA AEROPUERTO, ARGENTINA
BUP	42.52	-76.43	BUFFALO, N.Y., USA
BUR	34.12	-118.18	BURBANK, CALIF., USA
BNS	-16.51	145.43	CAIRNS, QUEENSL., AUSTRALIA
CAI	30.08	31.26	CAIRO-INT. ARPT, ARAB REP. OF EGYPT
CCU	44.50	-7.34	CALCUTTA, INDIA
CIT	34.08	-118.08	CALTECH
CAN	23.06	113.16	CANTON, CHINA (GUANGZHOU, ZHONG)
CPT	-34.02	18.28	CAPETOWN-MALAN ARPT, REP. S. AFRICA
CVQ	-24.53	113.40	CARNARVON, W. AUSTRALIA
CAS	33.39	-7.35	CASABLANCA, MOROCCO
ORD	41.59	-87.54	CHICAGO, ILL.-OHARE ARPT, USA
CHC	-43.42	172.38	CHRISTCHURCH, N.Z.
CUM	53.35	-64.27	CHURCHILL FALLS, N.F.E., CANADA
CVG	39.06	84.31	CINCINNATI, OHIO, USA
CKK	9.58	76.15	COCHIN, INDIA
CMA	6.56	79.51	COLOMBO, CEYLON
RML	6.56	79.51	COLOMBO, CEYLON-RATHMALANA
CPH	55.40	12.35	COPENHAGEN
CPH	55.40	12.35	COPENHAGEN, DENMARK
DAC	23.42	90.22	DACC, BANGLADESH
DKR	14.40	-17.26	DAKAR, SENEGAL
DAM	33.30	36.19	DAMASCUS-MEZZE ARPT, ARAB REP. OF SYRIA
DAR	12.23	130.44	DAR ES SALAM, TANZANIA
DRY	-12.28	130.50	DARWIN, NT, AUSTRALIA
YDA	64.04	-139.25	DAWSON CITY, Y.T., CANADA
YDQ	55.46	-120.14	DAWSON CREEK, B.C., CANADA
DEL	28.35	77.07	DELHI-PALAM INT. ARPT, INDIA
DEN	39.43	-105.01	DENVER, COLO., USA
DTT	42.13	-83.22	DETROIT-METROPOLITAN WAYNE CO. ARPT., MICH., USA
DTW	42.25	-83.01	DETROIT, MICH.-METROPOLITAN APT
DET	42.20	-83.03	DETROIT, MICH., USA
DHA	26.18	50.08	DHAHRAN, SAUDI ARABIA (AZ-ZAHARAN)
DKT	-6.10	106.48	DIJAKARTA, JAVA, INDONESIA
DOH	25.17	51.32	DOHA (AD-DAHHAN) QATAR, ARABIA
DLA	4.03	9.42	DOUALA, CAMEROON
DXB	25.18	55.18	DUBAI (DIBAYY), TRUCIAL QHAR
OUR	-19.55	30.56	DURBAN, REP. OF S. AFRICA

LBJ	-29.55	30.56	DURBAN, REP. S. AFRICA
LPC	-27.08	-109.23	EASTER ISLAND, PACIFIC OCEAN
YCO	53.33	-113.28	EDMONTON, ALTA., CANADA
YEG	53.33	-113.28	EDMONTON-INTERNATIONAL ARPT, CANADA
YPS	30.29	86.30	EGLIN AFB, BASE FLA., USA
ELU	61.14	149.54	ELMENDORF, AFR, ALASKA, USA
ELU	60.10	147.21	EVREYAN, ARMENIA, USSR (YEREVAN)
FAT	64.31	147.40	FAIRBANKS, ALASKA, USA
FTN	-46.35	147.50	FANNING, CAMEROON
YFO	54.46	-101.53	FLIN FLON, MAN., CANADA
FRA	50.02	8.33	FRANKFURT, GERMAN FEDERAL REP.
HGS	8.30	-13.15	FREETOWN, SIERRA LEONE
YFB	63.44	-68.28	FROBISHER BAY, N-N-T. CANADA
FNC	32.38	-16.54	FINCHAL, MADERIA IS.
GVA	46.13	6.09	GENEVA-MEVRIN
PTK	55.30	-44.36	GLASGOW, SCOT-PRESTWICK ARPT
GIW	64.15	-53.33	GIDJAHU, GREENLAND
GIW	63.49	144.49	GIAM, MARTANAS (AGANA NAS)
HLZ	-21.17	175.11	HAMILTON, NEW ZEALAND
HNW	21.02	105.51	HANOI, N. VIETNAM
HAV	23.08	-92.22	HAVANA, CUBA
HEL	60.10	24.58	HELSINKI, FINLAND
HTD	19.43	-155.05	HIILO, HAWAII, USA
HBA	-42.51	147.19	HOBART, TASMANIA
HKG	22.20	114.12	HONG KONG, BR BRITAN COLONY
HNL	2.50	159.57	HONOLULU, HI, ALASKA, USA
HTD	38.59	-95.27	HONOLULU, OAHU HAWAII, USA
HTD	38.54	-86.26	HONOLULU, OAHU HAWAII, USA
TYK	35.39	-117.49	INDIANAPOLIS, IND., USA
IKT	52.16	104.20	INVERMURRAY, S. AFRICA
ISP	40.44	-73.13	ISLIP, N.Y., USA
IST	40.58	-8.49	ISTANBUL, TURKEY (HAVA ALANTI)
IZM	38.25	27.09	IZMIR, TURKEY
RND	-26.08	28.14	JOHANNESBURG, S S AFRICA (JAN SMITS)
JUN	58.20	-134.27	JUNEAU, ALASKA, USA
KBL	34.30	69.10	KABUL, AFGHANISTAN
DSG	20.54	-156.26	KAHULUI, MAUI HAWAII, USA
KNA	31.19	32.25	KAMPALA, UGANDA (CENTERME)
KNU	21.32	84.30	KANDAHAR, AFGHANISTAN
KHI	26.52	67.03	KARACHI, PAKISTAN
KTM	17.42	95.20	KATHMANDU, NEPAL
KOI	-3.57	122.35	KENDARI, CELEBES, INDONESIA
HRK	50.00	36.15	KHARKOV, USSR
KRT	15.36	32.32	KHARTOUM, SUDAN
KIE	-4.13	155.38	KIEV, BOUCAINVILLE SOLOMON IS
JLT	50.26	30.31	KIEV, USSR-JULIAMI ARPT,
KTM	-26.43	24.46	KIMBERLEY, REP OF S AFRICA
KIN	18.00	-76.50	KINGSTON, JAMAICA
KJL	58.59	-79.58	KINGSTON, JAMAICA-TINSON PEN
KRN	67.51	20.16	KIRUNA, SWEDEN
KOA	21.24	-157.44	KONA, KAUAI HAWAII, USA
OTZ	66.53	-162.39	KOTZEBUE, ALASKA, USA
KRK	50.03	19.58	KRAKOW, POLAND
KUL	3.59	101.43	KUALA LUMPUR, MALAYSIA
KWT	29.30	47.45	KUWAIT, KUWAIT
KWA	9.05	167.20	KWAJALEIN, MARSHALL IS.

LOS	6.37	3.16	LAGOS-IKEJA ARPT, NIGERIA
TVL	38.54	-120.00	LAKE TAMOE, CALIF., USA (LAKE TAMOE ARPT)
LPB	-16.30	-68.09	LAPAZ, BOLIVIA
LPA	28.10	-110.18	LAPAZ, MEXICO
LAS	28.08	156.24	LAS PALMAS, CANARY IS
LAS	36.11	-115.08	LAS VEGAS, NEV., USA
LID	60.01	30.17	LENINGRAD, USSR (KOLOMAGI APT)
LTH	21.59	-159.21	LIHUE, KAUAI HAWAII, USA
LTM	-12.03	-77.03	LTMA, PERU
LIS	38.43	-9.08	LISBON, PORTUGAL
LJI	46.03	14.31	LJUBLJANA, YUGOSLAVIA
LON	51.40	.15	LONDON
LGW	51.09	-.21	LONDON, ENGLAND-GATWICK ARPT
LHR	51.27	-.28	LONDON, ENGLAND-HEATHROW ARPT
YXU	42.59	-81.14	LONDON, ONT., CANADA
LAX	33.56	-118.24	LOS ANGELES-INTERNATIONAL ARPT, CALIF., USA
LAD	-8.48	13.14	LIARD, ANGOLA
LPO	19.52	102.08	LIJANG PRABANG, LAOS
LBR	33.35	-101.51	LIRROCK, TEXAS, USA
LUX	49.37	6.10	LUXEMBOURG, LUXEMBOURG (FINDL)
MAA	11.00	78.15	MADRAS, INDIA
MAD	40.28	-3.34	MADRID, SPAIN (BARAJAS)
IXM	9.56	78.08	MADURAI, INDIA
AGP	34.43	-4.25	MALAGA, SPAIN
MOL	22.00	96.05	MANDALAY, BIRMA
MNL	14.34	121.01	MANILA-INT. ARPT, PHILIPPINES
RAK	31.49	-8.00	MARRAKECH, MOROCCO
MZT	23.13	-100.25	MAZATLAN, MEXICO
MMH	-77.50	166.25	MC MURDO, ANTARCTICA
MEL	-37.49	144.58	MELBOURNE-TULLAHARINE ARPT, VIC., AUSTRALIA
MDY	28.13	-177.26	MIDWAY ISLAND, PACIFIC OCEAN
LTN	45.27	9.16	MILAN, ITALY-FORLANINI-LIMATE
MLP	45.38	8.44	MILAN, ITALY-MALPENSA ARPT
MRA	-4.03	39.40	MOMDASA, KENYA
MLW	6.18	-10.47	MONROVIA, LIBERIA
MRJ	18.30	-77.55	MONTIGO BAY, JAMAICA
CSO	-34.52	-56.02	MONTVIDEO-CARRASCO AEROPUERTO, URUGUAY
MVD	-34.53	-56.11	MONTVIDEO, URUGUAY
YUL	45.28	-73.45	MONTREAL, QUE., CANADA
MOW	55.45	37.42	MOSCOW
DME	55.25	37.35	MOSCOW, USSR-DOMODODOVO ARPT
SVO	55.45	37.35	MOSCOW, US (MOSKVA-SHEREMETYEVO ARPT) USSR
VKO	55.37	37.17	MOSCOW-VNUKOVO ARPT, USSR
MCT	23.37	58.35	MUSCAT, OMAN (MUSQAT)
NBO	-1.17	36.49	NAIROBI, KENYA (ENTENHE)
NSN	-17.48	177.25	NANAI, FIJI IS.
NAP	40.51	14.17	NAPLES, ITALY (NAPOLI)
NAS	25.05	-77.21	NASSAU, BAHAMAS
NAT	-5.47	-35.13	NATAL, BRAZIL
MSY	29.58	-90.07	NEW ORLEANS, LA., USA
JFK	40.38	-73.47	NEW YORK, NY-KENNEDY INT ARPT.
NCE	43.40	7.14	NICE, FRANCE (COTE D'AZUR)
ICN	-1.11	33.23	NICOSIA, CYPRUS
OME	64.30	-165.24	NOME, ALASKA, USA
NLK	-29.03	167.56	NORFOLK, IS. PACIFIC OCEAN
MMJ	-22.16	166.27	NUMEA, NEW CAL-MAGENTA ARPT
OVH	55.02	82.55	NOV IBIRSK, USSR
PAK	37.47	-122.13	OAKLAND, CALIF., USA
ODS	46.28	30.44	ODESSA, USSR
OKA	26.22	127.45	OKINAWA, RYUKYU IS. (KADENAI)
OKC	35.28	-97.32	OKLAHOMA CITY, OKLA., USA
OMA	41.16	-95.57	OMAHA, NEB., USA

OMS	55.00	73.22	RUSSIA, USSR
OPD	41.11	-8.36	OPORTO, PORTUGAL
OSA	34.47	135.26	OSAKA, JAPAN (KOKUSAI-KUKO)
OSB	29.55	10.45	OSLO, NORWAY-FORNEBU ARPT
OSL	50.55	10.45	OSLO, NORWAY
OTM	41.25	-75.42	OTTAWA, ONTARIO, CANADA
PAG	-16.16	-170.42	PAGO PAGO, SAMOA
PAN	30.10	-85.41	PANAMA CITY, PAN-TOCUMEN ARPT
PAP	-17.32	-149.34	PAPETE, TAHITI, FR POLYNESIA
PAR	48.56	2.26	PARIS, FRANCE-LE BOURGET ARPT
PAS	48.56	2.26	PARIS, FRANCE-ORLY ARPT
PAU	48.43	2.24	PARIS-ORLY ARPT, FRANCE
PER	31.57	119.58	PARIS-VILLIERS ARPT, FRANCE
PEK	31.57	119.58	PEKING, PEKING, CHINA (NANYANGCHANG)
PHI	39.53	-75.14	PHILADELPHIA, PA, USA
PHX	33.27	-112.05	PHOENIX, ARIZ., USA
PIA	43.43	10.23	PISA, ITALY
PIN	6.58	158.13	PINAPLE, CAROLINES
PNI	6.58	158.13	PINAPLE, CAROLINES, PAC. OCEAN
PAP	18.32	-72.20	PORT AU PRINCE, HAITI
PDM	-31.58	25.40	PORT ELIZABETH, REP. S. AFRICA
PFL	-9.30	147.10	PORT KESWEE, PAPUA, N. GUINEA
POR	10.39	-61.31	PORT OF SPAIN, TRINIDAD
PDS	55.33	-124.36	PORTLAND, ORE., USA
PRG	50.00	15.26	PRAGUE, CZECHOSLOVAKIA
PRN	39.00	15.26	PRINCE EDWARD, N. KOREA
FNG	46.47	-71.23	QUEBEC, QUE. CANADA
QOR	34.02	-64.51	QATAR, MIDDLE EAST
RAA	-4.13	152.11	RAMAHL, NEW BRITAIN, N. GUINEA
RAB	16.47	96.10	RANGOON, BURMA
RGN	-31.14	-159.46	RAROTONGA, COOK IS. S. PACIFIC
RAP	39.31	-119.48	RENO, NEV., USA
RNO	64.02	-22.36	REYKJAVIK, ICE. KEFLAVIK ARPT.
REF	64.02	-22.36	REYKJAVIK, ICELAND
G16	-22.50	-43.15	RIO DE JANEIRO, BRAZIL (AEROPORTO DO GALVAO)
S10	-22.55	-43.10	RIO DE JANEIRO, BRAZIL (SANTOS DUMONT ARPT)
RED	-22.55	-43.10	RIO DE JANEIRO, BRAZIL (SANTOS DUMONT ARPT)
RIA	24.36	-46.43	RIYADH, SAUDI ARABIA, AR-RIYAD
CIA	41.46	12.36	ROME-CIAMPINO ARPT, ITALY
ROM	41.46	12.36	ROME, ITALY-DO DA VINCI DI FUMICINO ARPT, ITALY
FCO	41.46	12.36	ROME, ITALY-DO DA VINCI DI FUMICINO ARPT, ITALY
SGN	10.49	106.40	SANGHAI, S. VIETNAM (TAN SON NHUT)
SPN	-17.50	145.45	SAN PEDRO, MARIANA IS.
SAY	-17.50	145.45	SALISBURY, RHODESIA
SVC	40.46	-111.53	SALT LAKE CITY, UTAH, USA
SZG	47.48	13.02	SALTZBURG, AUSTRIA
SKO	39.40	66.09	SAMARKAND, USSR
SAN	32.43	-117.09	SAN DIEGO, CALIF., USA
SFO	37.37	-122.23	SAN FRANCISCO, CALIF., USA
SJU	18.28	-66.07	SAN JUAN, PUERTO RICO
SAC	35.42	-106.57	SANTA FE, N.M., USA
SCL	-33.30	-70.40	SANTIAGO, CHILE
SDO	23.32	-46.37	SAO PAULO, BRAZIL
WKO	23.00	47.08	SAD PAUL, BRAZIL-VIRACOPOS AEROPORTO
NDK	43.30	141.21	SAPPORO, JAPAN (OKADAMA ARPT)
SPK	47.07	-132.21	SAPPORO, JAPAN (OKADAMA ARPT)
SFA	37.52	136.56	SEATTLE, WASH. INT. ARPT, WASHINGTON, USA
SEL	37.52	136.56	SEATTLE, WASH. INT. ARPT, WASHINGTON, USA
SVQ	37.23	5.59	SEVILL, REP. OF SPAIN
SEZ	37.23	5.59	SEVILL, REP. OF SPAIN
SHA	31.12	121.23	SHANGHAI, CHINA
SHI	31.12	121.23	SHANGHAI, CHINA

SNN	52.30	-9.53	SHANNON, IRELAND (LINERICK)
SIN	1.21	103.54	SINGAPORE, SINGAPORE (PAYA-LEBAR)
SOF	42.40	23.18	SOFIA, BULGARIA (SOFIYA)
SFJ	67.00	-50.59	SONDRE STRONFJORD, GREENLAND
YJT	48.33	-58.35	STEPHENVILLE, NFLD. CANADA
STD	59.37	17.55	STOCKHOLM, SWEDEN (ARLANDA)
BMA	59.21	17.55	STOCKHOLM, SWEDEN-BROMMA ARPT
STT	18.21	-64.59	ST. THOMAS (HARRY TRUMAN APT) VIRGIN IS. USA
SYD	-33.52	151.13	SYDNEY-KINGSFORD SMITH ARPT, NEW SOUTH WALES, AUS.
TNN	23.00	120.11	TAIPEI, REP. OF CHINA (TAIWAN)
TPE	25.03	121.30	TAIPEI, REP. OF CHINA (TAIWAN)
TNR	-18.55	47.31	TANANARIVE, MALAGASY REP. (ANTANANARIVO)
TRW	1.25	173.00	TARAWA, GILBERT IS., PACIFIC OCEAN
TAS	41.20	69.18	TASHKENT, USSR
THR	35.40	51.26	TEHRAN, IRAN (TEHRAN)
TLV	32.07	34.45	TEL AVIV, ISRAEL
TIJ	32.32	-117.01	TIJUANA, MEXICO
TAR	11.15	-60.40	TORONTO, ONTARIO, CANADA
TYO	35.33	139.46	TOKYO-KOKUSAI-KUKO ARPT, JAPAN
TOM	16.46	3.01	TOMARUCTOU, MALI
TMH	-21.17	-175.08	TONGA, TONGATAPU (FUAAMOTU ARPT) NEW HEBRIDES
YYZ	43.41	-79.38	TORONTO-INT. ARPT, QUE., CANADA
TLS	43.36	1.26	TOULOUSE, FRANCE
TRZ	17.43	83.19	TRICHINOPOLY, INDIA (TIRUCHCHIR)
TRR	8.34	81.14	TRINCOMALEE, CEYLON
TTP	32.58	13.12	TRIPOLI, ARAB REP. OF LIBYA
TRV	8.28	76.57	TRIVANDRUM, INDIA
TKE	39.20	-120.11	TRUCKEE, CALIFORNIA, USA
YKK	7.23	151.43	TRUK, CAROLINES, PAC. OCEAN
TUS	32.13	-110.58	TUCSON, ARIZ., USA
TUN	36.48	10.11	TUNIS, TUNISIA
TRN	45.03	7.40	TURIN, ITALY (TORINO)
TWF	42.34	-114.28	TWIN FALLS, IDAHO, USA
ULN	47.55	106.53	ULAN BATOR, MONGOLIA (ULANBAATAR)
VLC	39.28	.22	VALENCIA, SPAIN (VALENCE)
YVR	49.11	-123.10	VANCOUVER-INTERNATIONAL ARPT, B.C., CANADA
YYJ	48.25	-123.22	VICTORIA, B.C., CANADA
VIE	48.13	16.20	VIENNA, AUSTRIA (WIEN, VIENNE)
VTE	17.58	102.36	VIENTIANE, LAOS
WAK	19.17	166.37	WAKE AIRPORT, WAKE ISLAND, PACIFIC OCEAN
WKE	19.17	166.36	WAKE ISLAND, PACIFIC OCEAN
WAL	47.28	-115.56	WALLACE, IDAHO, USA
WLS	-13.18	-173.10	WALLIS ISLES, S. PACIFIC OCEAN
WAW	52.15	21.00	WARSAW, POLAND (WARSZAWA)
WAR	52.15	21.00	WARSZAWA (WARSAW)
IAD	38.57	-77.27	WASHINGTON DC-DULLES INTERNATIONAL AIRPORT, USA
DCA	42.19	-83.25	WASHINGTON DC-NATIONAL ARPT, USA
WLG	-41.18	174.46	WELLINGTON, N.Z.
YWG	49.53	-97.09	WINNIPEG, MAN., CANADA
UUR	-31.31	137.10	WOMERA, S. AUSTRALIA
YAP	9.34	138.09	YAP, CAROLINES, PAC. OCEAN
YZF	62.27	-114.21	YELLOWKNIFE, N.W.T., CANADA
ZAG	45.48	15.58	ZAGREB, YUGOSLAVIA
ZAM	6.54	122.05	ZAMBOANGA, PHILIPPINE IS
ZNZ	6.10	39.11	ZANZIBAR, TANZANIA
ZRH	47.27	8.33	ZURICH-KLOTEN FLUGHAFEN, SWITZERLAND

AT MACH 1.2

4.7

RATE OF DESCENT (FEET/MIN) = 3333.333

DESCENDING GROUND SPEED (MILES/HOUR) = 570.00

FLIGHT ALTITUDE AND DISTANCE PROFILE IN 1/10 HOUR INCREMENTS.

20000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
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40006	40008	40009	40009	40008	40007	40006	40005

[illegible]

FLIGHT PROFILE TIME ■ **4.70 HOURS IN THE AIR**

COMPUTED GREAT CIRCLE LEG DISTANCE = 3622.6 THE INITIAL COURSE ANGLE = 53.877										
LEG START LATITUDE = 40.63		LEG START LONGITUDE = -73.77								
LEG END LATITUDE = 48.72		LEG END LONGITUDE = 2.38								
LAT.	LONG.	COURSE ANGLE	GEONAG. LAT.	ATHOS. DEPTH. GR/SQ. CH.	CHARGED PARTICLES AND GAMMA DOSE RATE (MREMS/HR) SOLAR AVG.		NEUTRONS DOSE RATE (MREMS/HR) SOLAR AVG.		TOTAL DOSE RATE DOSE RATE (MREMS/HR) SOLAR AVG.	
40.87	-73.33	60.03	52.33	710.12	.092562	.088927	.023644	.022716	.116266	.111942
41.35	-72.44	60.05	52.83	307.49	.181132	.165176	.053269	.048576	.213752	.213752
41.92	-71.36	60.08	53.40	193.27	.365089	.321369	.095950	.095950	.469111	.469111
42.56	-70.07	60.10	54.06	193.27	.365971	.321256	.102675	.090130	.468646	.468646
43.19	-68.76	60.11	54.69	193.27	.365958	.321148	.103305	.090681	.469163	.469163
43.80	-67.43	60.12	55.30	193.27	.365748	.321044	.103913	.091212	.469691	.469691
44.40	-66.06	60.12	55.88	193.27	.365643	.320943	.104436	.091722	.470139	.470139
44.98	-64.67	60.11	56.44	193.27	.365659	.320963	.104723	.091920	.470382	.470382
45.54	-63.25	60.09	56.97	193.27	.365721	.321011	.104957	.092034	.470580	.470580
46.09	-61.80	60.01	57.48	193.27	.365786	.321056	.104977	.092141	.470758	.470758
46.62	-60.33	60.01	57.95	193.27	.365832	.321099	.105094	.092243	.470926	.470926
47.12	-58.82	59.95	58.39	193.27	.365880	.321139	.105202	.092303	.471092	.471092
47.61	-57.29	59.87	58.81	193.27	.365924	.321176	.105303	.092426	.471228	.471228
48.08	-55.73	59.78	59.18	193.27	.365965	.321210	.105396	.092507	.471341	.471341
48.52	-54.14	59.67	59.53	193.27	.366002	.321241	.105480	.092580	.471483	.471483
48.95	-52.52	59.53	59.83	193.27	.366035	.321269	.105556	.092646	.471591	.471591
49.35	-50.88	59.37	60.11	193.27	.366065	.321293	.105622	.092704	.471697	.471697
49.72	-49.21	59.19	60.34	193.27	.366090	.321312	.105679	.092754	.471759	.471759
50.07	-47.51	58.97	60.53	193.27	.366111	.321332	.105727	.092795	.471837	.471837
50.40	-45.80	58.73	60.69	193.27	.366127	.321345	.105764	.092828	.471892	.471892
50.70	-44.05	58.44	60.80	193.27	.366140	.321356	.105792	.092852	.471932	.471932
50.98	-42.29	58.12	60.87	193.27	.366147	.321362	.105810	.092868	.471958	.471958
51.23	-40.51	57.76	60.90	193.27	.366151	.321365	.105816	.092875	.471969	.471969
51.45	-38.70	57.35	60.89	193.27	.366154	.321364	.105813	.092873	.471955	.471955
51.64	-36.99	56.89	60.84	193.27	.366144	.321350	.105803	.092862	.471947	.471947
51.80	-35.25	56.38	60.75	193.27	.366134	.321351	.105781	.092844	.471915	.471915
51.94	-33.51	55.80	60.62	193.27	.366120	.321340	.105768	.092814	.471868	.471868
52.05	-31.75	55.15	60.45	193.27	.366102	.321324	.105706	.092777	.471807	.471807
52.12	-29.49	54.42	60.24	193.27	.366079	.321305	.105654	.092732	.471733	.471733
52.17	-27.52	53.61	59.98	193.27	.366052	.321282	.105593	.092678	.471644	.471644
52.19	-25.75	52.69	59.70	193.27	.366021	.321256	.105532	.092617	.471543	.471543
52.18	-23.88	51.66	59.37	193.27	.365986	.321227	.105462	.092547	.471428	.471428
52.14	-22.01	50.51	58.01	193.27	.365947	.321195	.105394	.092470	.471301	.471301
52.07	-20.15	49.21	56.62	193.27	.365907	.321159	.105324	.092386	.471162	.471162
51.97	-18.59	47.74	55.19	193.27	.365858	.321121	.105253	.092295	.471011	.471011
51.84	-16.95	46.07	53.73	193.27	.365809	.321079	.105181	.092197	.470850	.470850
51.68	-15.41	44.17	52.25	193.27	.365756	.321035	.105109	.092092	.470677	.470677
51.50	-12.79	42.00	50.73	193.27	.365700	.320989	.105037	.091982	.470494	.470494
51.29	-10.98	39.51	49.18	193.27	.365644	.320940	.104961	.091865	.470302	.470302
51.04	-9.14	36.33	47.42	193.27	.365591	.320891	.104880	.091749	.469921	.469921
50.78	-7.42	33.29	45.02	193.27	.365538	.320841	.104799	.091633	.469433	.469433
50.48	-5.68	29.40	42.47	193.27	.365490	.320791	.104718	.091526	.468926	.468926
50.16	-3.95	24.87	39.70	193.27	.365440	.320741	.104637	.091419	.468419	.468419
49.82	-2.25	19.57	36.99	193.27	.365392	.320691	.104556	.091312	.467912	.467912
49.45	-0.57	13.41	32.41	193.27	.365344	.320642	.104475	.091205	.467405	.467405
49.11	1.18	7.37	27.81	193.27	.365296	.320593	.104394	.091098	.466898	.466898
48.81	2.02	1.80	23.29	710.12	.092525	.088991	.023428	.022508	.115953	.115953

	CHARGED PART. GAMMA RAY	NEUTRONS	TOTAL	
TOTAL FLIGHT DOSE FOR SOLAR MINIMUM CONDITIONS =	1.62793	.46587	2.09381	MILLIREMS PER FLIGHT PROFILE
TOTAL FLIGHT DOSE FOR SOLAR AVERAGE CONDITIONS =	1.43168	.40967	1.84135	MILLIREMS PER FLIGHT PROFILE
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR MIN.) =	.34637	.09912	.44549	MILLIRADS PER HOUR
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR AVG.) =	.30461	.08716	.39178	MILLIREMS PER HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR MINIMUM) =	.32888	.09412	.42299	MILLIREMS / (BLOCK TIME) HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR AVERAGE) =	.28923	.08276	.37199	MILLIREMS / (BLOCK TIME) HOUR
.EG BLOCK TIME = PROFILE TIME + 0.25 HOURS				

APPENDIX D

WEIGHTED AVERAGES AND STATISTICAL ERRORS

1. NORMALLY DISTRIBUTED VARIABLES

In computing the sample mean of some function $F(A)$ of the kinematical variables A of the decay, events with one pion in the ω mass region are given weight one and counted once while events with both pion triplets in the ω mass region are given weight one-half and counted as separate events.

$$\begin{aligned} \langle F(A) \rangle &= \frac{\sum_{i=1}^{N'} w_i F(A_i)}{\sum_{i=1}^{N'} w_i} \quad (D-1) \\ &= \frac{1}{N} \sum_{i=1}^{N'} w_i F(A_i) \end{aligned}$$

where $F(A_i)$ is any function of the kinematical variables A_i of the i 'th event, $w_i = 1$ or $1/2$ is the weight function, N is the number of events with at least one pion triplet in the ω mass region, and $N' = N +$ the number of events with both pion triplets in the ω mass region.

The statistical errors are approximated by the expression

$$\sigma^2 [F(A)] = \frac{1}{N^2} \left[\sum_{i=1}^{N'} w_i^2 \right] \quad (D-2)$$

$$\times \left[\frac{1}{N} \sum_{i=1}^{N'} w_i F^2(A_i) - \left(\frac{1}{N} \sum_{i=1}^{N'} w_i F(A_i) \right)^2 \right]$$

2. NON-NORMALLY DISTRIBUTED VARIABLES

The variables R_M^2 and $J(J+1)$ given by Eqns. (C-7) and (B-5) are not normally distributed. However, for each hypothesis of such variables one can calculate a chi-square and different hypotheses can be compared using a likelihood ratio or confidence level. Suppose one has n equations of the form

$$R = \langle F_k \rangle / \langle G_k \rangle \quad (D-3)$$

for $k = 1, 2, \dots, n$ where $\langle F_k \rangle$ and $\langle G_k \rangle$ are expectation values of n functions of the kinematical variables A which are approximated by

$$\langle F_k \rangle = \frac{\sum_{i=1}^{N'} w_i F_k(A_i)}{\sum_{i=1}^{N'} w_i} \quad (D-4)$$

$$= \frac{1}{N} \sum_{i=1}^{N'} w_i F_k(A_i)$$

and

$$\langle G_k \rangle = \frac{1}{N} \sum_{i=1}^{N'} w_i G_k(A_i)$$

where $w_i = 1$ or $1/2$ is the weight function, N is the number of events with at least one pion triplet in the ω mass region, and $N' = N +$ the number of events with both pion triplets in the ω mass region.

The equations to be satisfied by the parameter can be written

COMPUTED GREAT CIRCLE LEG DISTANCE = 5649.9 THE INITIAL COURSE ANGLE = 35.038

LEG START LATITUDE = 34.00 LEG START LONGITUDE = -118.15

LEG END LATITUDE = 48.72 LEG END LONGITUDE = 2.38

LAT.	LONG.	COURSE ANGLE	GEO MAG. LAT.	ATMOS. DEPTH GR/SQ. CM.	CHARGED PARTICLES AND GAMMA DOSE RATE (MREMS/HR)		NEUTRONS DOSE RATE (MREMS/HR)		TOTAL DOSE RATE DOSE RATE (MREMS/HR)	
					SOLAR MIN.	SOLAR AVG.	SOLAR MIN.	SOLAR AVG.	SOLAR MIN.	SOLAR AVG.
34.24	-117.94	39.20	41.26	827.73	.056611	.055474	.011776	.011539	.068387	.067014
34.73	-117.52	39.31	41.81	516.42	.112710	.106939	.030042	.028504	.142752	.135443
35.22	-117.10	39.42	42.35	307.49	.152000	.140911	.042821	.039697	.194821	.180608
35.75	-116.63	39.55	42.95	233.31	.229444	.210059	.065202	.059696	.294646	.269765
36.33	-116.10	39.69	43.61	233.31	.232827	.212709	.066411	.060673	.299239	.273182
36.91	-115.57	39.83	44.26	233.31	.236203	.215330	.067618	.061642	.303821	.276972
37.49	-115.03	39.98	44.91	233.31	.239571	.217931	.068821	.062605	.308321	.280335
38.06	-114.49	40.13	45.56	233.31	.242930	.220512	.070022	.063560	.312932	.284973
38.63	-113.93	40.29	46.21	233.31	.246281	.223074	.071220	.064550	.317500	.289582
39.20	-113.37	40.45	46.85	233.31	.249622	.225616	.072414	.065450	.322038	.294185
39.77	-112.79	40.61	47.50	233.31	.252957	.228137	.073605	.066383	.326558	.298750
40.33	-112.21	40.77	48.14	233.31	.256275	.230638	.074792	.067310	.331057	.299748
40.89	-111.62	40.94	48.78	233.31	.259586	.233118	.075975	.068228	.335551	.300347
41.44	-111.01	41.11	49.42	233.31	.262886	.235577	.077155	.069140	.340041	.300717
42.00	-110.40	41.29	50.05	233.31	.266172	.238048	.078320	.070000	.344443	.308049
42.55	-109.78	41.47	50.69	233.31	.269420	.240567	.079477	.070377	.348140	.311243
43.09	-109.14	41.65	51.32	233.31	.272656	.243672	.079617	.070751	.351823	.314423
43.64	-108.49	41.83	51.94	233.31	.275878	.246464	.079612	.071124	.355490	.317588
44.17	-107.84	42.02	52.57	233.31	.279086	.249242	.080056	.071495	.359142	.320736
44.71	-107.17	42.20	53.19	233.31	.281479	.251317	.080509	.071882	.361998	.323199
45.24	-106.48	42.40	53.81	233.31	.282067	.251842	.080986	.072308	.363053	.324150
45.77	-105.79	42.59	54.43	233.31	.282652	.252365	.081461	.072732	.364113	.325097
46.29	-105.08	42.79	55.04	233.31	.283234	.252884	.081933	.073154	.365167	.326038
46.81	-104.35	42.98	55.65	233.31	.283813	.253393	.082403	.073573	.366215	.326974
47.32	-103.62	43.18	56.25	233.31	.284386	.253893	.082871	.073993	.366855	.327546
47.83	-102.87	43.38	56.84	233.31	.284946	.254379	.083326	.074395	.367078	.327700
48.34	-102.10	43.59	57.45	233.31	.285486	.254855	.083777	.074795	.367194	.327776
48.83	-101.32	43.79	58.05	233.31	.286006	.255317	.084217	.075186	.367288	.327852
49.33	-100.52	44.00	58.63	233.31	.286496	.255767	.084647	.075567	.367392	.327927
49.82	-99.71	44.20	59.22	233.31	.286946	.256203	.085067	.075939	.367495	.328002
50.30	-98.88	44.41	59.80	233.31	.287366	.256623	.085477	.076304	.367597	.328077
50.77	-98.04	44.62	60.37	233.31	.287746	.257033	.085877	.076659	.367698	.328152
51.24	-97.17	44.83	60.94	233.31	.288086	.257433	.086267	.076999	.367798	.328227
51.71	-96.29	45.03	61.50	233.31	.288446	.257823	.086647	.077329	.367898	.328302
52.16	-95.39	45.24	62.05	233.31	.288816	.258203	.087017	.077649	.367998	.328377
52.61	-94.47	45.44	62.60	233.31	.289166	.258573	.087377	.077969	.368098	.328452
53.05	-93.54	45.65	63.14	233.31	.289486	.258933	.087727	.078279	.368198	.328527
53.49	-92.58	45.85	63.67	233.31	.289766	.259283	.088067	.078579	.368298	.328602
53.92	-91.61	46.06	64.19	233.31	.290046	.259623	.088397	.078869	.368398	.328677
54.33	-90.61	46.25	64.71	233.31	.290326	.259953	.088717	.079149	.368498	.328752
54.75	-89.60	46.45	65.21	233.31	.290586	.260273	.089027	.079419	.368598	.328827
55.15	-88.56	46.64	65.70	233.31	.290846	.260583	.089327	.079679	.368698	.328902
55.54	-87.50	46.83	66.19	233.31	.291086	.260883	.089617	.079929	.368798	.328977
55.92	-86.42	47.02	66.66	233.31	.291326	.261173	.089897	.080169	.368898	.329052
56.30	-85.32	47.20	67.12	233.31	.291546	.261453	.090167	.080399	.368998	.329127
56.66	-84.20	47.37	67.57	233.31	.291766	.261723	.090427	.080619	.369098	.329202
57.02	-83.05	47.54	68.01	233.31	.291966	.261983	.090677	.080829	.369198	.329277
57.36	-81.90	47.70	68.43	233.31	.292146	.262233	.090917	.081029	.369298	.329352
57.69	-80.71	47.85	68.83	233.31	.292326	.262473	.091147	.081219	.369398	.329427
58.01	-79.50	48.00	69.22	233.31	.292486	.262703	.091367	.081399	.369498	.329502
58.32	-78.28	48.14	69.59	233.31	.292626	.262923	.091577	.081569	.369598	.329577
58.63	-77.05	48.28	70.00	233.31	.292746	.263133	.091777	.081729	.369698	.329652

58.42	-77.03	48.27	69.94	233.31	284146	253100	084276	338557
58.90	-75.76	70.28	70.28	233.31	284146	253100	084276	338557
59.18	-74.46	48.59	70.69	233.31	284146	253100	084276	338557
59.44	-71.15	48.50	70.69	233.31	284146	253100	084276	338557
59.68	-71.82	48.68	71.16	233.31	284146	253100	084276	338557
59.91	-70.47	48.76	71.41	233.31	284146	253100	084276	338557
60.13	-69.10	48.82	71.63	233.31	284146	253100	084276	338557
60.34	-67.71	48.86	71.83	233.31	284146	253100	084276	338557
60.53	-66.31	48.90	72.01	233.31	284146	253100	084276	338557
60.70	-64.89	48.91	72.16	233.31	284146	253100	084276	338557
60.86	-63.46	48.91	72.31	233.31	284146	253100	084276	338557
61.03	-62.01	48.91	72.46	233.31	284146	253100	084276	338557
61.13	-60.55	48.91	72.61	233.31	284146	253100	084276	338557
61.24	-59.08	48.91	72.76	233.31	284146	253100	084276	338557
61.34	-57.59	48.91	72.91	233.31	284146	253100	084276	338557
61.44	-56.10	48.91	73.06	233.31	284146	253100	084276	338557
61.54	-54.61	48.91	73.21	233.31	284146	253100	084276	338557
61.63	-53.11	48.91	73.36	233.31	284146	253100	084276	338557
61.76	-51.60	48.91	73.51	233.31	284146	253100	084276	338557
61.86	-50.09	48.91	73.66	233.31	284146	253100	084276	338557
61.97	-48.58	48.91	73.81	233.31	284146	253100	084276	338557
62.07	-47.07	48.91	73.96	233.31	284146	253100	084276	338557
62.17	-45.56	48.91	74.11	233.31	284146	253100	084276	338557
62.27	-44.05	48.91	74.26	233.31	284146	253100	084276	338557
62.37	-42.54	48.91	74.41	233.31	284146	253100	084276	338557
62.47	-41.03	48.91	74.56	233.31	284146	253100	084276	338557
62.57	-39.52	48.91	74.71	233.31	284146	253100	084276	338557
62.67	-38.01	48.91	74.86	233.31	284146	253100	084276	338557
62.77	-36.50	48.91	75.01	233.31	284146	253100	084276	338557
62.87	-34.99	48.91	75.16	233.31	284146	253100	084276	338557
62.97	-33.48	48.91	75.31	233.31	284146	253100	084276	338557
63.07	-31.97	48.91	75.46	233.31	284146	253100	084276	338557
63.17	-30.46	48.91	75.61	233.31	284146	253100	084276	338557
63.27	-28.95	48.91	75.76	233.31	284146	253100	084276	338557
63.37	-27.44	48.91	75.91	233.31	284146	253100	084276	338557
63.47	-25.93	48.91	76.06	233.31	284146	253100	084276	338557
63.57	-24.42	48.91	76.21	233.31	284146	253100	084276	338557
63.67	-22.91	48.91	76.36	233.31	284146	253100	084276	338557
63.77	-21.40	48.91	76.51	233.31	284146	253100	084276	338557
63.87	-19.89	48.91	76.66	233.31	284146	253100	084276	338557
63.97	-18.38	48.91	76.81	233.31	284146	253100	084276	338557
64.07	-16.87	48.91	76.96	233.31	284146	253100	084276	338557
64.17	-15.36	48.91	77.11	233.31	284146	253100	084276	338557
64.27	-13.85	48.91	77.26	233.31	284146	253100	084276	338557
64.37	-12.34	48.91	77.41	233.31	284146	253100	084276	338557
64.47	-10.83	48.91	77.56	233.31	284146	253100	084276	338557
64.57	-9.32	48.91	77.71	233.31	284146	253100	084276	338557
64.67	-7.81	48.91	77.86	233.31	284146	253100	084276	338557
64.77	-6.30	48.91	78.01	233.31	284146	253100	084276	338557
64.87	-4.79	48.91	78.16	233.31	284146	253100	084276	338557
64.97	-3.28	48.91	78.31	233.31	284146	253100	084276	338557
65.07	-1.77	48.91	78.46	233.31	284146	253100	084276	338557
65.17	-0.26	48.91	78.61	233.31	284146	253100	084276	338557
65.27	12.25	48.91	78.76	233.31	284146	253100	084276	338557
65.37	13.74	48.91	78.91	233.31	284146	253100	084276	338557
65.47	15.23	48.91	79.06	233.31	284146	253100	084276	338557
65.57	16.72	48.91	79.21	233.31	284146	253100	084276	338557
65.67	18.21	48.91	79.36	233.31	284146	253100	084276	338557
65.77	19.70	48.91	79.51	233.31	284146	253100	084276	338557
65.87	21.19	48.91	79.66	233.31	284146	253100	084276	338557
65.97	22.68	48.91	79.81	233.31	284146	253100	084276	338557
66.07	24.17	48.91	79.96	233.31	284146	253100	084276	338557
66.17	25.66	48.91	80.11	233.31	284146	253100	084276	338557
66.27	27.15	48.91	80.26	233.31	284146	253100	084276	338557
66.37	28.64	48.91	80.41	233.31	284146	253100	084276	338557
66.47	30.13	48.91	80.56	233.31	284146	253100	084276	338557
66.57	31.62	48.91	80.71	233.31	284146	253100	084276	338557
66.67	33.11	48.91	80.86	233.31	284146	253100	084276	338557
66.77	34.60	48.91	81.01	233.31	284146	253100	084276	338557
66.87	36.09	48.91	81.16	233.31	284146	253100	084276	338557
66.97	37.58	48.91	81.31	233.31	284146	253100	084276	338557
67.07	39.07	48.91	81.46	233.31	284146	253100	084276	338557
67.17	40.56	48.91	81.61	233.31	284146	253100	084276	338557
67.27	42.05	48.91	81.76	233.31	284146	253100	084276	338557
67.37	43.54	48.91	81.91	233.31	284146	253100	084276	338557
67.47	45.03	48.91	82.06	233.31	284146	253100	084276	338557
67.57	46.52	48.91	82.21	233.31	284146	253100	084276	338557
67.67	48.01	48.91	82.36	233.31	284146	253100	084276	338557
67.77	49.50	48.91	82.51	233.31	284146	253100	084276	338557
67.87	50.99	48.91	82.66	233.31	284146	253100	084276	338557
67.97	52.48	48.91	82.81	233.31	284146	253100	084276	338557
68.07	53.97	48.91	82.96	233.31	284146	253100	084276	338557
68.17	55.46	48.91	83.11	233.31	284146	253100	084276	338557
68.27	56.95	48.91	83.26	233.31	284146	253100	084276	338557
68.37	58.44	48.91	83.41	233.31	284146	253100	084276	338557
68.47	59.93	48.91	83.56	233.31	284146	253100	084276	338557
68.57	61.42	48.91	83.71	233.31	284146	253100	084276	338557
68.67	62.91	48.91	83.86	233.31	284146	253100	084276	338557
68.77	64.40	48.91	84.01	233.31	284146	253100	084276	338557
68.87	65.89	48.91	84.16	233.31	284146	253100	084276	338557
68.97	67.38	48.91	84.31	233.31	284146	253100	084276	338557
69.07	68.87	48.91	84.46	233.31	284146	253100	084276	338557
69.17	70.36	48.91	84.61	233.31	284146	253100	084276	338557
69.27	71.85	48.91	84.76	233.31	284146	253100	084276	338557
69.37	73.34	48.91	84.91	233.31	284146	253100	084276	338557
69.47	74.83	48.91	85.06	233.31	284146	253100	084276	338557
69.57	76.32	48.91	85.21	233.31	284146	253100	084276	338557
69.67	77.81	48.91	85.36	233.31	284146	253100	084276	338557
69.77	79.30	48.91	85.51	233.31	284146	253100	084276	338557
69.87	80.79	48.91	85.66	233.31	284146	253100	084276	338557
69.97	82.28	48.91	85.81	233.31	284146	253100	084276	338557
70.07	83.77	48.91	85.96	233.31	284146	253100	084276	338557
70.17	85.26	48.91	86.11	233.31	284146	253100	084276	338557
70.27	86.75	48.91	86.26	233.31	284146	253100	084276	338557
70.37	88.24	48.91	86.41	233.31	284146	253100	084276	338557
70.47	89.73	48.91	86.56	233.31	284146	253100	084276	338557
70.57	91.22	48.91	86.71	233.31	284146	253100	084276	338557
70.67	92.71	48.91	86.86	233.31	284146	253100	084276	338557
70.77	94.20	48.91	87.01	233.31	284146	253100	084276	338557
70.87	95.69	48.91	87.16	233.31	284146	253100	084276	338557
70.97	97.18	48.91	87.31	233.31	284146	253100	084276	338557
71.07	98.67	48.91	87.46	233.31	284146	253100	084276	338557
71.17	100.16	48.91	87.61	233.31	284146	253100	084276	338557
71.27	101.65	48.91	87.76	233.31	284146	253100	084276	338557
71.37	103.14	48.91	87.91	233.31	284146	253100	084276	338557
71.47	104.63	48.91	88.06	233.31	284146	253100	084276	338557
71.57	106.12	48.91	88.21	233.31	284146	253100	084276	338557
71.67	107.61	48.91	88.36	233.31	284146	253100	084276	338557
71.77	109.10	48.91	88.51	233.31	284146	253100	084276	338557
71.87	110.59	48.91	88.66	233.31	284146	253100	084276	338557
71.97	112.08	48.91	88.81	233.31	284146	253100	084276	338557
72.07	113.57	48.91	88.96	233.31	284146	253100	084276	338557
72.17	115.06	48.91	89.11	233.31	284146	253100	084276	338557
72.27	116.55	48.91	89.26	2				

45.31	1.44	4.44	51.88	516.42	.135164	.126681	.037635	.035273	.172739	.161954
48.90	2.10	1.38	51.36	827.93	.066601	.064937	.014915	.014542	.081516	.079479

	CHARGED PART. GAMMA RAY	NEUTRONS	TOTAL	
TOTAL FLIGHT DOSE FOR SOLAR MINIMUM CONDITIONS =	3.11855	.91522	4.03377	MILLIREMS PER FLIGHT PROFILE
TOTAL FLIGHT DOSE FOR SOLAR AVERAGE CONDITIONS =	2.78923	.81844	3.60767	MILLIREMS PER FLIGHT PROFILE
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR MIN.) =	.27118	.07958	.35076	MILLIRADS PER HOUR
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR AVG.) =	.24254	.07117	.31371	MILLIREMS PER HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR MINIMUM) =	.26541	.07789	.34330	MILLIREMS / (BLOCK TIME) HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR AVERAGE) =	.23738	.06965	.30704	MILLIREMS / (BLOCK TIME) HOUR
LEG BLOCK TIME = PROFILE TIME + 0.25 HOURS				

LONDON

TO LOS ANGELES

AT MACH 1.2

SCHEDULE BLOCK TIME ON ONE WAY(HRS)= 7.3

RATE OF CLIMB(FEET/MIN)= 3333.333

CRUISING ALTITUDE(FEET)= 40000

RATE OF DESCENT(FEET/MIN)= 3333.333

CLIMBING GROUND SPEED(MILES/HOUR)=570.00 CRUISING SPEED(MILES/HOUR)= 792.00 DESCENDING GROUND SPEED(MILES/HOUR)=570.00

FLIGHT ALTITUDE AND DISTANCE PROFILE IN 1/10 HOUR INCREMENTS.

ALTITUDE

20000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	20000	0	40000	40000

DISTANCE

57.00	57.00	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	79.20	79.20	79.20	79.20
79.20	79.20	79.20	79.20	57.00	57.00		

TOTAL INPUT PROFILE DISTANCE = 5455.20 STATUTE MILES

FLIGHT PROFILE TIME = 7.00 HOURS IN THE AIR

COMPUTED GREAT CIRCLE LEG DISTANCE = 5450.5 THE INITIAL COURSE ANGLE = 311.947

LEG START LATITUDE = 81.40 LEG START LONGITUDE = .15

LEG END LATITUDE = 34.00 LEG END LONGITUDE = -118.15

LAT.	LONG.	COURSE ANGLE	GEOG.MAG. LAT.	ATMOS. DEPTH GR/50. CM.	CHARGED PARTICLES AND GAMMA		NEUTRONS		TOTAL DOSE RATE	
					DOSE RATE (MREMS/HR)	SOLAR MIN.	DOSE RATE (MREMS/HR)	SOLAR MIN.	DOSE RATE (MREMS/HR)	SOLAR MIN.
51.67	-1.35	312.78	54.48	710.12	.092639	.089001	.024094	.023148	.116713	.112148
52.22	-1.35	312.20	55.20	307.79	.181134	.165177	.054379	.049589	.235513	.214766
52.86	-2.59	311.50	56.05	193.27	.365627	.320927	.104627	.091836	.470253	.412763
53.58	-4.08	310.69	57.02	193.27	.365732	.321015	.104866	.092045	.470598	.413060
54.29	-5.61	309.87	57.99	193.27	.365836	.321102	.105103	.092251	.470940	.413354
54.97	-7.20	309.05	58.95	193.27	.365940	.321189	.105338	.092456	.471278	.413645
55.64	-8.84	308.23	59.89	193.27	.366042	.321274	.105569	.092658	.471611	.413932
56.28	-10.54	307.41	60.82	193.27	.366142	.321358	.105798	.092857	.471940	.414215
56.90	-12.30	306.59	61.74	193.27	.366241	.321440	.106023	.093053	.472254	.414494
57.49	-14.11	305.78	62.64	193.27	.366338	.321522	.106244	.093246	.472582	.414768
58.05	-15.98	304.98	63.52	193.27	.366434	.321601	.106460	.093435	.472894	.415036
58.59	-17.91	304.18	64.39	193.27	.366527	.321679	.106672	.093620	.473199	.415299
59.10	-19.90	303.40	65.23	193.27	.366593	.321729	.106823	.093750	.473416	.415479
59.57	-21.97	302.62	66.05	193.27	.366593	.321710	.106823	.093744	.473416	.415455
60.02	-24.05	301.86	66.84	193.27	.366593	.321692	.106823	.093739	.473416	.415431
60.42	-26.21	301.12	67.60	193.27	.366593	.321675	.106823	.093734	.473416	.415409
60.80	-28.42	300.39	68.34	193.27	.366593	.321658	.106823	.093729	.473416	.415387
61.13	-30.68	299.68	69.03	193.27	.366593	.321642	.106823	.093724	.473416	.415366
61.43	-32.99	298.99	69.69	193.27	.366593	.321627	.106823	.093720	.473416	.415347
61.69	-35.33	298.31	70.30	193.27	.366593	.321613	.106823	.093716	.473416	.415329
61.90	-37.72	297.66	70.87	193.27	.366593	.321600	.106823	.093712	.473416	.415312
62.08	-40.13	297.02	71.39	193.27	.366593	.321588	.106823	.093708	.473416	.415297
62.21	-42.57	296.39	71.85	193.27	.366593	.321578	.106823	.093705	.473416	.415283
62.30	-45.03	295.78	72.25	193.27	.366593	.321569	.106823	.093703	.473416	.415271
62.35	-47.49	295.19	72.58	193.27	.366593	.321561	.106823	.093700	.473416	.415261
62.35	-49.97	294.60	72.85	193.27	.366593	.321555	.106823	.093699	.473416	.415253
62.31	-52.43	294.01	73.04	193.27	.366593	.321550	.106823	.093697	.473416	.415248
62.22	-54.89	293.43	73.17	193.27	.366593	.321547	.106823	.093697	.473416	.415244
62.09	-57.33	292.85	73.21	193.27	.366593	.321543	.106823	.093696	.473416	.415243
61.92	-59.75	292.25	73.18	193.27	.366593	.321541	.106823	.093696	.473416	.415243
61.71	-62.14	291.64	73.08	193.27	.366593	.321541	.106823	.093697	.473416	.415247
61.45	-64.49	291.01	72.90	193.27	.366593	.321554	.106823	.093698	.473416	.415252
61.16	-66.80	290.35	72.65	193.27	.366593	.321559	.106823	.093700	.473416	.415259
60.83	-69.06	289.64	72.33	193.27	.366593	.321567	.106823	.093702	.473416	.415269
60.46	-71.28	288.89	71.94	193.27	.366593	.321575	.106823	.093705	.473416	.415280
60.05	-73.44	288.08	71.50	193.27	.366593	.321586	.106823	.093708	.473416	.415293
59.61	-75.55	287.20	70.99	193.27	.366593	.321597	.106823	.093711	.473416	.415308
59.14	-77.60	286.23	70.44	193.27	.366593	.321610	.106823	.093715	.473416	.415325
58.64	-79.59	285.17	69.83	193.27	.366593	.321624	.106823	.093719	.473416	.415343
58.10	-81.53	283.98	69.19	193.27	.366593	.321639	.106823	.093723	.473416	.415362
57.54	-83.41	282.67	68.50	193.27	.366593	.321654	.106823	.093728	.473416	.415382
56.95	-85.22	281.20	67.78	193.27	.366593	.321671	.106823	.093733	.473416	.415403
56.33	-86.99	279.55	67.02	193.27	.366593	.321688	.106823	.093738	.473416	.415426
55.69	-88.69	277.69	66.23	193.27	.366593	.321706	.106823	.093743	.473416	.415449
55.03	-90.34	275.61	65.42	193.27	.366593	.321725	.106823	.093748	.473416	.415473
54.35	-91.93	273.27	64.58	193.27	.366548	.321697	.105720	.093662	.473258	.415359
53.64	-93.47	270.63	63.72	193.27	.366455	.321619	.105509	.093474	.472955	.415097
52.92	-94.96	267.66	62.84	193.27	.366360	.321540	.105294	.093290	.472654	.414830
52.18	-96.40	264.34	61.95	193.27	.366264	.321459	.105074	.093098	.472338	.414557
51.42	-97.79	260.64	61.03	193.27	.366165	.321377	.105050	.092903	.472015	.414280
50.65	-99.14	256.35	60.11	193.27	.366065	.321293	.105022	.092704	.471697	.413998

49.06	-100.44	252.06	59.17	193.27	.365983	.321208	.105392	.092503	.471355	.413711
49.04	-101.70	247.20	58.21	193.27	.365860	.321122	.105158	.092299	.471018	.413421
48.24	-102.92	242.03	57.25	193.27	.365756	.321035	.104921	.092093	.470677	.413128
47.41	-104.10	236.62	56.27	193.27	.365651	.320948	.104682	.091884	.470333	.412831
46.57	-105.24	231.09	55.29	193.27	.365550	.320865	.103904	.091504	.469854	.412449
45.72	-106.35	225.55	54.30	193.27	.365928	.321215	.103004	.090338	.468841	.411953
44.86	-107.43	220.12	53.29	193.27	.366108	.321387	.101914	.089465	.468022	.410952
43.98	-108.47	214.91	52.29	193.27	.361169	.317303	.101095	.088916	.462254	.406119
43.10	-109.49	210.00	51.27	193.27	.354067	.311409	.100348	.088258	.454415	.399668
42.21	-110.47	205.45	50.25	193.27	.346922	.305466	.099597	.087596	.446519	.393162
41.31	-111.43	201.28	49.23	193.27	.339380	.299927	.097575	.086232	.436956	.386159
40.41	-112.36	197.49	48.19	193.27	.331684	.294453	.095128	.084450	.426812	.378903
39.50	-113.26	194.07	47.16	193.27	.323952	.288891	.092469	.082240	.416821	.371531
38.58	-114.15	191.00	46.12	193.27	.316186	.283243	.090200	.080082	.406936	.364045
37.65	-115.01	188.25	45.07	193.27	.308390	.277597	.087720	.078537	.396110	.355446
36.72	-115.84	185.78	44.02	193.27	.300584	.271651	.085232	.077044	.385796	.348735
35.78	-116.66	183.57	42.97	193.27	.292712	.265788	.082735	.075125	.375447	.340913
34.97	-117.35	181.85	42.06	307.49	.150901	.139973	.042477	.039402	.193377	.179380
34.29	-117.92	180.52	41.30	710.12	.077338	.074894	.018331	.017046	.095840	.082840

	CHARGED PART. GAMMA RAY	NEUTRONS	TOTAL	
TOTAL FLIGHT DOSE FOR SOLAR MINIMUM CONDITIONS =	2.42943	.70196	3.13139	MILLIREMS PER FLIGHT PROFILE
TOTAL FLIGHT DOSE FOR SOLAR AVERAGE CONDITIONS =	2.13881	.61791	2.75672	MILLIREMS PER FLIGHT PROFILE
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR MIN.) =	.34706	.10028	.44734	MILLIRADS PER HOUR
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR AVG.) =	.30554	.08827	.39382	MILLIREMS PER HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR MINIMUM) =	.33509	.09682	.43192	MILLIREMS / (BLOCK TIME) HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR AVERAGE) =	.29501	.08523	.38024	MILLIREMS / (BLOCK TIME) HOUR
LEG BLOCK TIME = PROFILE TIME + 0.25 HOURS				

LOS ANGELES

TO NEW YORK

SUBSONIC FLIGHT (0.75 MACH)

SCHEDULE BLOCK TIME ON ONE WAY(MRS)= 5.1

RATE OF CLIMB(FEET/MIN)= 2000.000

CRUISING ALTITUDE(FEET)= 36000 RATE OF DESCENT(FEET/MIN)= 2000.000

CLIMBING GROUND SPEED(MILES/HOUR)=413.00

CRUISING SPEED(MILES/HOUR)= 495.80 DESCENDING GROUND SPEED(MILES/HOUR)=413.00

FLIGHT ALTITUDE AND DISTANCE PROFILE IN 1/10 HOUR INCREMENTS.

ALTITUDE

12000	24000	36000	36000	36000	36000	36000	36000
36000	36000	36000	36000	36000	36000	36000	36000
36000	36000	36000	36000	36000	36000	36000	36000
36000	36000	36000	36000	36000	36000	36000	36000
35000	36000	36000	36000	36000	36000	36000	36000
36000	36000	36000	36000	36000	36000	36000	36000
24000	12000	0					

DISTANCE

41.30	41.30	41.30	49.58	49.58	49.58	49.58	49.58
49.58	49.58	49.58	49.58	49.58	49.58	49.58	49.58
49.58	49.58	49.58	49.58	49.58	49.58	49.58	49.58
49.58	49.58	49.58	49.58	49.58	49.58	49.58	49.58
49.58	49.58	49.58	49.58	49.58	49.58	49.58	49.58
49.58	49.58	49.58	49.58	49.58	49.58	49.58	49.58
41.30	41.30	41.30					

TOTAL INPUT PROFILE DISTANCE = 2478.90 STATUTE MILES

FLIGHT PROFILE TIME = 5.10 HOURS IN THE AIR

COMPUTED GREAT CIRCLE LEG DISTANCE = 2453.1 THE INITIAL COURSE ANGLE = 65.982

LEG START LATITUDE = 34.00 LEG START LONGITUDE = -118.15

LEG END LATITUDE = 40.63 LEG END LONGITUDE = -73.77

LAT.	LONG.	COURSE ANGLE	GEOG. LAT.	ATMOS. DEPT. GR/Sq. CM.	CHARGED PARTICLES AND GAMMA DOSE RATE (MREMS/HR)		NEUTRONS DOSE RATE (MREMS/HR)		TOTAL DOSE RATE DOSE RATE (MREMS/HR)	
					SOLAR MIN.	SOLAR AVG.	SOLAR MIN.	SOLAR AVG.	SOLAR MIN.	SOLAR AVG.
34.12	-117.82	99.29	41.16	827.93	.056497	.055366	.011742	.011507	.068238	.066872
34.36	-117.16	99.56	41.50	516.42	.111878	.106197	.029784	.028271	.141651	.134469
34.60	-116.49	99.83	41.84	307.49	.150056	.139260	.042212	.039175	.192298	.178435
34.85	-115.75	100.14	42.21	233.31	.225611	.207063	.063832	.058584	.289444	.265647
35.13	-114.94	100.49	42.61	233.31	.227674	.208683	.064569	.059183	.29224	.270966
35.40	-114.13	100.86	43.00	233.31	.229707	.210275	.065296	.059772	.295003	.270047
35.66	-113.31	101.23	43.39	233.31	.231709	.211838	.066011	.060350	.297720	.272189
35.92	-112.48	101.62	43.77	233.31	.233679	.213372	.066716	.060718	.300595	.274240
36.17	-111.65	102.03	44.15	233.31	.235618	.214876	.067409	.061475	.303028	.276351
36.41	-110.81	102.45	44.52	233.31	.237523	.216351	.068090	.062022	.305613	.278371
36.65	-109.97	102.89	44.88	233.31	.239394	.217795	.068758	.062555	.308153	.280349
36.89	-109.12	103.35	45.23	233.31	.241231	.219208	.069415	.063078	.310646	.282286
37.12	-108.27	103.83	45.58	233.31	.243032	.220590	.070058	.063599	.313090	.284179
37.34	-107.41	104.33	45.92	233.31	.244796	.221940	.070689	.064089	.315495	.286029
37.55	-106.55	104.85	46.25	233.31	.246523	.223259	.071306	.064577	.317829	.287836
37.76	-105.68	105.40	46.58	233.31	.248211	.224544	.071910	.065053	.320121	.289597
37.97	-104.81	105.98	46.90	233.31	.249860	.225796	.072499	.065517	.322359	.291313
38.16	-103.93	106.59	47.21	233.31	.251469	.227015	.073074	.065968	.324543	.292983
38.35	-103.05	107.23	47.51	233.31	.253037	.228200	.073634	.066407	.326671	.294606
38.54	-102.16	107.90	47.81	233.31	.254563	.229350	.074180	.066833	.328742	.296183
38.71	-101.27	108.61	48.09	233.31	.256045	.230465	.074710	.067246	.330758	.297711
38.88	-100.38	109.37	48.37	233.31	.257484	.231545	.075224	.067646	.332708	.299191
39.05	-99.48	110.16	48.64	233.31	.258878	.232589	.075722	.068032	.334600	.300621
39.20	-98.57	111.01	48.90	233.31	.260227	.233590	.076204	.068406	.336431	.302002
39.35	-97.67	111.92	49.15	233.31	.261529	.234567	.076669	.068765	.338198	.303333
39.49	-96.75	112.88	49.40	233.31	.262783	.235501	.077118	.069111	.339901	.304612
39.63	-95.84	113.91	49.63	233.31	.263989	.236396	.077549	.069443	.341538	.305840
39.75	-94.92	115.01	49.85	233.31	.265146	.237254	.077962	.069761	.343168	.307015
39.87	-94.00	116.18	50.07	233.31	.266249	.238115	.078381	.070099	.344530	.308124
39.99	-93.07	117.45	50.27	233.31	.267296	.239023	.078826	.070431	.345722	.309154
40.09	-92.15	118.81	50.47	233.31	.268292	.239887	.079283	.070746	.346855	.310133
40.19	-91.22	120.28	50.65	233.31	.269235	.240708	.079764	.071059	.347935	.311061
40.28	-90.28	121.86	50.82	233.31	.270126	.241478	.079817	.071368	.348963	.311936
40.37	-89.35	123.57	50.99	233.31	.270963	.242204	.079933	.071555	.349935	.312759
40.44	-88.41	125.43	51.14	233.31	.271745	.242893	.079941	.071646	.350796	.313529
40.51	-87.47	127.44	51.28	233.31	.272473	.243514	.079942	.071730	.351615	.314244
40.57	-86.53	129.62	51.41	233.31	.273146	.244097	.079923	.071808	.352390	.314905
40.62	-85.59	131.99	51.53	233.31	.273762	.244631	.079920	.071879	.353092	.315510
40.67	-84.64	134.57	51.64	233.31	.274322	.245116	.079937	.071944	.353719	.316060
40.70	-83.70	137.36	51.74	233.31	.274824	.245551	.079947	.071992	.354291	.316553
40.73	-82.75	140.39	51.83	233.31	.275269	.245937	.079958	.072034	.354797	.316990
40.76	-81.80	143.66	51.90	233.31	.275656	.246272	.079962	.072068	.355238	.317376
40.77	-80.85	147.19	51.96	233.31	.275985	.246557	.079967	.072100	.355612	.317691
40.78	-79.91	150.97	52.02	233.31	.276255	.246791	.079964	.072108	.355919	.317958
40.78	-78.96	154.99	52.06	233.31	.276466	.246973	.079963	.072112	.356160	.318165
40.77	-78.01	159.24	52.09	233.31	.276618	.247105	.079914	.072121	.356333	.318315
40.75	-77.06	163.69	52.11	233.31	.276711	.247186	.079927	.072122	.356439	.318406
40.72	-76.11	168.30	52.11	233.31	.276745	.247215	.079932	.072124	.356477	.318439
40.70	-75.24	172.60	52.11	307.49	.181132	.165151	.052933	.048270	.234055	.213446
40.66	-74.42	176.55	52.10	516.42	.135168	.126685	.037707	.035361	.172875	.162026
40.63	-73.67	180.49	52.08	827.93	.066634	.064959	.015010	.014635	.081644	.079604

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	CHARGED PART. GAMMA RAY	NEUTRONS	TOTAL	
TOTAL FLIGHT DOSE FOR SOLAR MINIMUM CONDITIONS =	1.23432	.35626	1.59058	MILLIREMS PER FLIGHT PROFILE
TOTAL FLIGHT DOSE FOR SOLAR AVERAGE CONDITIONS =	1.11310	.32116	1.43426	MILLIREMS PER FLIGHT PROFILE
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR MIN.) =	.24202	.06985	.31188	MILLIRADS PER HOUR
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR AVG.) =	.21025	.06297	.28123	MILLIREMS PER HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR MINIMUM) =	.23071	.06659	.29730	MILLIREMS / (BLOCK TIME) HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR AVERAGE) =	.20806	.06003	.26809	MILLIREMS / (BLOCK TIME) HOUR.

LEG BLOCK TIME = PROFILE TIME + 0.25 HOURS

LOS ANGELES

TO NEW YORK

AT 1.4 MACH

SCHEDULE BLOCK TIME ON ONE WAY(MRS)=

5.8

RATE OF CLIMB(Feet/min)= 3333.333

CRUISING ALTITUDE(Feet)=

40000

RATE OF DESCENT(Feet/min)= 3333.333

CLIMBING GROUND SPEED(MILES/HOUR)=665.00 CRUISING SPEED(MILES/HOUR)= 924.00 DESCENDING GROUND SPEED(MILES/HOUR)=665.00

FLIGHT ALTITUDE AND DISTANCE PROFILE IN 1/10 HOUR INCREMENTS.

ALTITUDE

20000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	40000	40000	40000	40000	40000	40000
40000	40000	20000	0				

DISTANCE

66.50	66.50	92.40	92.40	92.40	92.40	92.40	92.40
92.40	92.40	92.40	92.40	92.40	92.40	92.40	92.40
92.40	92.40	92.40	92.40	92.40	92.40	92.40	92.40
92.40	92.40	66.50	66.50				

TOTAL INPUT PROFILE DISTANCE = 2483.60 STATUTE MILES

FLIGHT PROFILE TIME = 2.80 HOURS IN THE AIR

COMPUTED GREAT CIRCLE LEG DISTANCE = 2453.1 THE INITIAL COURSE ANGLE = 65.982

LEG START LATITUDE = 34.00 LEG START LONGITUDE = -118.15

LEG END LATITUDE = 40.63 LEG END LONGITUDE = -73.77

LAT. LONG. COURSE ANGLE GEOMAG. LAT. CHARGED PARTICLES AND GAMMA DOSE RATE (MR/MS/HR) SOLAR MIN. SOLAR AVG.

ATMOS. DEPTH GR/SS. CH. DOSE RATE (MR/MS/HR) SOLAR MIN. SOLAR AVG.

NEUTRONS DOSE RATE (MR/MS/HR) SOLAR MIN. SOLAR AVG.

TOTAL DOSE RATE DOSE RATE (MR/MS/HR) SOLAR MIN. SOLAR AVG.

34.19	-117.62	99.37	41.26	710.12	0.77268	0.74830	0.18510	0.17926	0.95779	0.92756
34.58	-116.55	99.81	41.81	307.49	0.49946	0.19167	0.42178	0.39146	0.92124	0.78313
35.02	-115.25	100.36	42.46	193.27	0.28884	0.26287	0.81518	0.74182	0.79502	0.37099
35.52	-113.73	101.04	43.19	193.27	0.29433	0.267019	0.83554	0.75525	0.77597	0.32545
36.00	-112.20	101.76	43.90	193.27	0.29847	0.271044	0.84490	0.76821	0.84437	0.347825
36.46	-110.64	102.54	44.59	193.27	0.30488	0.274839	0.86575	0.78068	0.91353	0.352907
36.90	-109.09	103.38	45.26	193.27	0.30957	0.278520	0.88195	0.79265	0.97912	0.357785
37.32	-107.47	104.30	45.90	193.27	0.31458	0.282043	0.89679	0.80412	0.94226	0.362458
37.72	-105.86	105.29	46.52	193.27	0.31951	0.285407	0.91142	0.81506	0.91033	0.36613
38.10	-104.23	106.38	47.11	193.27	0.32358	0.288607	0.92544	0.82547	0.87154	0.371154
38.45	-102.58	107.57	47.67	193.27	0.32761	0.291639	0.93880	0.83534	0.82161	0.375173
38.78	-100.92	108.90	48.20	193.27	0.331751	0.294501	0.95149	0.84465	0.76500	0.378668
39.09	-99.25	110.37	48.71	193.27	0.335619	0.297189	0.96347	0.85340	0.73156	0.382329
39.37	-97.56	112.02	49.18	193.27	0.339057	0.299699	0.97473	0.86158	0.68557	0.385957
39.62	-95.86	113.88	49.62	193.27	0.342358	0.302028	0.98522	0.86916	0.640379	0.389445
39.86	-94.14	115.99	50.03	193.27	0.345595	0.304194	0.99437	0.87576	0.601770	0.391770
40.06	-92.42	118.40	50.41	193.27	0.348822	0.306382	0.99913	0.88173	0.564332	0.394164
40.24	-90.68	121.17	50.75	193.27	0.352042	0.308363	0.99963	0.88783	0.52735	0.396333
40.40	-88.94	124.36	51.05	193.27	0.355251	0.310333	0.99963	0.88938	0.490356	0.398370
40.53	-87.19	128.07	51.32	193.27	0.358401	0.311687	0.99963	0.88938	0.45333	0.399371
40.63	-85.43	132.39	51.55	193.27	0.361607	0.313020	0.99963	0.88938	0.41631	0.401331
40.71	-83.67	137.43	51.74	193.27	0.364744	0.31431	0.99963	0.88938	0.37937	0.40347
40.75	-81.91	143.28	51.89	193.27	0.367808	0.315014	0.99963	0.88938	0.34247	0.405613
40.78	-80.14	149.61	52.01	193.27	0.370868	0.315668	0.99963	0.88938	0.30547	0.407752
40.77	-78.37	157.59	52.08	193.27	0.373906	0.316090	0.99963	0.88938	0.26847	0.409891
40.74	-76.61	165.88	52.11	193.27	0.376935	0.316280	0.99963	0.88938	0.23145	0.412030
40.69	-75.09	173.38	52.11	307.49	0.181375	0.165175	0.252332	0.222666	0.116145	0.111584
40.63	-73.82	179.74	52.08	710.12	0.925553	0.888918	0.23592	0.222666	0.116145	0.111584

	CHARGED PART. GAMMA RAY	NEUTRONS	TOTAL	
TOTAL FLIGHT DOSE FOR SOLAR MINIMUM CONDITIONS =	.85334	.24209	1.09543	MILLIREMS PER FLIGHT PROFILE
TOTAL FLIGHT DOSE FOR SOLAR AVERAGE CONDITIONS =	.75944	.21541	.97485	MILLIREMS PER FLIGHT PROFILE
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR MIN.) =	.30476	.08646	.39122	MILLIRADS PER HOUR
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR AVG.) =	.27123	.07693	.34816	MILLIREMS PER HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR MINIMUM) =	.27978	.07937	.35916	MILLIREMS / (BLOCK TIME) HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR AVERAGE) =	.24900	.07063	.31962	MILLIREMS / (BLOCK TIME) HOUR
<hr/>				
LEG BLOCK TIME = PROFILE TIME + 0.25 HOURS				

SUBSONIC FLIGHT (0.75 MACH)

10.0

RATE OF DESCENT (FEET/MIN) = 2000.000

DESCENDING GROUND SPEED (MILES/HOUR) = 413.00

FLIGHT ALTITUDE AND DISTANCE PROFILE IN 1/10 HOUR INCREMENTS.

[illegible][illegible]

FLIGHT PROFILE TIME 10.00 HOURS IN THE AIR

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COMPUTED GREAT CIRCLE LEG DISTANCE = 4884.0 THE INITIAL COURSE ANGLE = 33.163

LEG START LATITUDE = 38.55 LEG START LONGITUDE = -77.00

LEG END LATITUDE = 55.45 LEG END LONGITUDE = -37.42

LAT.	LONG.	COURSE ANGLE	GEOMD. LAT.	ATMOS. PRESS. MB.	CHARGED PARTICLES AND GAMMA DOSE RATE (MR/HR) SOLAR AVO.	NEUTRONS DOSE RATE (MR/HR) SOLAR AVO.	TOTAL DOSE RATE (MR/HR) SOLAR AVO.
38.50	-76.79	36.57	56.17	827.93	.066540	.014757	.081303
39.30	-76.37	36.60	56.68	516.42	.135141	.037235	.172376
39.80	-75.94	36.64	51.19	307.49	.181131	.052504	.233635
40.34	-75.45	36.69	51.75	233.31	.274888	.079475	.354363
40.94	-74.92	36.75	52.36	233.31	.278902	.079906	.358808
41.53	-74.38	36.81	52.96	233.31	.281100	.080334	.361434
42.11	-73.82	36.87	53.56	233.31	.281891	.080794	.362685
42.70	-73.29	36.94	54.16	233.31	.282337	.081254	.363591
43.28	-72.76	37.00	54.76	233.31	.282597	.081688	.364285
43.86	-72.20	37.08	55.34	233.31	.282598	.082110	.365220
44.44	-71.51	37.15	55.92	233.31	.282633	.082614	.366227
45.01	-70.90	37.23	56.50	233.31	.282687	.083191	.367378
45.58	-70.28	37.31	57.04	233.31	.282763	.083787	.368565
46.15	-69.64	37.40	57.65	233.31	.282865	.084365	.369711
46.71	-69.00	37.48	58.21	233.31	.282966	.084965	.370882
47.27	-68.34	37.57	58.77	233.31	.283067	.085151	.371708
47.83	-67.66	37.66	59.32	233.31	.283166	.085236	.372362
48.38	-66.97	37.76	59.87	233.31	.283265	.085362	.372949
48.94	-66.28	37.85	60.41	233.31	.283362	.085483	.373411
49.50	-65.55	37.95	60.91	233.31	.283458	.085595	.373793
50.01	-64.81	38.05	61.47	233.31	.283553	.085703	.374111
50.54	-64.06	38.15	61.98	233.31	.283650	.085829	.374366
51.07	-63.29	38.25	62.49	233.31	.283747	.085947	.374583
51.59	-62.51	38.35	62.99	233.31	.283846	.086029	.374765
52.11	-61.70	38.45	63.48	233.31	.283946	.086118	.374913
52.62	-60.88	38.55	63.97	233.31	.284046	.086206	.375026
53.13	-60.03	38.66	64.44	233.31	.284146	.086297	.375097
53.63	-59.17	38.76	64.90	233.31	.284246	.086382	.375167
54.12	-58.29	38.86	65.35	233.31	.284346	.086475	.375238
54.61	-57.38	38.96	65.78	233.31	.284446	.086567	.375309
55.11	-56.45	39.06	66.21	233.31	.284546	.086657	.375382
55.60	-55.50	39.15	66.62	233.31	.284646	.086746	.375458
56.09	-54.54	39.23	67.02	233.31	.284746	.086832	.375532
56.58	-53.57	39.33	67.39	233.31	.284846	.086918	.375607
57.04	-52.52	39.42	67.76	233.31	.284946	.087002	.375683
57.58	-51.47	39.50	68.11	233.31	.285046	.087087	.375759
58.11	-50.40	39.58	68.44	233.31	.285146	.087172	.375836
58.63	-49.31	39.65	68.75	233.31	.285246	.087256	.375913
59.15	-48.19	39.71	69.05	233.31	.285346	.087339	.375990
59.65	-47.04	39.77	69.32	233.31	.285446	.087424	.376067
59.95	-45.86	39.82	69.57	233.31	.285546	.087507	.376144
59.83	-44.66	39.86	69.81	233.31	.285646	.087589	.376221
59.80	-43.33	39.91	70.02	233.31	.285746	.087672	.376298
60.59	-42.17	39.94	70.20	233.31	.285846	.087754	.376375
61.37	-40.97	39.97	70.37	233.31	.285946	.087836	.376452
61.56	-39.73	39.99	70.52	233.31	.286046	.087918	.376529
61.66	-38.23	39.99	70.62	233.31	.286146	.087999	.376606
61.77	-36.56	39.96	70.71	233.31	.286246	.088079	.376683
62.17	-35.47	39.81	70.78	233.31	.286346	.088158	.376760
62.45	-34.05	39.74	70.81	233.31	.286446	.088236	.376837
62.71	-32.60	39.65	70.83	233.31	.286546	.088313	.376914

62.96	-31.12	39.54	70.61	233.31	284166	253385	084276	075152	368422	358537
63.20	-28.63	39.42	70.78	233.31	284166	253386	084276	075152	368422	358538
63.42	-28.10	39.27	70.71	233.31	284166	253387	084276	075153	368422	358539
63.62	-28.56	38.09	70.62	233.31	284166	253388	084276	075153	368422	358541
63.80	-24.99	38.89	70.51	233.31	284166	253390	084276	075154	368422	358544
63.97	-23.41	38.67	70.37	233.31	284166	253393	084276	075154	368422	358547
64.12	-21.80	38.42	70.20	233.31	284166	253396	084276	075155	368422	358551
64.26	-20.18	38.14	70.02	233.31	284166	253399	084276	075155	368422	358555
64.37	-18.54	37.83	69.81	233.31	284166	253403	084276	075157	368422	358560
64.47	-16.90	37.49	69.58	233.31	284166	253407	084276	075159	368422	358566
64.55	-15.24	37.12	69.32	233.31	284166	253411	084276	075160	368422	358571
64.61	-13.57	36.71	69.05	233.31	284166	253416	084276	075161	368422	358578
64.65	-11.90	36.28	68.75	233.31	284166	253421	084276	075163	368422	358584
64.67	-10.22	35.81	68.44	233.31	284166	253427	084276	075165	368422	358592
64.67	-8.54	35.30	68.11	233.31	284166	253433	084276	075166	368422	358599
64.65	-6.87	34.76	67.76	233.31	284166	253439	084276	075168	368422	358607
64.62	-5.19	34.19	67.40	233.31	284166	253446	084276	075170	368422	358616
64.56	-3.52	33.58	67.02	233.31	284166	253452	084276	075172	368422	358625
64.49	-1.86	32.93	66.62	233.31	284166	253459	084276	075174	368422	358634
64.40	-0.21	32.25	66.21	233.31	284166	253467	084276	075176	368422	358643
64.29	1.43	31.55	65.79	233.31	284166	253474	084276	075179	368422	358653
64.16	3.05	30.79	65.35	233.31	284166	253482	084276	075181	368422	358663
64.01	4.66	30.00	64.90	233.31	284166	253490	084258	075168	368422	358674
63.85	6.25	29.19	64.44	233.31	284166	253501	084176	075098	368322	358685
63.67	7.83	28.33	63.97	233.31	284166	253512	084092	075026	368238	358699
63.47	9.38	27.45	63.49	233.31	284166	253523	084007	074953	368153	358727
63.26	10.91	26.53	63.00	233.31	284166	253535	083919	074879	368065	358743
63.03	12.41	25.58	62.50	233.31	284166	253547	083830	074802	367976	358761
62.78	13.89	24.66	61.99	233.31	284166	253559	083739	074725	367886	358784
62.52	15.35	23.68	61.47	233.31	284166	253571	083647	074646	367793	358817
62.24	16.78	22.54	60.95	233.31	284166	253583	083554	074567	367700	358849
61.95	18.18	21.47	60.41	233.31	284166	253595	083459	074486	367605	358881
61.65	19.55	20.37	59.87	233.31	284166	253608	083363	074404	367509	358913
61.33	20.90	19.25	59.33	233.31	284166	253621	083266	074320	367412	358941
61.00	22.22	18.09	58.77	233.31	284166	253634	083167	074236	367313	358970
60.65	23.52	16.91	58.22	233.31	284166	253647	083068	074151	367214	358998
60.30	24.78	15.71	57.65	233.31	284166	253660	082967	074066	367113	359026
59.93	26.02	14.48	57.08	233.31	284166	253673	082866	073979	367012	359054
59.55	27.23	13.22	56.51	233.31	284166	253686	082763	073892	366910	359082
59.16	28.41	11.94	55.93	233.31	284078	253698	082658	073795	366806	359110
58.75	29.57	10.63	55.34	233.31	283523	253712	082551	073698	366696	359138
58.35	30.69	9.30	54.76	233.31	282965	253726	082441	073598	366581	359166
57.92	31.80	7.94	54.16	233.31	282402	253740	082328	073492	366469	359194
57.49	32.87	6.56	53.57	233.31	281836	253754	082211	073381	366350	359222
57.06	33.92	5.15	52.97	233.31	281270	253768	082092	073266	366234	359250
56.61	34.95	3.72	52.36	233.31	280700	253782	081968	073147	366113	359278
56.19	35.87	2.38	51.81	233.31	280131	253796	081837	073022	365994	359306
55.81	36.69	1.14	51.30	233.31	279563	253810	081701	072892	365869	359334
55.41	37.49	356.89	50.79	827.93	0665575	253824	081561	072754	365740	359362
										359390

	CHARGED PART. GAMMA RAY	NEUTRONS	TOTAL	
TOTAL FLIGHT DOSE FOR SOLAR MINIMUM CONDITIONS =	2.74359	.86593	3.54952	MILLIREMS PER FLIGHT PROFILE
TOTAL FLIGHT DOSE FOR SOLAR AVERAGE CONDITIONS =	2.45099	.71987	3.17086	MILLIREMS PER FLIGHT PROFILE
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR MIN.) =	.27436	.08059	.35495	MILLIRADS PER HOUR
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR AVG.) =	.24510	.07199	.31709	MILLIREMS PER HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR MINIMUM) =	.26767	.07863	.34630	MILLIREMS / (BLOCK TIME) HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR AVERAGE) =	.23912	.07023	.30935	MILLIREMS / (BLOCK TIME) HOUR
LEG BLOCK TIME = PROFILE TIME + 0.25 HOURS				

SUBSONIC FLIGHT (0.83 MACH)

B.B.

RATE OF DESCENT (FEET/MIN) = 2000.000

DESCENDING GROUND SPEED (MILES/HOUR) = 457.00

FLIGHT ALTITUDE AND DISTANCE PROFILE IN 1/10 HOUR INCREMENTS.

ALTITUDE[illegible]

DISTANCE

[illegible]

TOTAL INPUT PROFILE DISTANCE = 6772.77 STATUTE MILES

FLIGHT PROFILE TIME = 9.80 HOURS IN THE AIR

COMPUTED GREAT CIRCLE LEG DISTANCE = 4773.2 TIME INITIAL COURSE ANGLE = 148-800

LEG START LATITUDE = 40-63 LEG START LONGITUDE = -73-77

LEG END LATITUDE = -22-00 LEG END LONGITUDE = -42-30

LAT.	LONG.	COURSE	GEOMAG. LAT.	ATMOS. DEPTH GR/SQ. CM.	CHARGED PARTICLES AND GAMMA		NEUTRONS		TOTAL DOSE RATE	
					DOSE RATE (MREMS/HR)	SOLAR AVG.	DOSE RATE (MREMS/HR)	SOLAR AVG.	DOSE RATE (MREMS/HR)	SOLAR AVG.
40.35	-73.55	150.40	51.80	827.93	0.06621	0.04957	0.01074	0.01599	0.08195	0.07956
39.75	-73.75	150.40	51.28	827.93	0.12617	0.04957	0.03742	0.035073	0.12574	0.12143
39.31	-72.60	151.32	50.96	827.93	0.06621	0.04957	0.03742	0.035073	0.03395	0.03235
38.58	-72.19	151.32	50.05	827.93	0.06621	0.04957	0.03742	0.035073	0.04760	0.04506
37.69	-71.68	152.33	49.38	827.93	0.06621	0.04957	0.03742	0.035073	0.06076	0.05822
37.20	-71.19	152.33	48.69	827.93	0.06621	0.04957	0.03742	0.035073	0.03951	0.03686
36.51	-70.70	153.34	48.00	827.93	0.06621	0.04957	0.03742	0.035073	0.03020	0.02729
35.82	-70.22	153.83	47.31	827.93	0.06621	0.04957	0.03742	0.035073	0.02536	0.02236
35.12	-69.75	154.31	46.62	827.93	0.06621	0.04957	0.03742	0.035073	0.02053	0.01753
34.42	-69.29	154.78	45.92	827.93	0.06621	0.04957	0.03742	0.035073	0.01569	0.01269
33.72	-68.83	155.24	45.22	827.93	0.06621	0.04957	0.03742	0.035073	0.01086	0.00786
33.02	-68.36	155.69	44.52	827.93	0.06621	0.04957	0.03742	0.035073	0.00603	0.00303
32.32	-67.90	156.15	43.82	827.93	0.06621	0.04957	0.03742	0.035073	0.00120	0.00020
31.62	-67.44	156.60	43.12	827.93	0.06621	0.04957	0.03742	0.035073	0.00037	0.00037
30.91	-67.00	156.98	42.42	827.93	0.06621	0.04957	0.03742	0.035073	0.00004	0.00004
30.20	-66.56	157.39	41.69	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
29.50	-66.24	157.80	40.98	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
28.79	-65.84	158.19	40.27	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
28.08	-65.43	158.58	39.55	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
27.36	-65.03	158.96	38.83	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
26.65	-64.64	159.34	38.11	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
25.94	-64.25	159.71	37.39	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
25.22	-63.87	160.07	36.67	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
24.51	-63.49	160.42	35.95	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
23.79	-63.11	160.77	35.23	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
23.07	-62.74	161.11	34.50	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
22.35	-62.37	161.44	33.77	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
21.63	-62.01	161.77	33.04	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
20.91	-61.65	162.10	32.31	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
20.19	-61.29	162.41	31.58	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
19.47	-60.94	162.73	30.85	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
18.75	-60.59	163.04	30.11	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
18.02	-60.24	163.34	29.38	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
17.30	-59.90	163.64	28.65	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
16.57	-59.55	163.94	27.91	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
15.85	-59.20	164.23	27.17	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
15.12	-58.85	164.52	26.43	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
14.40	-58.50	164.81	25.69	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
13.67	-58.15	165.09	24.95	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
12.95	-57.80	165.37	24.22	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
12.22	-57.45	165.65	23.48	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
11.49	-57.10	165.92	22.74	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
10.76	-56.75	166.19	22.00	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
10.03	-56.50	166.46	21.26	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
9.31	-56.27	166.73	20.51	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
8.58	-56.03	166.99	19.77	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
7.85	-55.79	167.26	19.03	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
7.12	-55.55	167.52	18.28	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
6.39	-55.31	167.78	17.54	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
5.66	-55.07	168.04	16.79	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000
4.93	-54.83	168.30	16.05	827.93	0.06621	0.04957	0.03742	0.035073	0.00000	0.00000

420	54.05	150.54	233.31	139.69	13726	62946	02223	16641	16194
3.7	53.73	168.62	233.21	137852	136266	026707	020012	164559	160278
2.74	53.42	169.08	233.31	136235	136266	026467	025801	164559	158603
2.01	53.11	169.34	233.31	13616	131336	026228	025859	160845	158925
1.28	52.79	169.60	233.31	135989	128866	025969	025377	158937	158342
55	52.48	169.86	233.31	131378	128393	025749	025164	157128	157557
-1.0	52.17	170.12	233.31	128759	126916	025510	024951	155238	151967
-1.85	51.86	170.38	233.31	128138	126437	025270	024737	153408	150174
-2.38	51.54	170.64	233.31	127826	125916	025030	024522	151966	147886
-3.11	51.23	170.91	233.31	127524	125433	0247917	024312	150417	145544
-3.84	50.92	171.18	233.31	127224	124951	024571	024091	149031	143030
-4.57	50.60	171.45	233.31	127460	124469	0243571	023691	147661	140600
-5.30	50.29	171.72	233.31	127288	124005	0241225	0234770	146819	138819
-6.03	49.98	171.99	233.31	127064	123523	023879	0232609	145421	136875
-6.76	49.64	172.27	233.31	126841	123041	023606	023048	144032	134832
-7.49	49.34	172.55	233.31	126617	122559	0233706	022887	142641	132889
-8.22	48.71	173.13	233.31	126395	122076	0231333	022655	1412505	130905
-8.94	48.39	173.42	233.31	126172	121594	0228979	022426	140000	128924
-9.67	48.07	173.72	233.31	1259403	121111	022668	022203	138759	126959
-10.40	47.75	174.02	233.31	125708	120629	022431	021983	137511	124969
-11.13	47.42	174.33	233.31	125477	120146	022197	021764	136264	122931
-11.86	47.10	174.65	233.31	125244	119663	021961	021548	135011	120911
-12.58	46.77	174.97	233.31	125011	119180	021726	021335	133764	118882
-13.31	46.44	175.30	233.31	124779	118697	021491	021122	132517	116854
-14.04	46.11	175.63	233.31	124546	118214	021256	020909	131270	114824
-14.76	45.78	175.98	233.31	124313	117731	021021	020696	130023	112794
-15.49	45.44	176.33	233.31	124080	117248	020786	020483	128776	110764
-16.22	45.10	176.69	233.31	123847	116765	020571	020270	127529	108734
-16.94	44.77	177.06	233.31	123614	116282	020356	020057	126282	106704
-17.66	44.42	177.44	233.31	123381	115799	020141	019744	125035	104674
-18.39	44.08	177.84	233.31	123148	115316	019926	019519	123788	102644
-19.11	43.73	178.24	233.31	122915	114833	019711	019304	122541	100614
-19.83	43.38	178.64	233.31	122682	114350	019496	019089	121294	98570
-20.56	43.03	179.04	233.31	122449	113867	019281	018874	120047	96481
-21.28	42.68	179.42	233.31	122216	113384	019066	018659	118800	94392
-21.99	42.33	179.80	233.31	121983	112901	018851	018444	117552	92303
-22.69	41.98	180.18	233.31	121750	112418	018636	018229	116305	90214
-23.39	41.63	180.56	233.31	121517	111935	018421	017814	115058	88125
-24.09	41.28	180.94	233.31	121284	111452	018206	017600	113811	86036
-24.79	40.93	181.32	233.31	121051	110969	017991	017387	112564	83947
-25.49	40.58	181.70	233.31	120818	110486	017776	017183	111317	81858
-26.19	40.23	182.08	233.31	120585	110003	017561	016970	110070	79769
-26.89	39.88	182.46	233.31	120352	109520	017346	016759	108823	77680
-27.59	39.53	182.84	233.31	120119	109037	017131	016548	107576	75591
-28.29	39.18	183.22	233.31	119886	108554	016916	016337	106329	73502
-28.99	38.83	183.60	233.31	119653	108071	016701	016126	105082	71413
-29.69	38.48	183.98	233.31	119420	107588	016486	015915	103835	69324
-30.39	38.13	184.36	233.31	119187	107105	016271	015704	102588	67235
-31.09	37.78	184.74	233.31	118954	106622	016056	015493	101341	65146
-31.79	37.43	185.12	233.31	118721	106139	015841	015282	100094	63057
-32.49	37.08	185.50	233.31	118488	105656	015626	015071	98907	60968
-33.19	36.73	185.88	233.31	118255	105173	015411	014860	96818	58879
-33.89	36.38	186.26	233.31	118022	104690	015196	014649	94729	56790
-34.59	36.03	186.64	233.31	117789	104207	014981	014438	92630	54701
-35.29	35.68	187.02	233.31	117556	103724	014766	014227	90541	52612
-35.99	35.33	187.40	233.31	117323	103241	014551	014016	88452	50523
-36.69	34.98	187.78	233.31	117090	102758	014336	013805	86363	48434
-37.39	34.63	188.16	233.31	116857	102275	014121	013594	84274	46345
-38.09	34.28	188.54	233.31	116624	101792	013906	013383	82185	44256
-38.79	33.93	188.92	233.31	116391	101309	013691	013172	80096	42167
-39.49	33.58	189.30	233.31	116158	100826	013476	012961	78007	40078
-40.19	33.23	189.68	233.31	115925	100343	013261	012750	75918	37989
-40.89	32.88	190.06	233.31	115692	99860	013046	012539	73829	35900
-41.59	32.53	190.44	233.31	115459	99377	012831	012328	71740	33811
-42.29	32.18	190.82	233.31	115226	98894	012616	012117	69651	31722
-42.99	31.83	191.20	233.31	114993	98411	012401	011906	67562	29633
-43.69	31.48	191.58	233.31	114760	97928	012186	011695	65473	27544
-44.39	31.13	191.96	233.31	114527	97445	011971	011484	63384	25455
-45.09	30.78	192.34	233.31	114294	96962	011756	011273	61295	23366
-45.79	30.43	192.72	233.31	114061	96479	011541	011062	59206	21277
-46.49	30.08	193.10	233.31	113828	95996	011326	010851	57117	19188
-47.19	29.73	193.48	233.31	113595	95513	011111	010640	55028	17099
-47.89	29.38	193.86	233.31	113362	95030	010896	010429	52939	15010
-48.59	29.03	194.24	233.31	113129	94547	010681	010218	50850	12921
-49.29	28.68	194.62	233.31	112896	94064	010466	010007	48761	10832
-49.99	28.33	195.00	233.31	112663	93581	010251	009796	46672	8743
-50.69	27.98	195.38	233.31	112430	93098	010036	009585	44583	6654
-51.39	27.63	195.76	233.31	112197	92615	009821	009374	42494	4565
-52.09	27.28	196.14	233.31	111964	92132	009606	009163	40405	2476
-52.79	26.93	196.52	233.31	111731	91649	009391	008978	38316	387
-53.49	26.58	196.90	233.31	111498	91166	009176	008763	36227	178
-54.19	26.23	197.28	233.31	111265	90683	008961	008548	34138	169
-54.89	25.88	197.66	233.31	111032	90200	008746	008333	32049	70
-55.59	25.53	198.04	233.31	110799	89717	008531	008118	30000	61
-56.29	25.18	198.42	233.31	110566	89234	008316	007903	27951	52
-56.99	24.83	198.80	233.31	110333	88751	008101	007690	25902	43
-57.69	24.48	199.18	233.31	110100	88268	007886	007473	23853	34
-58.39	24.13	199.56	233.31	109867	87785	007671	007258	21804	25
-59.09	23.78	199.94	233.31	109634	87302	007456	007043	19755	16
-59.79	23.43	200.32	233.31	109401	86819	007241	006828	17706	7
-60.49	23.08	200.70	233.31	109168	86336	007026	006613	15657	1
-61.19	22.73	201.08	233.31	108935	85853	006811	006398	13608	2
-61.89	22.38	201.46	233.31	108702	85370	006596	006183	11559	3
-62.59	22.03	201.84	233.31	108469	84887	006381	005968	9510	4
-63.29	21.68	202.22	233.31	108236	84404	006166	005753	7461	5
-63.99	21.33	202.60	233.31	108003	83921	005951	005538	5412	6
-64.69	20.98	202.98	233.31	107770	83438	005736	005323	3363	7
-65.39	20.63	203.36	233.31	107537	82955	005521	005108	1314	8
-66.09	20.28	203.74	233.31	107304	82472	005306	004893	9265	9
-66.79	19.93	204.12	233.31	107071	81989	005091	004678	7216	10
-67.49	19.58	204.50	233.31	106838	81506	004876	004463	5167	11
-68.19	19.23	204.88	233.31	106605	81023	004661	004248	3118	12
-68.89	18.88	205.26	233.31	106372	80540	004446	004033	1069	13
-69.59	18.53	205.64	233.31	106139	80057	004231	003818	905	14
-70.29	18.18	206.02	233.31	105906	79574	004016	003603	700	15
-70.99	17.83	206.40	233.31	105673	79091	003801	003388	495	16
-71.69	17.48	206.78	233.31	105440	78608	003586	003173	290	17
-72.39	17.13	207.16	233.31	105207	78125	003371	002958	85	18
-73.09	16.78	207.54	233.31	104974	77642	003156	002743	80	19
-73.79	16.43	207.92	233.31	104741	77159	002941	002528	55	20
-74.49	16.08	208.30	233.31	104508	76676	002726	002313	30	21
-75.19	15.73	208.68	233.31	104275	76193	002511	002098	5	22
-75.89	15.38	209.06	233.31	1040					

	CHARGED PART. GAMMA RAY	NEUTRONS	TOTAL	
TOTAL FLIGHT DOSE FOR SOLAR MINIMUM CONDITIONS =	1.43420	.33158	1.76578	MILLIREMS PER FLIGHT PROFILE
TOTAL FLIGHT DOSE FOR SOLAR AVERAGE CONDITIONS =	1.36099	.31292	1.67391	MILLIREMS PER FLIGHT PROFILE
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR MIN.) =	.16298	.03768	.20066	MILLIRADS PER HOUR
AVG. DOSE / FLIGHT PROFILE HOUR (SOLAR AVG.) =	.15466	.03556	.19022	MILLIREMS PER HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR MINIMUM) =	.15847	.03664	.19511	MILLIREMS / (BLOCK TIME) HOUR
AVG. DOSE / BLOCK TIME HOUR (SOLAR AVERAGE) =	.15039	.03458	.18496	MILLIREMS / (BLOCK TIME) HOUR

LEG BLOCK TIME = PROFILE TIME + 0.25 HOURS.