NASA TECHNICAL MEMORANDUM

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A COLLECTION OF LOWER THERMOSPHERIC (100 to 300 KM ALTITUDE) CHEMICAL COMPOSITION, TEMPERATURE, AND MASS DENSITY DATA

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16. ABSTRACT

This report contains atmospheric data that have been obtained by various investigators from 38 rocket-probe flights and two satellite-borne absorption spectrometers. The data sample is by no means complete but should provide valuable inputs to studies concerning the structure and variability of the atmosphere.

Atmospheric temperature, mass density, and constituent number densities of N_2, O_2, O, He, and H as calculated from the MSFC Modified Jacchia Model Atmosphere, 1967, for the conditions of a particular observation are tabulated from 120 to 1,000 km for most of the observations. These data should also provide valuable inputs to various studies. In using these data, however, the investigator should consider the limitations (constant 120 km boundary conditions, empirical temperature, etc.) of the MSFC Model Atmosphere.

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TECHNICAL MEMORANDUM X-53994

A COLLECTION OF LOWER THERMOSPHERIC (100 TO 300 KM ALTITUDE) CHEMICAL COMPOSITION, TEMPERATURE, AND MASS DENSITY DATA

SUMMARY

This report contains atmospheric data that have been obtained by various investigators from 38 rocket-probe flights and two satellite-borne absorption spectrometers. The data sample is by no means complete but should provide valuable inputs to studies concerning the structure and variability of the atmosphere.

Atmospheric temperature, mass density, and constituent number densities of N_2, O_2, O, He, and H as calculated from the MSFC Modified Jacchia Model Atmosphere, 1967, for the conditions of a particular observation are tabulated from 120 to 1,000 km for most of the observations. These data should also provide valuable input to various studies. In using these data, however, the investigator should consider the limitations (constant 120 km boundary conditions, empirical temperature, etc.) of the MSFC Model Atmosphere.

INTRODUCTION

In conducting studies for the development of an improved description of the upper atmosphere, it is necessary that a very large amount of data be considered. As these data are scattered through numerous technical reports and scientific publications, this document was developed to provide a compilation of rocket-probe data and also to provide a listing of the various source references. It is anticipated that this report will be very useful to investigators concerned with the development of an improved upper atmospheric model.

The report may also be useful to investigators concerned with the finite structure of the atmosphere. These investigators, however, should obtain the original source references, so that proper consideration may be given to the assumptions made in reducing a particular set of data.

MEASURED DATA

The conditions under which the measurements were made are given for each of the observations in Table 1. Tests 10 and 35, however, consist of observations taken under different conditions. The flight conditions for these tests are provided with the data.

All of the tests except tests 10, 28, 29, and 35 consist of measurements that were made by rocket-borne mass spectrometers. Some of these mass spectrometers measured N_2 only, while others also measured O_2, O, He, H, or Ar. Test 10 consists of atmospheric mass density deduced from the NRL 1965-16D satellite, Tests 28 and 29 consist of data deduced from the OSO-III satellite, and Test 35 is a collection of O/O_2 ratios at 120 km altitude.

The data sample contained is by no means complete, but the document will be updated on a continuing basis and will finally include all available data.

THE MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

The MSFC Modified Jacchia Model Atmosphere (1967), which is basically a computerized version of Jacchia's Static Diffusion Model [1], is used to calculate the gas properties of the atmosphere between 120 and 1,000 km altitude for the conditions under which each of the observations were taken.

In developing the MSFC model, the diffusion equation was integrated by a technique given by Walker [2], and the temperature dependency of the thermal diffusion factor for hydrogen was obtained from the hydrogen profiles of Jacchia's model. The contribution of hydrogen to the total mass density, however, is very small (approximately one percent at 500 km) and could be neglected without any serious consequences.

The MSFC model is simpler and better defined than the other existing models. However, as in other current models, constant boundary limitations do not allow the atmospheric composition and temperature to be realistically defined. These quantities represent only one of the many combinations of temperature and composition that may be associated with the mass density. This weakness does not limit the accuracy of the mass density that is defined by the MSFC model.

Another limitation of the MSFC model is that it does not adequately represent the atmosphere at high latitudes. From the analysis of satellite drag data, it has been established that a polar bulge exists in the winter hemisphere between about 60 and 80 degrees latitude. The atmospheric density at the center of this bulge may be a factor of 2 or 3 higher than the density at the lower latitudes. This polar bulge has not been incorporated into the current MSFC Model Atmosphere.

Even though the MSFC model is seriously limited as described above, the calculated gas properties which were obtained from its application may be of use to some investigators. Tabulations of the gas properties from 120 to 1,000 km altitude were developed using the MSFC model and are given following the respective test condition for which the calculations were made.

Table I. Flight Conditions for Rocket-Probe Observations

Test #	Date	Day Number	GMT Time	Local Time	Daily 10.7 cm Solar Flux	81-day Mean Solar Flux	3 Hourly a_p*	Latitude N(+),S(-)	Longitude E(+),W(-)	Source Reference
1	Jan. 24, 1967	24	0900	0400	152	128	3.7	28.4575	-80.5278	[3]
2	Jan. 24, 1967	24	1151	0651	152	128	1.8	28.4575	-80.5278	[3]
3	Jan. 24, 1967	24	1509	1009	152	128	0.0	28.4575	-80.5278	[3]
4	Jan. 24, 1967	24	1934	1434	152	128	1.4	28.4575	-80.5278	[3]
5	Jan. 24, 1967	24	2250	1750	152	128	2.0	28.4575	-80.5278	[3]
6	Jan. 25, 1967	25	0300	2200	152	128	2.5	28.4575	-80.5278	[3]
7	Apr. 25, 1967	115	0630	0130	131	146	18.2	28.4574	-80.5278	[3]
8	Apr. 25, 1967	115	1900	1400	131	146	5.2	28.4574	-80.5278	[3]
9	Mar. 19, 1965	78	1809	1309	77	76	5.0	37.83	-75.48	[4]
10	Atmospheric density deduced from the NRL 1965-16 D satellite									[21]
11	Nov. 9, 1965	313	1916	1316	82	77	4.0	58.73	-93.82	[4]
12	Nov. 10, 1965	314	0700	0100	85	77	0.0	58.73	-93.82	[4]
13	Apr. 15, 1965	105	1045	0345	75	74	5.0	32.3	-106.49	[5]
14	Nov. 30, 1966	334	1045	0445	97	112	10.0	32.3	-106.49	[6]
15	Dec. 2, 1966	336	2009	1409	97	112	4.0	32.3	-106.49	[6]
16	June 21, 1967	172	1849	1249	119	131	4.0	32.3	-106.49	[7]
17	July 20, 1967	171	0800	0200	131	128	7.0	32.3	-106.49	[7]
18	July 20, 1967	171	1824	1224	131	128	3.0	32.3	-106.49	[7]
19	Dec. 11, 1965	345	0443	0443	76	78	16.0	39.6	9.4	[8]
20	June 6, 1963	208	1430	0730	77	82	3.0	32.3	-106.49	[9]
21	Nov. 20, 1962	324	2141	1641	87	88	4.0	37.83	-75.48	[10]
22	Apr. 18, 1963	108	2104	1604	88	79	18.0	37.83	-75.48	[10]
23	July 20, 1963	201	2154	1654	76	83	10.0	37.83	-75.48	[10]
24	Aug. 26, 1966	238	1831	1331	127	102	3.0	37.83	-75.48	[4]
25	Aug. 28, 1966	240	0403	2303	130	103	3.0	37.83	-75.48	[4]

*These values are representative of the geomagnetic conditions six hours prior to time of flight.

Table I. Flight Conditions for Rocket-Probe Observations (Continued)

Test #	Date	Day Number	GMT Time	Local Time	Daily 10.7 cm Solar Flux	81-day Mean Solar Flux	3 Hourly a_p^*	Latitude N(+),S(-)	Longitude E(+),W(-)	Source Reference
26	Aug. 26, 1966	238	1851	1351	127	102	3.0	37.83	-75.48	[4]
27	Jan. 29, 1964	29	0309	2209	78	78	20.0	37.83	-75.48	[10]
28	Mar. 19, 1967	78	1200	0600	137	149	20.0	32.00	-107.00	[11]
29	Mar. 19, 1967	78	1300	1800	137	149	22.0	-20.00	+82.00	[11]
30	Mar. 2, 1966	61	1800	1300	78	84	3.0	37.83	-75.48	[12]
31	May 18, 1962	138	1802	1302	94	97	2.0	37.83	-75.48	[13]
32	Nov. 26, 1963	330	1816	1316	82	84	5.0	37.83	-75.48	[14]
33	Mar. 28, 1963	87	0755	0255	73	78	0.0	37.83	-75.48	[14]
34	Dec. 12, 1966	346	1920	1320	162	113	2.0	58.73	-93.82	[15]
35	Collection of O/O_2 ratios at 120 km altitude									[16]
36	Dec. 12, 1966	346	1920	1320	162	113	2.0	58.73	-93.82	[17]
37	Dec. 12, 1966	346	1920	1320	162	113	2.0	58.73	-93.82	[18]
38	Dec. 12, 1966	346	1920	1320	162	113	2.0	58.73	-93.82	[19]
39	Dec. 11. 1965	345	0443	0443	76	78	16.0	39.60	9.40	[19]
40	Nov. 2, 1967	306	0000	1430	143	139	7.0	-31.00	-136.00	[20]

Reference [3], Test #1.

ETR 1474, MUMP 8

January 24, 1967

09:00 Z

04:00 Local (EST)

Cape Kennedy, Florida

molecular nitrogen

ALTITUDE (km)	TEMPERATURE (°K)	DENSITY (part/cc)
140	504	3.75×10^{10}
145	544	2.57
150	596	1.78
155	639	1.29×10^{10}
160	676	9.61×10^{9}
165	707	7.33
170	736	5.67
175	762	4.45
180	785	3.53
185	802	2.84
190	817	2.30
195	828	1.88
200	840	1.54
205	847	1.27
210	855	1.05×10^{9}
215	860	8.72×10^{8}
220	865	7.25
225	868	6.05
230	872	5.05
235	873	4.23
240	876	3.54
245	877	2.97
250	879	2.49
255	876	2.10
260	879	1.76
265	879	1.48
270	884	1.24
275	888	1.04×10^{8}
280	885	8.80×10^{7}
285	885	7.42
290	884	6.26
295	884	5.28
300	885	4.45
305	884	3.76
310	882	3.18
315	883	2.68
320	885	2.26×10^{7}

Test No. 1

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JANUARY 24, 1967 GM TIME 9 HRS 8 MINS LAT 28.46000 DEGS LONG -80.53000 DEGS

F10 152.00000 F10B 128.00000 AP 3.7000 EXOS TEMP 865.2216 HOUR ANG -127.5939

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45946-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	4.03540-12	579.8	7.57567-03	25.7	20.0	6.33488+10	9.79147+09	2.14866+10	2.05754+07	0.00000
86.	160.	1.32243-12	705.0	3.15571-03	24.6	25.6	1.96465+10	2.64172+09	1.01213+10	1.58254+07	0.00000
97.	180.	5.57178-13	775.0	1.53031-03	23.5	29.6	7.68893+09	9.16503+08	5.68615+09	1.32171+07	0.00000
108.	200.	2.66594-13	814.2	8.06774-04	22.4	32.8	3.34801+09	3.56891+08	3.46176+09	1.14579+07	0.00000
119.	220.	1.37884-13	836.3	4.48706-04	21.3	35.6	1.54111+09	1.47607+08	2.19672+09	1.01230+07	0.00000
130.	240.	7.53260-14	848.8	2.61349-04	20.3	38.1	7.31999+08	6.31701+07	1.42647+09	9.03632+06	0.00000
140.	260.	4.29317-14	855.8	1.57017-04	19.5	40.4	3.54360+08	2.76027+07	9.39038+08	8.11389+06	0.00000
151.	280.	2.53320-14	859.8	9.69415-05	18.7	42.5	1.73689+08	1.22273+07	6.23528+08	7.31138+06	0.00000
162.	300.	1.53878-14	862.1	6.12208-05	18.0	44.5	8.58849+07	5.46948+06	4.16472+08	6.60302+06	0.00000
173.	320.	9.57845-15	863.4	3.94014-05	17.5	46.3	4.27562+07	2.46518+06	2.79388+08	5.97238+06	0.00000
183.	340.	6.08561-15	864.2	2.57684-05	17.0	47.9	2.14052+07	1.11814+06	1.88080+08	5.40800+06	0.00000
194.	360.	3.93307-15	864.6	1.70878-05	16.5	49.5	1.07693+07	5.10006+05	1.26991+08	4.90130+06	0.00000
205.	380.	2.57842-15	864.9	1.14727-05	16.2	51.0	5.44289+06	2.33830+05	8.59749+07	4.44543+06	0.00000
216.	400.	1.71079-15	865.0	7.79229-06	15.8	52.5	2.76277+06	1.07735+05	5.83531+07	4.03468+06	0.00000
227.	420.	1.14689-15	865.1	5.35273-06	15.4	54.1	1.40821+06	4.98742+04	3.97010+07	3.66418+06	0.00000
237.	440.	7.75927-16	865.2	3.71982-06	15.0	55.9	7.20697+05	2.31956+04	2.70741+07	3.32970+06	0.00000
248.	460.	5.29394-16	865.2	2.61718-06	14.6	58.0	3.70311+05	1.08370+04	1.85054+07	3.02752+06	0.00000
259.	480.	3.64142-16	865.2	1.86642-06	14.0	60.4	1.91024+05	5.08583+03	1.26771+07	2.75432+06	0.00000
270.	500.	2.52663-16	865.2	1.35959-06	13.4	63.8	9.89217+04	2.39739+03	8.70375+06	2.50717+06	7.14705+04
281.	520.	1.76796-16	865.2	1.00278-06	12.7	67.7	5.14237+04	1.13507+03	5.98889+06	2.28345+06	7.12084+04
291.	540.	1.24898-16	865.2	7.53343-07	11.9	72.4	2.68340+04	5.39746+02	4.12981+06	2.08083+06	6.95735+04
302.	560.	8.91785-17	865.2	5.77284-07	11.1	78.1	1.40554+04	2.57767+02	2.85396+06	1.89721+06	6.79852+04
313.	580.	6.44476-17	865.2	4.51602-07	10.3	85.1	7.38959+03	1.23628+02	1.97648+06	1.73072+06	6.64419+04
324.	600.	4.72132-17	865.2	3.60725-07	9.4	93.3	3.89946+03	5.95443+01	1.37168+06	1.57967+06	6.49423+04
335.	620.	3.51185-17	865.2	2.94060-07	8.6	102.8	2.06529+03	2.87994+01	9.53950+05	1.44257+06	6.34848+04
345.	640.	2.65640-17	865.2	2.44368-07	7.8	113.6	1.09783+03	1.39872+01	6.64813+05	1.31804+06	6.20681+04
356.	660.	2.04597-17	865.2	2.06675-07	7.1	125.5	5.85670+02	6.82130+00	4.64286+05	1.20489+06	6.06908+04
367.	680.	1.60594-17	865.2	1.77547-07	6.5	138.1	3.13562+02	3.34022+00	3.24879+05	1.10201+06	5.93516+04
378.	700.	1.28506-17	865.2	1.54602-07	6.0	151.2	1.68473+02	1.64226+00	2.27800+05	1.00842+06	5.80493+04
388.	720.	1.04799-17	865.2	1.36177-07	5.5	164.2	9.08372+01	8.10682-01	1.60051+05	9.23249+05	5.67827+04
399.	740.	8.70254-18	865.2	1.21103-07	5.2	176.8	4.91483+01	4.01780-01	1.12675+05	8.45689+05	5.55506+04
410.	760.	7.34662-18	865.2	1.08553-07	4.9	188.8	2.66841+01	1.99912-01	7.94790+04	7.75027+05	5.43520+04
421.	780.	6.29942-18	865.2	9.78357-08	4.6	199.8	1.45373+01	9.98592-02	5.61730+04	7.10617+05	5.31857+04
432.	800.	5.47174-18	865.2	8.88259-08	4.4	209.8	7.94674+00	5.00752-02	3.97762+04	6.51876+05	5.20508+04
443.	820.	4.80694-18	865.2	8.09116-08	4.3	218.7	4.35869+00	2.52074-02	2.82226+04	5.98278+05	5.09462+04
453.	840.	4.26345-18	865.2	7.39644-08	4.1	226.7	2.39868+00	1.27377-02	2.00622+04	5.49349+05	4.98710+04
464.	860.	3.81155-18	865.2	6.78122-08	4.0	233.8	1.32443+00	6.46093-03	1.42883+04	5.04660+05	4.88243+04
475.	880.	3.42997-18	865.2	6.23243-08	4.0	240.1	7.33682-01	3.28950-03	1.01953+04	4.63824+05	4.78051+04
486.	900.	3.10320-18	865.2	5.73996-08	3.9	245.8	4.07757-01	1.68105-03	7.28826+03	4.26491+05	4.68127+04
496.	920.	2.81991-18	865.2	5.29567-08	3.8	250.9	2.27352-01	8.62251-04	5.21976+03	3.92343+05	4.58461+04
507.	940.	2.57169-18	865.2	4.89380-08	3.8	255.6	1.27170-01	4.43891-04	3.74517+03	3.61095+05	4.49047+04
518.	960.	2.35223-18	865.2	4.52858-08	3.7	260.0	7.13596-02	2.29348-04	2.69204+03	3.32487+05	4.39876+04
529.	980.	2.15874-18	865.2	4.19594-08	3.7	264.2	4.01686-02	1.18926-04	1.93853+03	3.06282+05	4.30940+04
540.	1000.	1.98150-18	865.2	3.89229-08	3.7	268.2	2.26819-02	6.18886-05	1.39842+03	2.82269+05	4.22235+04

Reference [3], Test #2.

ETR 1828, MUMP 6

January 24, 1967

11:51 Z

06:51 Local (EST)

Cape Kennedy, Florida

molecular nitrogen

ALTITUDE (km)	TEMPERATURE (°K)	DENSITY (part/cc)
140	573	3.25×10^{10}
145	625	2.29
150	669	1.68
155	698	1.28×10^{10}
160	724	9.90×10^{9}
165	743	7.80
170	759	6.20
175	768	5.00
180	781	4.02
185	787	3.27
190	801	2.64
195	808	2.16
200	819	1.76
205	824	1.45
210	833	1.19×10^{9}
215	837	9.85×10^{8}
220	844	8.13
225	847	6.75
230	851	5.61
235	854	4.67
240	862	3.87
245	859	3.25
250	863	2.71
255	868	2.26
260	876	1.88
265	877	1.58
270	876	1.33
275	875	1.12×10^{8}
280	882	9.35×10^{7}
285	880	7.90
290	880	6.65
295	873	5.65
300	880	4.72
305	880	3.98
310	882	3.35
315	884	2.82
320	885	2.38×10^{7}

Test No. 2

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JANUARY 24, 1967 GM TIME 11 HRS 51 MINS LAT 28.46000 DEGS LONG -80.53000 DEGS

F10 152.00000 F10B 128.00000 AP 1.8000 EXOS TEMP 855.8777 HOUR ANG -84.7269

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	4.03493-12	580.1	7.57829-03	25.7	20.0	6.33425+10	9.79102+09	2.14810+10	2.05703+07	0.00000
86.	160.	1.32274-12	705.5	3.15825-03	24.6	25.6	1.96524+10	2.64286+09	1.01204+10	1.58213+07	0.00000
97.	180.	5.57532-13	775.5	1.53219-03	23.5	29.6	7.69498+09	9.17418+08	5.68705+09	1.32142+07	0.00000
108.	200.	2.66867-13	814.8	8.08075-04	22.4	32.8	3.35237+09	3.57459+08	3.46327+09	1.14561+07	0.00000
119.	220.	1.38075-13	836.9	4.50584-04	21.3	35.6	1.54393+09	1.47931+08	2.19832+09	1.01221+07	0.00000
130.	240.	7.54544-14	849.4	2.61936-04	20.3	38.1	7.33723+08	6.33470+07	1.42794+09	9.03609+06	0.00000
140.	260.	4.30173-14	856.5	1.57414-04	19.5	40.4	3.55383+08	2.76967+07	9.40284+08	8.11427+06	0.00000
151.	280.	2.53892-14	860.5	9.72114-05	18.7	42.6	1.74282+08	1.22763+07	6.24542+08	7.31226+06	0.00000
162.	300.	1.54262-14	862.8	6.14062-05	18.0	44.5	8.62236+07	5.49474+06	4.17275+08	6.60431+06	0.00000
173.	320.	9.60456-15	864.1	3.95300-05	17.5	46.3	4.29473+07	2.47805+06	2.80010+08	5.97398+06	0.00000
183.	340.	6.10356-15	864.8	2.58584-05	17.0	47.9	2.15121+07	1.12465+06	1.88555+08	5.40986+06	0.00000
194.	360.	3.94554-15	865.3	1.71513-05	16.6	49.5	1.08287+07	5.13279+05	1.27349+08	4.90535+06	0.00000
205.	380.	2.58717-15	865.5	1.15178-05	16.2	51.0	5.47574+06	2.35469+05	8.62431+07	4.44761+06	0.00000
216.	400.	1.71698-15	865.7	7.82453-06	15.8	52.5	2.78088+06	1.08554+05	5.85523+07	4.03695+06	0.00000
227.	420.	1.15130-15	865.8	5.37589-06	15.4	54.1	1.41816+06	5.02826+04	3.98481+07	3.66652+06	0.00000
237.	440.	7.79081-16	865.8	3.73654-06	15.0	55.9	7.26158+05	2.33991+04	2.71823+07	3.33207+06	0.00000
248.	460.	5.31661-16	865.8	2.62930-06	14.6	58.0	3.73306+05	1.09384+04	1.85847+07	3.02988+06	0.00000
259.	480.	3.65776-16	865.9	1.87525-06	14.0	60.5	1.92665+05	5.13635+03	1.27351+07	2.75667+06	0.00000
270.	500.	2.53845-16	865.9	1.36602-06	13.4	63.8	9.98213+04	2.42259+03	8.74606+06	2.50949+06	7.10874+04
281.	520.	1.77852-16	865.9	1.00751-06	12.7	67.7	5.19171+04	1.14765+03	6.01970+06	2.28573+06	7.08242+04
291.	540.	1.25518-16	865.9	7.56847-07	11.9	72.4	2.71048+04	5.46035+02	4.15222+06	2.08305+06	6.91993+04
302.	560.	8.96321-17	865.9	5.79902-07	11.1	78.1	1.42042+04	2.60916+02	2.87025+06	1.89937+06	6.76208+04
313.	580.	6.47791-17	865.9	4.53576-07	10.3	85.0	7.47147+03	1.25208+02	1.98832+06	1.73281+06	6.60870+04
324.	600.	4.74565-17	865.9	3.62231-07	9.4	93.2	3.94457+03	6.03388+01	1.38028+06	1.58169+06	6.45965+04
335.	620.	3.52978-17	865.9	2.95224-07	8.6	102.7	2.09019+03	2.91998+01	9.60194+05	1.44450+06	6.31478+04
345.	640.	2.66969-17	865.9	2.45280-07	7.8	113.5	1.11160+03	1.41894+01	6.69347+05	1.31990+06	6.17597+04
356.	660.	2.05588-17	865.9	2.07401-07	7.1	125.3	5.93297+02	6.92368+00	4.67560+05	1.20667+06	6.03706+04
367.	680.	1.61340-17	865.9	1.78135-07	6.5	137.9	3.17796+02	3.39219+00	3.27272+05	1.10371+06	5.90395+04
378.	700.	1.29072-17	865.9	1.55086-07	6.0	151.0	1.70828+02	1.66871+00	2.29540+05	1.01005+06	5.77450+04
388.	720.	1.05234-17	865.9	1.36582-07	5.5	164.0	9.21502+01	8.24178-01	1.61317+05	9.24802+05	5.64[illegible]+04
399.	740.	8.73638-18	865.9	1.21447-07	5.2	176.8	4.98820+01	4.08686-01	1.13596+05	8.47168+05	5.52[illegible]+04
410.	760.	7.37933-18	865.9	1.08850-07	4.9	188.6	2.70930+01	2.03456-01	8.01500+04	7.76434+05	5.4[illegible]
421.	780.	6.32084-18	865.9	9.81954-08	4.6	199.8	1.47879+01	1.01683-01	5.66621+04	7.11954+05	5.29105+04
432.	800.	5.48921-18	865.9	8.90551-08	4.4	209.7	8.07651+00	5.10164-02	4.01350+04	6.53145+05	5.1[illegible]
443.	820.	4.82142-18	865.9	8.11166-08	4.3	218.6	4.43188+00	2.56945-02	2.84632+04	5.99482+05	5.06442+04
453.	840.	4.27564-18	865.9	7.41491-08	4.2	226.6	2.44007+00	1.29905-02	2.02527+04	5.50490+05	4.96154+04
464.	860.	3.82202-18	865.9	6.79796-08	4.0	233.7	1.34788+00	6.59259-03	1.44277+04	5.05741+05	4.85748+04
475.	880.	3.43907-18	865.9	6.24769-08	4.0	240.1	7.47010-01	3.35825-03	1.02973+04	4.64847+05	4.75616+04
486.	900.	3.11122-18	865.9	5.73393-08	3.9	245.7	4.15350-01	1.71705-03	7.36310+03	4.27459+05	4.65750+04
496.	920.	2.82706-18	865.9	5.30871-08	3.8	250.9	2.31686-01	8.81164-04	5.27469+03	3.93258+05	4.56140+04
507.	940.	2.57813-18	865.9	4.90562-08	3.8	255.6	1.29653-01	4.53856-04	3.78554+03	3.61960+05	4.46[illegible]+04
518.	960.	2.35808-18	865.9	4.53949-08	3.7	260.0	7.27843-02	2.34614-04	2.72174+03	3.33304+05	4.3[illegible]+04
528.	980.	2.16209-18	865.9	4.20602-08	3.7	264.2	4.09885-02	1.21718-04	1.96040+03	3.07054+05	4.26[illegible]+04
540.	1000.	1.98642-18	865.9	3.90162-08	3.7	268.2	2.31548-02	6.33725-05	1.41455+03	2.82998+05	4.20[illegible]+04

Reference [3], Test #3.

ETR 1165, MUMP 3

January 24, 1967

15:09 Z

10:09 Local (EST)

Cape Kennedy, Florida

molecular nitrogen

ALTITUDE (km)	TEMPERATURE (°K)	DENSITY (part/cc)
140	630	3.52×10^{10}
145	654	2.65
150	678	2.02
155	694	1.57
160	715	1.22×10^{10}
165	735	9.56×10^{9}
170	753	7.57
175	770	6.03
180	784	4.85
185	800	3.90
190	810	3.18
195	822	2.59
200	832	2.12
205	843	1.74
210	855	1.43
215	866	1.18×10^{9}
220	874	9.80×10^{8}
225	881	8.16
230	893	6.77
235	906	5.63
240	917	4.70
245	924	3.95
250	933	3.32
255	940	2.80
260	950	2.36
265	956	2.00
270	959	1.70
275	968	1.44
280	969	1.23
285	982	1.04×10^{8}
290	976	8.97×10^{7}
295	983	7.64
300	982	6.56
305	986	5.61
310	988	4.81
315	991	4.12
320	990	3.55×10^{7}

Test No. 3

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JANUARY 24,1967 GM TIME 15 HRS 9 MINS LAT 28.46000 DEGS LONG -80.53000 DEGS

F10 152.00000 F10B 128.00000 AP .0000 EXOS TEMP 935.0226 HOUR ANG -35.0933

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	5.40000+07	0.00000
78.	140.	3.98642-12	608.3	7.83929-03	25.7	20.9	6.26774+10	9.73939+09	2.09221+10	2.00701+07	0.00000
86.	160.	1.35136-12	750.3	3.41651-03	24.7	27.1	2.02045+10	2.75201+09	1.00137+10	1.54140+07	0.00000
97.	180.	5.92014-13	830.3	1.72759-03	23.7	31.5	8.28925+09	1.00861+09	5.76305+09	1.29189+07	0.00000
108.	200.	2.94264-13	875.4	9.45684-04	22.7	34.9	3.79415+09	4.16025+08	3.60460+09	1.12601+07	0.00000
119.	220.	1.57686-13	901.0	5.45170-04	21.7	37.7	1.83800+09	1.82461+08	2.35304+09	1.00111+07	0.00000
130.	240.	8.89634-14	915.5	3.26553-04	20.7	40.3	9.19252+08	8.28447+07	1.57290+09	8.99720+06	0.00000
140.	260.	5.21973-14	923.8	2.01666-04	19.9	42.7	4.68678+08	3.84123+07	1.06621+09	8.13588+06	0.00000
151.	280.	3.16191-14	928.5	1.27128-04	19.1	44.9	2.41944+08	1.80554+07	7.29120+08	7.38409+06	0.00000
162.	300.	1.96771-14	931.3	8.26378-05	18.4	47.0	1.25989+08	8.56884+06	5.01556+08	6.71727+06	0.00000
173.	320.	1.25310-14	932.8	5.44389-05	17.9	48.9	6.60406+07	4.09667+06	3.46504+08	6.12015+06	0.00000
183.	340.	8.13907-15	933.8	3.64199-05	17.4	50.6	3.48042+07	1.97048+06	2.40197+08	5.58233+06	0.00000
194.	360.	5.37604-15	934.3	2.46921-05	16.9	52.3	1.84286+07	9.52837+05	1.66981+08	5.09622+06	0.00000
205.	380.	3.60203-15	934.6	1.69388-05	16.5	53.8	9.79967+06	4.62995+05	1.16379+08	4.65581+06	0.00000
216.	400.	2.44288-15	934.8	1.17445-05	16.2	55.4	5.23218+06	2.26009+05	8.13034+07	4.25620+06	0.00000
227.	420.	1.67407-15	934.9	8.22504-06	15.8	56.9	2.80438+06	1.10814+05	5.69271+07	3.89320+06	0.00000
237.	440.	1.15765-15	934.9	5.81697-06	15.5	58.6	1.50879+06	5.45673+04	3.99460+07	3.56315+06	0.00000
248.	460.	8.07034-16	935.0	4.15511-06	15.1	60.4	8.14750+05	2.69837+04	2.80898+07	3.26285+06	0.00000
259.	480.	5.66812-16	935.0	2.99928-06	14.7	62.4	4.41572+05	1.33991+04	1.97939+07	2.98943+06	0.00000
270.	500.	4.01008-16	935.0	2.19491-06	14.2	64.9	2.40181+05	6.68089+03	1.39768+07	2.74034+06	4.18237+04
281.	520.	2.85689-16	935.0	1.62351-06	13.7	67.8	1.31105+05	3.34469+03	9.88933+06	2.51330+06	4.15441+04
291.	540.	2.05029-16	935.0	1.21734-06	13.1	71.3	7.18172+04	1.68122+03	7.01131+06	2.30622+06	4.06607+04
302.	560.	1.48294-16	935.0	9.26486-07	12.4	75.4	3.94776+04	8.48439+02	4.98078+06	2.11726+06	3.98011+04
313.	580.	1.08176-16	935.0	7.16496-07	11.7	80.4	2.17757+04	4.29864+02	3.54529+06	1.94475+06	3.89643+04
324.	600.	7.96579-17	935.0	5.63527-07	11.0	86.4	1.20526+04	2.18646+02	2.52846+06	1.78716+06	3.81498+04
334.	620.	5.92774-17	935.0	4.50982-07	10.2	93.4	6.69363+03	1.11644+02	1.80677+06	1.64314+06	3.73569+04
345.	640.	4.46300-17	935.0	3.67255-07	9.4	101.6	3.72995+03	5.72263+01	1.29355+06	1.51146+06	3.65848+04
356.	660.	3.40367-17	935.0	3.04195-07	8.7	111.0	2.08542+03	2.94451+01	9.27881+05	1.39099+06	3.58330+04
367.	680.	2.63287-17	935.0	2.56056-07	8.0	121.5	1.16982+03	1.52079+01	6.66839+05	1.28072+06	3.51006+04
378.	700.	2.06740-17	935.0	2.18767-07	7.3	133.0	6.58365+02	7.88412+00	4.80134+05	1.17975+06	3.43864+04
389.	720.	1.64917-17	935.0	1.89432-07	6.8	145.1	3.71729+02	4.10251+00	3.46347+05	1.08725+06	3.36896+04
399.	740.	1.33689-17	935.0	1.65982-07	6.3	157.8	2.10564+02	2.14262+00	2.50299+05	1.00245+06	3.30093+04
410.	760.	1.10125-17	935.0	1.46933-07	5.8	170.5	1.19655+02	1.12312+00	1.81217+05	9.24698+05	3.23448+04
421.	780.	9.21318-18	935.0	1.31210-07	5.5	183.0	6.82107+01	5.90854-01	1.31440+05	8.53358+05	3.16952+04
432.	800.	7.82158-18	935.0	1.18036-07	5.2	195.0	3.90066+01	3.11956-01	9.55064+04	7.87878+05	3.10601+04
443.	820.	6.73031-18	935.0	1.06840-07	4.9	206.3	2.23757+01	1.65292-01	6.95203+04	7.27743+05	3.04392+04
453.	840.	5.86201-18	935.0	9.72007-08	4.7	216.7	1.28753+01	8.78907-02	5.06941+04	6.72495+05	2.98796+04
464.	860.	5.16071-18	935.0	8.88071-08	4.5	226.1	7.43136+00	4.68981-02	3.70308+04	6.21714+05	2.92988+04
475.	880.	4.58571-18	935.0	8.14243-08	4.4	234.6	4.30227+00	2.51116-02	2.70971+04	5.75017+05	2.87324+04
486.	900.	4.10729-18	935.0	7.48740-08	4.3	242.2	2.49825+00	1.34924-02	1.98624+04	5.32056+05	2.81800+04
496.	920.	3.70361-18	935.0	6.90195-08	4.2	249.0	1.45503+00	7.27425-03	1.45841+04	4.92516+05	2.76412+04
507.	940.	3.35850-18	935.0	6.37543-08	4.1	255.0	8.49953-01	3.93512-03	1.07267+04	4.56106+05	2.71156+04
518	960.	3.05992-18	935.0	5.89945-08	4.0	260.4	4.97960-01	2.13592-03	7.90276+03	4.22566+05	2.66027+04
529.	980.	2.79863-18	935.0	5.46729-08	4.0	265.3	2.92590-01	1.16321-03	5.83198+03	3.91655+05	2.61023+04
540.	1000.	2.56838-18	935.0	5.07351-08	3.9	269.7	1.72417-01	6.35578-04	4.31093+03	3.63155+05	2.56139+04

Reference [3], Test #4.

ETR 0381, MUMP 1

January 24, 1967

19:34 Z

14:34 Local (EST)

Cape Kennedy, Florida

molecular nitrogen

ALTITUDE (km)	TEMPERATURE (°K)	DENSITY (part/cc)
140	618	3.70×10^{10}
145	687	2.61
150	743	1.94
155	788	1.49
160	834	1.16×10^{10}
165	872	9.24×10^{9}
170	905	7.47
175	939	6.08
180	963	5.03
185	986	4.19
190	1007	3.51
195	1021	2.97
200	1039	2.51
205	1051	2.14
210	1068	1.82
215	1072	1.57
220	1080	1.35
225	1091	1.16
230	1089	1.01×10^{9}
235	1090	8.76×10^{8}
240	1092	7.60
245	1094	6.60
250	1098	5.72
255	1095	4.99
260	1101	4.32
265	1102	3.76
270	1105	3.27
275	1105	2.85
280	1098	2.50
285	1103	2.17
290	1104	1.89
295	1104	1.65
300	1104	1.44
305	1110	1.25
310	1102	1.10×10^{8}
315	1104	9.58×10^{7}
320	1110	8.33×10^{7}

Test No. 4

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JANUARY 24, 1967 GM TIME 19 HRS 34 MINS LAT 28.46000 DEGS LONG -80.53000 DEGS

F10 152.00000 F10B 128.00000 AP 1.4000 EXOS TEMP 1034.1417 HOUR ANG -329.8619

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.92145-12	644.8	8.15961-03	25.8	22.2	6.17651+10	9.65753+09	2.02363+10	1.94681+07	0.00000
86.	160.	1.37970-12	810.1	3.74693-03	24.8	29.1	2.07736+10	2.87207+09	9.84504+09	1.49079+07	0.00000
97.	180.	6.31548-13	904.8	1.98979-03	23.9	34.0	8.98326+09	1.11935+09	5.81563+09	1.25319+07	0.00000
108.	200.	3.28039-13	959.2	1.13916-03	23.0	37.7	4.35097+09	4.92905+08	3.74812+09	1.09820+07	0.00000
119.	220.	1.83332-13	990.6	6.84059-04	22.1	40.7	2.23496+09	2.31267+08	2.52639+09	9.82977+06	0.00000
130.	240.	1.07562-13	1008.8	4.25265-04	21.2	43.4	1.18670+09	1.12469+08	1.74590+09	8.90075+06	0.00000
140.	260.	6.54201-14	1019.3	2.71728-04	20.4	45.9	6.42785+08	5.58939+07	1.22441+09	8.11516+06	0.00000
151.	280.	4.09543-14	1025.4	1.77627-04	19.7	48.2	3.52651+08	2.81689+07	8.66621+08	7.42463+06	0.00000
162.	300.	2.62702-14	1029.0	1.18391-04	19.0	50.4	1.95188+08	1.43349+07	6.17140+08	6.81143+06	0.00000
173.	320.	1.72099-14	1031.1	8.02414-05	18.4	52.4	1.08743+08	7.34614+06	4.41400+08	6.25913+06	0.00000
183.	340.	1.14835-14	1032.3	5.51801-05	17.9	54.4	6.09014+07	3.78886+06	3.16766+08	5.75826+06	0.00000
194.	360.	7.78637-15	1033.1	3.84293-05	17.4	56.2	3.42605+07	1.96349+06	2.27953+08	5.30217+06	0.00000
205.	380.	5.35364-15	1033.5	2.70631-05	17.0	57.9	1.93510+07	1.02217+06	1.64438+08	4.88567+06	0.00000
216.	400.	3.72572-15	1033.8	1.92491-05	16.6	59.5	1.09707+07	5.34391+05	1.18882+08	4.50466+06	0.00000
227.	420.	2.62011-15	1033.9	1.38159-05	16.3	61.1	6.24180+06	2.80514+05	8.61256+07	4.15567+06	0.00000
237.	440.	1.85946-15	1034.0	1.00008-05	16.0	62.7	3.56353+06	1.47827+05	6.25192+07	3.83572+06	0.00000
248.	460.	1.33027-15	1034.1	7.29876-06	15.7	64.3	2.04132+06	7.82026+04	4.54711+07	3.54217+06	0.00000
259.	480.	9.58520-16	1034.1	5.37038-06	15.3	66.1	1.17321+06	4.15266+04	3.31345+07	3.27265+06	0.00000
270.	500.	6.95229-16	1034.1	3.98776-06	15.0	68.0	6.76480+05	2.21333+04	2.41901+07	3.02507+06	2.17699+04
281.	520.	5.07346-16	1034.1	2.98562-06	14.6	70.2	3.91320+05	1.18403+04	1.76927+07	2.79752+06	2.16187+04
291.	540.	3.72439-16	1034.1	2.25646-06	14.2	72.7	2.27087+05	6.35714+03	1.29640+07	2.58827+06	2.12026+04
302.	560.	2.75023-16	1034.1	1.72280-06	13.7	75.6	1.32197+05	3.42550+03	9.51635+06	2.39575+06	2.07969+04
313.	580.	2.04319-16	1034.1	1.32988-06	13.2	79.0	7.71982+04	1.85241+03	6.99804+06	2.21854+06	2.04012+04
324.	600.	1.52760-16	1034.1	1.03879-06	12.6	83.0	4.52207+04	1.00528+03	5.15526+06	2.05535+06	2.00152+04
335.	620.	1.14991-16	1034.1	8.21705-07	12.0	87.8	2.65705+04	5.47465+02	3.80439+06	1.90499+06	1.96387+04
345.	640.	8.72017-17	1034.1	6.58665-07	11.4	93.3	1.56596+04	2.99182+02	2.81239+06	1.76641+06	1.92714+04
356.	660.	6.66656-17	1034.1	5.35263-07	10.7	99.7	9.25707+03	1.64064+02	2.08264+06	1.63861+06	1.89129+04
367.	680.	5.14201-17	1034.1	4.41067-07	10.0	107.2	5.48862+03	9.02760+01	1.54487+06	1.52071+06	1.85631+04
378.	700.	4.00480-17	1034.1	3.68492-07	9.3	115.6	3.26392+03	4.98428+01	1.14791+06	1.41188+06	1.82217+04
389.	720.	3.15218-17	1034.1	3.12007-07	8.7	125.1	1.94667+03	2.78116+01	8.54383+05	1.31140+06	1.78885+04
399.	740.	2.50934-17	1034.1	2.67560-07	8.1	135.5	1.16442+03	1.53471+01	6.36971+05	1.21857+06	1.75632+04
410.	760.	2.02170-17	1034.1	2.32174-07	7.5	146.8	6.98525+02	8.55642+00	4.75668+05	1.13279+06	1.72455+04
421.	780.	1.64928-17	1034.1	2.03655-07	7.0	158.7	4.20240+02	4.78832+00	3.55794+05	1.05347+06	1.69354+04
432.	800.	1.36273-17	1034.1	1.80376-07	6.5	171.1	2.53540+02	2.68771+00	2.66562+05	9.80102+05	1.66327+04
443.	820.	1.14042-17	1034.1	1.61130-07	6.1	183.6	1.53398+02	1.51349+00	2.00031+05	9.12213+05	1.63367+04
453.	840.	9.66395-18	1034.1	1.45016-07	5.7	196.1	9.30690+01	8.54993-01	1.50345+05	8.49364+05	1.60477+04
464.	860.	8.28817-18	1034.1	1.31356-07	5.4	208.3	5.66230+01	4.84530-01	1.13179+05	7.91159+05	1.57654+04
475.	880.	7.18905-18	1034.1	1.19640-07	5.2	219.9	3.45441+01	2.75449-01	8.53352+04	7.37231+05	1.54896+04
486.	900.	6.30114-18	1034.1	1.09482-07	4.9	230.9	2.11319+01	1.57078-01	6.44413+04	6.87247+05	1.52201+04
496.	920.	5.57550-18	1034.1	1.00585-07	4.8	241.0	1.29621+01	8.98523-02	4.87384+04	6.40899+05	1.49568+04
507.	940.	4.97542-18	1034.1	9.27225-08	4.6	250.4	7.97217+00	5.15553-02	3.69185+04	5.97906+05	1.46994+04
518.	960.	4.47327-18	1034.1	8.57186-08	4.5	258.8	4.91622+00	2.96712-02	2.80075+04	5.58008+05	1.44477+04
529.	980.	4.04813-18	1034.1	7.94353-08	4.4	266.5	3.03970+00	1.71260-02	2.12794+04	5.20969+05	1.42018+04
540.	1000.	3.68414-18	1034.1	7.37640-08	4.3	273.4	1.88437+00	9.91688-03	1.61918+04	4.86570+05	1.39613+04

Reference [3], Test #5.

ETR 0611, MUMP 2

January 24, 1967

22:50 Z

17:50 Local (EST)

Cape Kennedy, Florida

molecular nitrogen

ALTITUDE (km)	TEMPERATURE (°K)	DENSITY (part/cc)
140	656	3.53×10^{10}
145	671	2.72
150	690	2.10
155	706	1.64
160	733	1.27
165	754	1.00×10^{10}
170	769	7.99×10^{9}
175	785	6.40
180	805	5.13
185	826	4.13
190	840	3.37
195	861	2.74
200	877	2.25
205	896	1.85
210	907	1.54
215	922	1.28
220	934	1.07×10^{9}
225	940	9.02×10^{8}
230	948	7.60
235	957	6.41
240	964	5.43
245	969	4.61
250	974	3.92
255	978	3.34
260	981	2.85
265	986	2.43
270	988	2.08
275	990	1.78
280	995	1.52
285	992	1.31
290	997	1.12×10^{8}
295	1000	9.61×10^{7}

Test No. 5

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JANUARY 24, 1967 GM TIME 22 HRS 50 MINS LAT 28.46000 DEGS LONG -80.53000 DEGS

F10 152.00000 F10B 126.00000 AP 2.0000 EXOS TEMP 1005.1955 HOUR ANG -279.5270

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.93975-12	634.6	8.07280-03	25.8	21.8	6.20242+10	9.68195+09	2.04227+10	1.96304+07	0.00000
86.	160.	1.37264-12	783.3	3.65574-03	24.8	28.5	2.06324+10	2.84123+09	9.89545+09	1.50466+07	0.00000
97.	180.	6.21198-13	883.6	1.91598-03	23.8	33.3	8.79992+09	1.08958+09	5.80630+09	1.26404+07	0.00000
108.	200.	3.18900-13	935.2	1.08365-03	22.9	36.9	4.19887+09	4.71547+08	3.71289+09	1.10624+07	0.00000
119.	220.	1.76213-13	964.7	6.43508-04	22.0	39.9	2.12340+09	2.17298+08	2.48152+09	9.88473+06	0.00000
130.	240.	1.02286-13	981.7	3.95985-04	21.1	42.5	1.10953+09	1.03747+08	1.69975+09	8.93501+06	0.00000
140.	260.	6.15978-14	991.6	2.50649-04	20.3	45.0	5.91272+08	5.06047+07	1.18123+09	8.12539+06	0.00000
151.	280.	3.82114-14	997.2	1.62423-04	19.5	47.2	3.19103+08	2.50278+07	8.28341+08	7.41943+06	0.00000
162.	300.	2.43054-14	1000.5	1.07371-04	18.8	49.4	1.73729+08	1.24982+07	5.84391+08	6.79124+06	0.00000
173.	320.	1.57982-14	1002.5	7.22052-05	18.2	51.4	9.52033+07	6.28679+06	4.14074+08	6.22624+06	0.00000
183.	340.	1.04634-14	1003.6	4.92799-05	17.7	53.3	5.24467+07	3.18108+06	2.94379+08	5.71477+06	0.00000
194.	360.	7.04388-15	1004.2	3.40685-05	17.3	55.1	2.90234+07	1.61784+06	2.09867+08	5.24988+06	0.00000
205.	380.	4.80911-15	1004.6	2.38201-05	16.9	56.7	1.61268+07	8.26614+05	1.49984+08	4.82626+06	0.00000
216.	400.	3.32341-15	1004.9	1.68239-05	16.5	58.3	8.99507+06	4.24182+05	1.07429+08	4.43958+06	0.00000
227.	420.	2.32086-15	1005.0	1.19933-05	16.2	59.9	5.03548+06	2.18578+05	7.71110+07	4.08619+06	0.00000
237.	440.	1.63556-15	1005.1	8.62511-06	15.8	61.5	2.82885+06	1.13084+05	5.54623+07	3.76293+06	0.00000
248.	460.	1.16189-15	1005.1	6.25628-06	15.5	63.1	1.59470+06	5.87367+04	3.99707+07	3.46700+06	0.00000
259.	480.	8.31559-16	1005.2	4.57754-06	15.2	64.9	9.02029+05	3.06268+04	2.88624+07	3.19593+06	0.00000
270.	500.	5.98865-16	1005.2	3.38318-06	14.8	67.0	5.11936+05	1.60308+04	2.08812+07	2.94748+06	2.60390+04
281.	520.	4.34100-16	1005.2	2.52271-06	14.4	69.3	2.91507+05	8.42269+03	1.51356+07	2.71963+06	2.58468+04
291.	540.	3.16625-16	1005.2	1.90074-06	13.9	72.0	1.66534+05	4.44193+03	1.09916+07	2.51058+06	2.53352+04
302.	560.	2.32397-16	1005.2	1.44837-06	13.4	75.2	9.54482+04	2.35126+03	7.99694+06	2.31867+06	2.48366+04
313.	580.	1.71699-16	1005.2	1.11724-06	12.8	79.0	5.48815+04	1.24918+03	5.82889+06	2.14242+06	2.43505+04
324.	600.	1.27745-16	1005.2	8.73199-07	12.2	83.5	3.16569+04	6.66086+02	4.25635+06	1.98046+06	2.38767+04
335.	620.	9.57700-17	1005.2	6.92028-07	11.6	88.7	1.83181+04	3.56452+02	3.11367+06	1.83158+06	2.34148+04
345.	640.	7.24005-17	1005.2	5.56453-07	10.9	94.9	1.06329+04	1.91436+02	2.28184+06	1.69464+06	2.29643+04
356.	660.	5.52396-17	1005.2	4.54104-07	10.2	102.1	6.19110+03	1.03178+02	1.67520+06	1.56864+06	2.25250+04
367.	680.	4.25751-17	1005.2	3.76089-07	9.5	110.4	3.61593+03	5.58054+01	1.23200+06	1.45265+06	2.20965+04
378.	700.	3.31790-17	1005.2	3.15988-07	8.8	119.7	2.11835+03	3.02885+01	9.07634+05	1.34501+06	2.16785+04
388.	720.	2.61672-17	1005.2	2.69152-07	8.1	130.0	1.24478+03	1.64960+01	6.69826+05	1.24738+06	2.12708+04
399.	740.	2.09011-17	1005.2	2.32199-07	7.5	141.2	7.33629+02	9.01507+00	4.95172+05	1.15663+06	2.08729+04
410.	760.	1.69179-17	1005.2	2.02662-07	7.0	153.1	4.33669+02	4.94349+00	3.66681+05	1.07295+06	2.04846+04
421.	780.	1.38612-17	1005.2	1.78732-07	6.5	165.5	2.57110+02	2.71995+00	2.71989+05	9.95738+05	2.01057+04
432.	800.	1.15459-17	1005.2	1.59078-07	6.1	178.1	1.52879+02	1.50154+00	2.02088+05	9.24469+05	1.97358+04
443.	820.	9.73254-18	1005.2	1.42715-07	5.7	190.8	9.11668+01	8.31672-01	1.50400+05	8.58656+05	1.93748+04
453.	840.	8.30970-18	1005.2	1.28912-07	5.4	202.7	5.45222+01	4.62161-01	1.12116+05	7.97855+05	1.90224+04
464.	860.	7.18061-18	1005.2	1.17123-07	5.1	214.3	3.26999+01	2.57661-01	8.37137+04	7.41662+05	1.86782+04
475.	880.	6.27386-18	1005.2	1.06931-07	4.9	225.2	1.96674+01	1.44114-01	6.26074+04	6.89705+05	1.83421+04
486.	900.	5.53658-18	1005.2	9.80414-08	4.7	235.3	1.18622+01	8.08641-02	4.68975+04	6.41645+05	1.80139+04
496.	920.	4.92944-18	1005.2	9.02000-08	4.6	244.5	7.17447+00	4.55181-02	3.51855+04	5.97170+05	1.76933+04
507.	940.	4.42312-18	1005.2	8.32296-08	4.4	252.8	4.35123+00	2.57028-02	2.64400+04	5.55997+05	1.73801+04
518.	960.	3.99562-18	1005.2	7.69882-08	4.3	260.3	2.64619+00	1.45591-02	1.98994+04	5.17865+05	1.70741+04
529.	980.	3.63036-18	1005.2	7.13645-08	4.3	267.0	1.61364+00	8.27243-03	1.49999+04	4.82535+05	1.67751+04
540.	1000.	3.31477-18	1005.2	6.62700-08	4.2	273.0	9.86649-01	4.71484-03	1.13241+04	4.49789+05	1.64830+04

Reference [3], Test #6.

ETR 0851, MUMP 7

January 24, 1967

03:00 Z

22:00 Local (EST)

Cape Kennedy, Florida

molecular nitrogen

ALTITUDE (km)	TEMPERATURE (°K)	DENSITY (part/cc)
140	594	3.59×10^{10}
145	635	2.60
150	665	1.95
155	685	1.50
160	707	1.16×10^{10}
165	718	9.18×10^{9}
170	731	7.27
175	743	5.78
180	754	4.63
185	762	3.73
190	774	3.00
195	786	2.42
200	794	1.97
205	800	1.61
210	811	1.31
215	823	1.07×10^{9}
220	831	8.79×10^{8}
225	845	7.20
230	850	5.97
235	855	4.96
240	863	4.11
245	866	3.43
250	875	2.85
255	877	2.39
260	881	2.00
265	883	1.68
270	887	1.41
275	894	1.18
280	890	1.00×10^{8}
285	894	8.41×10^{7}
290	894	7.10
295	894	6.00
300	895	5.07×10^{7}

Test No. 6

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JANUARY 25, 1967 GM TIME 3 HRS 0 MINS LAT 28.46000 DEGS LONG -80.53000 DEGS

F10 152.00000 F10B 128.00000 AP 2.5000 EXOS TEMP 926.1764 HOUR ANG -217.9032

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
70.	140.	3.99251-12	604.8	7.80758-03	25.7	20.8	6.27616+10	9.74634+09	2.09899+10	2.01303+07	0.00000
80.	160.	1.34813-12	744.7	3.38463-03	24.7	26.9	2.01413+10	2.73925+09	1.00281+10	1.54635+07	0.00000
90.	180.	5.07919-13	823.4	1.70303-03	23.6	31.2	8.21821+09	9.97545+08	5.75531+09	1.29555+07	0.00000
100.	200.	2.90922-13	867.7	9.28088-04	22.6	34.6	3.73979+09	4.08707+08	3.58851+09	1.12851+07	0.00000
110.	220.	1.55240-13	892.8	5.32879-04	21.6	37.5	1.80086+09	1.78023+08	2.33482+09	1.00262+07	0.00000
120.	240.	8.72464-14	907.1	3.18035-04	20.7	40.0	8.95235+08	8.02698+07	1.55543+09	9.00366+06	0.00000
130.	260.	5.10111-14	915.2	1.95756-04	19.8	42.4	4.53656+08	3.69592+07	1.05075+09	8.13503+06	0.00000
140.	280.	3.08028-14	919.9	1.23605-04	19.1	44.6	2.32762+08	1.72512+07	7.16056+08	7.37710+06	0.00000
150.	300.	1.91131-14	922.5	7.97389-05	18.4	46.6	1.20469+08	8.13016+06	4.90861+08	6.70519+06	0.00000
160.	320.	1.21385-14	924.1	5.23832-05	17.8	48.5	6.27634+07	3.85995+06	3.37939+08	6.10389+06	0.00000
170.	340.	7.86342-15	924.9	3.49500-05	17.3	50.3	3.28768+07	1.84377+06	2.33450+08	5.56272+06	0.00000
180.	360.	5.18057-15	925.5	2.36330-05	16.9	51.9	1.73031+07	8.85425+05	1.61732+08	5.07395+06	0.00000
190.	380.	3.46214-15	925.8	1.61705-05	16.5	53.5	9.14599+06	4.27290+05	1.12334+08	4.63150+06	0.00000
200.	400.	2.34196-15	925.9	1.11840-05	16.1	55.0	4.85404+06	2.07159+05	7.82096+07	4.23037+06	0.00000
210.	420.	1.60075-15	926.0	7.81400-06	15.8	56.6	2.58627+06	1.00883+05	5.45750+07	3.86628+06	0.00000
220.	440.	1.10409-15	926.1	5.51419-06	15.4	58.2	1.38323+06	4.93423+04	3.81663+07	3.53553+06	0.00000
230.	460.	7.67717-16	926.1	3.93115-06	15.0	60.0	7.42568+05	2.42364+04	2.67483+07	3.23483+06	0.00000
240.	480.	5.37843-16	926.1	2.83293-06	14.6	62.1	4.00104+05	1.19547+04	1.87857+07	2.96129+06	0.00000
250.	500.	3.79601-16	926.2	2.07113-06	14.1	64.7	2.16364+05	5.92123+03	1.32209+07	2.71230+06	4.45926+04
260.	520.	2.69087-16	926.2	1.53083-06	13.6	67.7	1.17423+05	2.94485+03	9.32362+06	2.48552+06	4.43066+04
270.	540.	1.93247-16	926.2	1.14759-06	13.0	71.3	6.39538+04	1.47054+03	6.58856+06	2.27886+06	4.33555+04
280.	560.	1.39522-16	926.2	8.73688-07	12.3	75.6	3.49548+04	7.37289+02	4.66520+06	2.09044+06	4.24302+04
290.	580.	1.01630-16	926.2	6.76261-07	11.6	80.8	1.91717+04	3.71132+02	3.30990+06	1.91855+06	4.15298+04
300.	600.	7.47604-17	926.2	5.32624-07	10.8	87.0	1.05515+04	1.87557+02	2.35298+06	1.76186+06	4.06535+04
310.	620.	5.56023-17	926.2	4.27030-07	10.0	94.3	5.82716+03	9.51565+01	1.67598+06	1.61840+06	3.98005+04
320.	640.	4.18626-17	926.2	3.48498-07	9.3	102.8	3.22904+03	4.84650+01	1.19809+06	1.48751+06	3.89701+04
330.	660.	3.19463-17	926.2	2.89336-07	8.5	112.5	1.79536+03	2.47793+01	8.55253+05	1.36786+06	3.81617+04
340.	680.	2.47388-17	926.2	2.44133-07	7.8	123.3	1.00156+03	1.27176+01	6.12707+05	1.25844+06	3.73749+04
350.	700.	1.94589-17	926.2	2.09068-07	7.2	135.0	5.80585+02	6.55185+00	4.39777+05	1.15832+06	3.66078+04
360.	720.	1.55565-17	926.2	1.81429-07	6.6	147.4	3.14797+02	3.38806+00	3.16247+05	1.06666+06	3.58611+04
370.	740.	1.26432-17	926.2	1.59283-07	6.1	160.1	1.77350+02	1.75854+00	2.27638+05	9.82710+05	3.51337+04
380.	760.	1.04440-17	926.2	1.41243-07	5.7	172.8	1.00238+02	9.16123-01	1.64448+05	9.05786+05	3.44250+04
390.	780.	8.76310-18	926.2	1.26311-07	5.3	185.2	5.68360+01	4.79008-01	1.18911+05	8.35265+05	3.37344+04
400.	800.	7.46094-18	926.2	1.13763-07	5.1	197.0	3.23289+01	2.51366-01	8.61397+04	7.70583+05	3.30615+04
410.	820.	6.43755-18	926.2	1.03068-07	4.8	208.1	1.84470+01	1.32382-01	6.25123+04	7.11230+05	3.24056+04
420.	840.	5.62105-18	926.2	9.38369-08	4.6	218.2	1.05587+01	6.99684-02	4.54466+04	6.56741+05	3.17662+04
430.	860.	4.95952-18	926.2	8.57794-08	4.5	227.3	6.06238+00	3.71115-02	3.30982+04	6.06694+05	3.11429+04
440.	880.	4.41530-18	926.2	7.86776-08	4.3	235.5	3.49145+00	1.97532-02	2.41473+04	5.60707+05	3.05352+04
450.	900.	3.96090-18	926.2	7.23657-08	4.2	242.8	2.01692+00	1.05506-02	1.76477+04	5.18431+05	2.99426+04
460.	920.	3.57615-18	926.2	6.67162-08	4.1	249.2	1.16865+00	5.65472-03	1.29198+04	4.79549+05	2.93647+04
470.	940.	3.24614-18	926.2	6.16296-08	4.1	255.0	6.79166-01	3.04111-03	9.47471+03	4.43772+05	2.88010+04
480.	960.	2.95975-18	926.2	5.70273-08	4.0	260.3	3.95874-01	1.64106-03	6.96005+03	4.10839+05	2.82511+04
490.	980.	2.70863-18	926.2	5.28461-08	3.9	265.0	2.31428-01	8.88543-04	5.12141+03	3.80510+05	2.77146+04
500.	1000.	2.48644-18	926.2	4.90344-08	3.9	269.3	1.35689-01	4.82704-04	3.77477+03	3.52567+05	2.71911+04

Reference [3], Test #7.

ETR 1942, MUMP 4

April 25, 1967

06:30 Z

01:30 Local (EST)

Cape Kennedy, Florida

molecular nitrogen

ALTITUDE (km)	TEMPERATURE (°K)	DENSITY (part/cc)
145	591	3.70×10^{10}
150	628	2.74
155	658	2.04
160	690	1.55
165	720	1.18×10^{10}
170	747	9.19×10^{9}
175	774	7.22
180	796	5.77
185	816	4.61
190	831	3.74
195	846	3.07
200	860	2.51
205	875	2.06
210	887	1.70
215	898	1.41
220	906	1.18×10^{9}
225	915	9.82×10^{8}
230	922	8.27
235	927	7.00
240	931	5.92
245	935	5.00
250	937	4.23
255	939	3.60
260	940	3.06
265	941	2.60
270	941	2.21
275	942	1.88
280	942	1.60
285	942	1.36
290	942	1.17×10^{8}
295	942	9.90×10^{7}
300	942	8.45
305	942	7.20
310	942	6.08
315	942	5.19
320	942	4.41×10^{7}

Test No. 7

NSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE APRIL 25, 1967 GM TIME 6 HRS 30 MINS LAT 28.46000 DEGS LONG -80.53000 DEGS

F10 131.00000 F10B 146.00000 AP 18.2000 EXOS TEMP 1026.8204 HOUR ANG 198.3433

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
68.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
78.	140.	3.92602-12	642.2	8.13818-03	25.8	22.1	6.18299+10	9.66373+09	2.02824+10	1.95081+07	0.00000
88.	160.	1.37807-12	805.9	3.72430-03	24.8	29.0	2.07397+10	2.86458+09	9.85784+09	1.49423+07	0.00000
97.	180.	6.29022-13	899.5	1.97136-03	23.9	33.8	8.93838+09	1.11202+09	5.81370+09	1.25590+07	0.00000
108.	200.	3.25786-13	953.2	1.12522-03	22.9	37.5	4.31336+09	4.87598+08	3.73970+09	1.10023+07	0.00000
119.	220.	1.81563-13	984.1	6.73824-04	22.1	40.5	2.20714+09	2.27765+08	2.51548+09	9.64379+06	0.00000
130.	240.	1.06243-13	1002.0	4.17839-04	21.2	43.2	1.16731+09	1.10264+08	1.73457+09	8.90919+06	0.00000
140.	260.	6.44586-14	1012.3	2.66359-04	20.4	45.6	6.29743+08	5.45459+07	1.21374+09	8.11665+06	0.00000
151.	280.	4.02609-14	1018.3	1.73739-04	19.6	48.0	3.44096+08	2.73620+07	8.57100+08	7.42379+06	0.00000
162.	300.	2.57713-14	1021.8	1.15563-04	18.9	50.1	1.89677+08	1.38594+07	6.08951+08	6.80685+06	0.00000
173.	320.	1.68500-14	1023.9	7.81724-05	18.4	52.2	1.05242+08	7.07130+06	4.34535+08	6.25137+06	0.00000
183.	340.	1.12226-14	1025.1	5.36564-05	17.8	54.1	5.87009+07	3.62915+06	3.11116+08	5.74785+06	0.00000
194.	360.	7.59589-15	1025.8	3.72999-05	17.4	55.9	3.28886+07	1.87200+06	2.23368+08	5.28952+06	0.00000
205.	380.	5.21355-15	1026.2	2.62209-05	17.0	57.6	1.85010+07	9.70036+05	1.60759+08	4.87121+06	0.00000
216.	400.	3.62194-15	1026.5	1.86175-05	16.6	59.2	1.04466+07	5.04803+05	1.15955+08	4.48875+06	0.00000
227.	420.	2.54271-15	1026.6	1.33400-05	16.3	60.8	5.91980+06	2.63770+05	8.38126+07	4.13864+06	0.00000
237.	440.	1.80140-15	1026.7	9.64064-06	16.0	62.4	3.36623+06	1.38371+05	6.07016+07	3.81782+06	0.00000
248.	460.	1.28648-15	1026.7	7.02509-06	15.6	64.0	1.92066+06	7.28687+04	4.40491+07	3.52364+06	0.00000
259.	480.	9.25360-16	1026.8	5.16170-06	15.3	65.8	1.09952+06	3.85201+04	3.20261+07	3.25370+06	0.00000
270.	500.	6.70039-16	1026.8	3.82821-06	14.9	67.8	6.31505+05	2.04390+04	2.33285+07	3.00587+06	2.27595+04
281.	520.	4.86146-16	1026.8	2.86315-06	14.6	70.0	3.63881+05	1.08853+04	1.70245+07	2.77821+06	2.25980+04
291.	540.	3.57768-16	1026.8	2.16213-06	14.1	72.5	2.10346+05	5.81852+03	1.24468+07	2.56898+06	2.21601+04
302.	560.	2.63788-16	1026.8	1.64987-06	13.7	75.5	1.21980+05	3.12148+03	9.11657+06	2.37658+06	2.17330+04
313.	580.	1.95698-16	1026.8	1.27325-06	13.1	79.0	7.09592+04	1.68062+03	6.68937+06	2.19959+06	2.13166+04
324.	600.	1.46130-16	1026.8	9.94610-07	12.5	83.1	4.14078+04	9.08081+02	4.91714+06	2.03668+06	2.09105+04
335.	620.	1.09883-16	1026.8	7.87057-07	11.9	88.0	2.42381+04	4.92395+02	3.62082+06	1.88667+06	2.05143+04
345.	640.	8.32588-17	1026.8	6.31324-07	11.3	93.7	1.42313+04	2.67931+02	2.67092+06	1.74848+06	2.01279+04
356.	660.	6.36143-17	1026.8	5.13537-07	10.8	100.3	8.38122+03	1.46298+02	1.97365+06	1.62111+06	1.97509+04
367.	680.	4.90527-17	1026.8	4.23666-07	9.9	107.9	4.95083+03	8.01584+01	1.46091+06	1.50366+06	1.93830+04
378.	700.	3.82057-17	1026.8	3.54434-07	9.2	116.6	2.93323+03	4.40697+01	1.08323+06	1.39532+06	1.90240+04
389.	720.	3.00830-17	1026.8	3.00539-07	8.5	126.2	1.74300+03	2.43108+01	8.04544+05	1.29533+06	1.86736+04
399.	740.	2.39652-17	1026.8	2.58107-07	7.9	136.9	1.03878+03	1.34560+01	5.98560+05	1.20302+06	1.83316+04
410.	760.	1.93281-17	1026.8	2.24296-07	7.4	148.3	6.20888+02	7.47265+00	4.46054+05	1.11774+06	1.79978+04
421.	780.	1.57886-17	1026.8	1.97013-07	6.8	160.4	3.72182+02	4.16357+00	3.32953+05	1.03894+06	1.76718+04
432.	800.	1.30659-17	1026.8	1.74712-07	6.4	172.8	2.23738+02	2.32743+00	2.48936+05	9.66088+05	1.73535+04
443.	820.	1.09534-17	1026.8	1.56244-07	6.0	185.4	1.34883+02	1.30526+00	1.86422+05	8.98708+05	1.70427+04
453.	840.	9.29900-18	1026.8	1.40753-07	5.6	197.8	8.15445+01	7.34363-01	1.39832+05	8.36365+05	1.67391+04
464.	860.	7.99007-18	1026.8	1.27596-07	5.3	209.9	4.94361+01	4.14486-01	1.05052+05	7.78656+05	1.64426+04
475.	880.	6.94317-18	1026.8	1.16292-07	5.1	221.3	3.00535+01	2.34683-01	7.90480+04	7.25216+05	1.61529+04
486.	900.	6.09619-18	1026.8	1.06473-07	4.9	232.1	1.83205+01	1.33296-01	5.95742+04	6.75708+05	1.58699+04
496.	920.	5.40278-18	1026.8	9.78584-08	4.7	242.0	1.11985+01	7.59452-02	4.49676+04	6.29824+05	1.55935+04
507.	940.	4.82822-18	1026.8	9.02342-08	4.6	251.1	6.86368+00	4.34035-02	3.39948+04	5.87283+05	1.53231+04
518.	960.	4.34637-18	1026.8	8.34332-08	4.4	259.3	4.21808+00	2.48815-02	2.57388+04	5.47824+05	1.50589+04
529.	980.	3.93751-18	1026.8	7.73249-08	4.3	266.7	2.59912+00	1.43069-02	1.95174+04	5.11211+05	1.48007+04
540.	1000.	3.58667-18	1026.8	7.18061-08	4.3	273.4	1.60576+00	8.25129-03	1.48221+04	4.77224+05	1.45484+04

Reference [3], Test #8.

ETR 4803, MUMP 5

April 25, 1967

19:00 Z

14:00 Local (EST)

Cape Kennedy, Florida

molecular nitrogen

ALTITUDE (km)	TEMPERATURE (°K)	DENSITY (part/cc)
140	616	4.81×10^{10}
145	654	3.56
150	693	2.65
155	736	2.00
160	777	1.54
165	814	1.20×10^{10}
170	848	9.54×10^{9}
175	880	7.69
180	907	6.24
185	931	5.13
190	951	4.26
195	969	3.55
200	983	2.99
205	997	2.52
210	1010	2.14
215	1021	1.81
220	1030	1.54
225	1037	1.32
230	1044	1.13×10^{9}
235	1049	9.66×10^{8}
240	1053	8.34
245	1057	7.20
250	1060	6.21
255	1062	5.38
260	1065	4.63
265	1067	4.01
270	1069	3.47
275	1071	3.01
280	1072	2.61
285	1073	2.27
290	1075	1.97
295	1076	1.70
300	1077	1.48
305	1078	1.29
310	1080	1.12×10^{8}
315	1081	9.60×10^{7}
320	1082	8.29×10^{7}

Test No. 8

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE APRIL 25, 1967 GM TIME 19 HRS 0 MINS LAT 28.46000 DEGS LONG -80.53000 DEGS

F10 131.00000 F10B 146.00000 AP 5.2000 EXOS TEMP 1184.3997 HOUR ANG 26.3567

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
90.	140.	5.83754-12	689.4	8.52186-03	25.8	23.6	6.05558+10	9.53245+09	1.94432+10	1.87905+07	0.00000
95.	160.	1.39983-12	888.0	4.14452-03	24.9	31.7	2.12294+10	2.98307+09	9.58334+09	1.43002+07	0.00000
97.	180.	6.70599-13	1006.4	2.32667-03	24.1	37.4	9.69306+09	1.23968+09	5.80322+09	1.20290+07	0.00000
100.	200.	3.65495-13	1077.2	1.40387-03	23.3	41.7	4.98870+09	5.85926+08	3.85638+09	1.05838+07	0.00000
110.	220.	2.14342-13	1119.8	8.85592-04	22.5	45.1	2.73428+09	2.96339+08	2.69007+09	9.53150+06	0.00000
130.	240.	1.31769-13	1145.1	5.76445-04	21.8	48.0	1.55353+09	1.55808+08	1.92871+09	8.69595+06	0.00000
140.	260.	8.37777-14	1160.5	3.84436-04	21.0	50.7	9.02161+08	8.38809+07	1.40574+09	7.99414+06	0.00000
151.	280.	5.46745-14	1169.8	2.61560-04	20.3	53.2	5.31305+08	4.58533+07	1.03519+09	7.38296+06	0.00000
162.	300.	3.64598-14	1175.5	1.81023-04	19.7	55.5	3.15902+08	2.53293+07	7.67537+08	6.83839+06	0.00000
173.	320.	2.47892-14	1178.9	1.27163-04	19.1	57.7	1.89133+08	1.40992+07	5.71807+08	6.34613+06	0.00000
185.	340.	1.71046-14	1181.0	9.05050-05	18.6	59.9	1.13844+08	7.89502+06	4.27506+08	5.89709+06	0.00000
194.	360.	1.19847-14	1182.3	6.51656-05	18.1	61.9	6.88288+07	4.44283+06	3.20523+08	5.48513+06	0.00000
205.	380.	8.50672-15	1183.1	4.74064-05	17.7	63.8	4.17728+07	2.51098+06	2.40882+08	5.10579+06	0.00000
216.	400.	6.10798-15	1183.6	3.48059-05	17.3	65.6	2.54405+07	1.42473+06	1.81410+08	4.75564+06	0.00000
227.	420.	4.43064-15	1183.9	2.57675-05	16.9	67.4	1.55441+07	8.11377+05	1.36883+08	4.43190+06	0.00000
237.	440.	3.24311-15	1184.1	1.92212-05	16.6	69.1	9.52684+06	4.63706+05	1.03473+08	4.13221+06	0.00000
248.	460.	2.39298-15	1184.2	1.44391-05	16.3	70.7	5.85642+06	2.65915+05	7.83529+07	3.85455+06	0.00000
259.	480.	1.77833-15	1184.3	1.09190-05	16.0	72.4	3.61064+06	1.53000+05	5.94314+07	3.59711+06	0.00000
270.	500.	1.33005-15	1184.3	8.31193-06	15.8	74.1	2.23244+06	8.83206+04	4.51537+07	3.35828+06	9.75714+04
281.	520.	1.00054-15	1184.4	6.36676-06	15.5	75.9	1.38422+06	5.11486+04	3.43616+07	3.13659+06	9.74808+03
291.	540.	7.56685-16	1184.4	4.90822-06	15.2	77.8	8.60676+05	2.97159+04	2.61908+07	2.93072+06	9.58410+03
302.	560.	5.75120-16	1184.4	3.80891-06	14.9	79.9	5.36628+05	1.73187+04	1.99944+07	2.73945+06	9.42379+03
313.	580.	4.39203-16	1184.4	2.97629-06	14.5	82.3	3.35500+05	1.01250+04	1.52879+07	2.56166+06	9.26705+03
324.	600.	3.36965-16	1184.4	2.34270-06	14.2	84.9	2.10323+05	5.93768+03	1.17073+07	2.39634+06	9.11379+03
335.	620.	2.59721-16	1184.4	1.85032-06	13.8	87.9	1.32204+05	3.49277+03	8.97912+06	2.24255+06	8.96392+03
345.	640.	2.01125-16	1184.4	1.48629-06	13.3	91.3	8.33217+04	2.06082+03	6.89714+06	2.09943+06	8.81735+03
356.	660.	1.56506-16	1184.4	1.19917-06	12.9	95.2	5.26518+04	1.21960+03	5.30588+06	1.96618+06	8.67398+03
367.	680.	1.22407-16	1184.4	9.76474-07	12.3	99.7	3.33582+04	7.23921+02	4.08784+06	1.84207+06	8.53375+03
378.	700.	9.62575-17	1184.4	8.02845-07	11.8	104.8	2.11892+04	4.30971+02	3.15408+06	1.72644+06	8.39655+03
389.	720.	7.61340-17	1184.4	6.66706-07	11.2	110.7	1.34940+04	2.57323+02	2.43718+06	1.61866+06	8.26232+03
399.	740.	6.05940-17	1184.4	5.59318-07	10.7	117.3	8.61535+03	1.54089+02	1.88597+06	1.51816+06	8.13097+03
410.	760.	4.85501-17	1184.4	4.74059-07	10.1	124.8	5.51442+03	9.25372+01	1.46153+06	1.42441+06	8.00243+03
421.	780.	3.91827-17	1184.4	4.05895-07	9.5	133.1	3.53844+03	5.57317+01	1.13423+06	1.33693+06	7.87663+03
432.	800.	3.18673-17	1184.4	3.50990-07	8.9	142.3	2.27816+03	3.36604+01	8.81470+05	1.25526+06	7.75349+03
443.	820.	2.61308-17	1184.4	3.06409-07	8.4	152.4	1.46778+03	2.03872+01	6.86003+05	1.17900+06	7.63294+03
453.	840.	2.16124-17	1184.4	2.69907-07	7.9	163.2	9.48804+02	1.23624+01	5.34626+05	1.10776+06	7.51493+03
464.	860.	1.80363-17	1184.4	2.39754-07	7.4	174.7	6.14813+02	7.54141+00	4.17229+05	1.04118+06	7.39937+03
475.	880.	1.51911-17	1184.4	2.14617-07	7.0	186.7	3.99348+02	4.60565+00	3.26057+05	9.78940+05	7.28622+03
486.	900.	1.29147-17	1184.4	1.93467-07	6.6	199.0	2.60012+02	2.82039+00	2.55154+05	9.20733+05	7.17541+03
496.	920.	1.10822-17	1184.4	1.75504-07	6.2	211.6	1.69691+02	1.73180+00	1.99939+05	8.66278+05	7.06688+03
507.	940.	9.59725-18	1184.4	1.60105-07	5.9	224.1	1.11005+02	1.06623+00	1.56882+05	8.15316+05	6.96057+03
518.	960.	8.38551-18	1184.4	1.46785-07	5.6	236.4	7.28831+01	6.58191-01	1.23260+05	7.67607+05	6.85643+03
529.	980.	7.38927-18	1184.4	1.35161-07	5.4	248.4	4.78321+01	4.07377-01	9.69719+04	7.22927+05	6.75440+03
540.	1000.	6.56374-18	1184.4	1.24934-07	5.2	259.9	3.15064+01	2.52798-01	7.63897+04	6.81070+05	6.65444+03

Reference [4], Test #9.

NASA 18.01

March 19, 1965

18:09 Z

13:09 LOCAL

Wallops Is., Va.

molecular nitrogen

ALTITUDE (Km.)	DENSITY (part/cc)	TEMPERATURE ($^{\circ}$Kelvin)
168	7.29×10^{9}	693
170	6.62	697
175	5.21	706
180	4.12	714
185	3.29	723
190	2.63	732
195	2.10	740
200	1.69	748
205	1.37	756
210	1.11×10^{9}	764
215	8.94×10^{8}	772
220	7.27	779
225	5.92	786
230	4.82	793
235	3.91	800
240	3.18	806
245	2.59	812
250	2.12	818
255	1.74	823
260	1.45	828
265	1.21	832
270	1.00×10^{8}	836
275	8.34×10^{7}	840
280	6.95	842
285	5.78	845
290	4.83	846
295	4.05	848
300	3.38	849
305	2.84	850
310	2.38×10^{7}	850

Test No. 9

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE MARCH 19, 1968 GM TIME 18 HRS 0 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 77.00000 F10B 76.00000 AP 5.0000 EXOS TEMP 838.7558 HOUR ANG -343.8816

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
78.	140.	4.05441-12	568.6	7.46801-03	25.7	19.6	6.36052+10	9.80921+09	2.17185+10	2.07852+07	0.00000
86.	160.	1.30932-12	687.3	3.05176-03	24.5	25.0	1.93979+10	2.59409+09	1.01582+10	1.59938+07	0.00000
97.	180.	5.42484-13	753.6	1.45393-03	23.4	28.9	7.43819+09	8.78899+08	5.64688+09	1.33355+07	0.00000
108.	200.	2.55396-13	790.7	7.54519-04	22.3	32.0	3.16994+09	3.33878+08	3.39779+09	1.15325+07	0.00000
119.	220.	1.30145-13	811.5	4.14740-04	21.2	34.8	1.42755+09	1.54663+08	2.12997+09	1.01607+07	0.00000
130.	240.	7.01571-14	823.3	2.38057-04	20.2	37.3	6.63281+08	5.61942+07	1.36607+09	9.04325+06	0.00000
140.	260.	3.95125-14	829.9	1.41396-04	19.3	39.5	3.14090+08	2.39425+07	8.68103+08	8.09550+06	0.00000
151.	280.	2.30652-14	833.7	8.63799-05	18.5	41.6	1.50598+08	1.03422+07	5.82369+08	7.27241+06	0.00000
162.	300.	1.38722-14	835.9	5.40052-05	17.9	43.5	7.26511+07	4.51164+06	3.84149+08	6.54753+06	0.00000
173.	320.	8.55370-15	837.1	3.44207-05	17.3	45.3	3.54840+07	1.98332+06	2.54512+08	5.90388+06	0.00000
183.	340.	5.38446-15	837.8	2.22983-05	16.8	46.9	1.73825+07	8.77508+05	1.69221+08	5.32948+06	0.00000
194.	360.	3.44796-15	838.2	1.46505-05	16.4	48.4	8.55838+06	3.90481+05	1.12856+08	4.81529+06	0.00000
205.	380.	2.23952-15	838.4	9.74910-06	16.0	49.8	4.23349+06	1.74684+05	7.54729+07	4.35404+06	0.00000
216.	400.	1.47213-15	838.6	6.56624-06	15.6	51.4	2.10345+06	7.85420+04	5.06034+07	3.93970+06	0.00000
227.	420.	9.77739-16	838.6	4.47612-06	15.2	53.0	1.04960+06	3.54871+04	3.40129+07	3.56709+06	0.00000
237.	440.	6.55428-16	838.7	3.09003-06	14.8	55.0	5.25936+05	1.61106+04	2.29167+07	3.23171+06	0.00000
248.	460.	4.43209-16	838.7	2.16253-06	14.5	57.2	2.64621+05	7.34835+03	1.54769+07	2.92961+06	0.00000
259.	480.	3.02298-16	838.7	1.53650-06	13.7	59.9	1.33682+05	3.36726+03	1.04767+07	2.65730+06	0.00000
270.	500.	2.08189-16	838.7	1.12058-06	13.0	63.8	6.78050+04	1.55006+03	7.10816+06	2.41170+06	8.92908+04
281.	520.	1.44714-16	838.7	8.27602-07	12.2	68.2	3.45278+04	7.16780+02	4.83364+06	2.19003+06	8.90911+04
291.	540.	1.01692-16	838.8	6.23961-07	11.4	73.6	1.76513+04	3.32941+02	3.29431+06	1.98986+06	8.69819+04
302.	560.	7.23470-17	838.8	4.80878-07	10.5	80.2	9.05886+03	1.55336+02	2.25019+06	1.80899+06	8.49343+04
313.	580.	5.21969-17	838.8	3.79015-07	9.6	88.2	4.66703+03	7.27943+01	1.54038+06	1.64546+06	8.29462+04
324.	600.	3.82602-17	838.8	3.05407-07	8.7	97.5	2.41360+03	3.42619+01	1.05678+06	1.49754+06	8.10157+04
335.	620.	2.85429-17	838.8	2.51319-07	7.9	108.1	1.25294+03	1.61957+01	7.28574+05	1.36364+06	7.91407+04
345.	640.	2.17049-17	838.8	2.10837-07	7.2	120.0	6.52866+02	7.68867+00	5.00617+05	1.24239+06	7.73195+04
356.	660.	1.66422-17	838.8	1.79933-07	6.5	132.7	3.41455+02	3.66561+00	3.45663+05	1.13252+06	7.55503+04
367.	680.	1.33419-17	838.8	1.55853-07	6.0	145.9	1.79243+02	1.75497+00	2.39174+05	1.03290+06	7.38312+04
378.	700.	1.07874-17	838.8	1.36698-07	5.5	159.2	9.44360+01	8.43736-01	1.65838+05	9.42544+05	7.21607+04
389.	720.	8.89379-18	838.8	1.21148-07	5.1	172.1	4.99350+01	4.07327-01	1.15226+05	8.60535+05	7.05370+04
399.	740.	7.46996-18	838.8	1.08288-07	4.8	184.3	2.64992+01	1.97451-01	8.02250+04	7.86064+05	6.89588+04
410.	760.	6.36936-18	838.8	9.74666-08	4.6	195.8	1.41126+01	9.61049-02	5.59696+04	7.18404+05	6.74244+04
421.	780.	5.51061-18	838.8	8.82218-08	4.4	205.7	7.54251+00	4.69660-02	3.91265+04	6.56899+05	6.59325+04
432.	800.	4.82593-18	838.8	8.02197-08	4.2	214.8	4.04524+00	2.30441-02	2.74068+04	6.00960+05	6.44817+04
443.	820.	4.26868-18	838.8	7.32165-08	4.1	222.9	2.17712+00	1.13516-02	1.92357+04	5.50057+05	6.30706+04
453.	840.	3.80642-18	838.8	6.70308-08	4.0	230.1	1.17575+00	5.61395-03	1.35274+04	5.03714+05	6.16980+04
464.	860.	3.41775-18	838.8	6.15259-08	3.9	236.6	6.37132-01	2.78721-03	9.53157+03	4.61500+05	6.03626+04
475.	880.	3.08570-18	838.8	5.65967-08	3.8	242.4	3.46430-01	1.38917-03	6.72909+03	4.23029+05	5.90633+04
486.	900.	2.79836-18	838.8	5.21608-08	3.7	247.7	1.88999-01	6.95033-04	4.75973+03	3.87950+05	5.77988+04
496.	920.	2.54701-18	838.8	4.81527-08	3.7	252.6	1.03455-01	3.49068-04	3.37314+03	3.55950+05	5.65662+04
507.	940.	2.32511-18	838.8	4.45192-08	3.6	257.2	5.68169-02	1.75976-04	2.39500+03	3.26744+05	5.53603+04
518.	960.	2.12772-18	838.8	4.12163-08	3.6	261.7	3.13059-02	8.90479-05	1.70369+03	3.00074+05	5.42041+04
529.	980.	1.95105-18	838.8	3.82071-08	3.6	266.0	1.73056-02	4.52279-05	1.21418+03	2.75709+05	5.30666+04
540.	1000.	1.79212-18	838.8	3.54604-08	3.5	270.2	9.59723-03	2.30563-05	8.66910+02	2.53439+05	5.19629+04

Test #10
Reference [21]

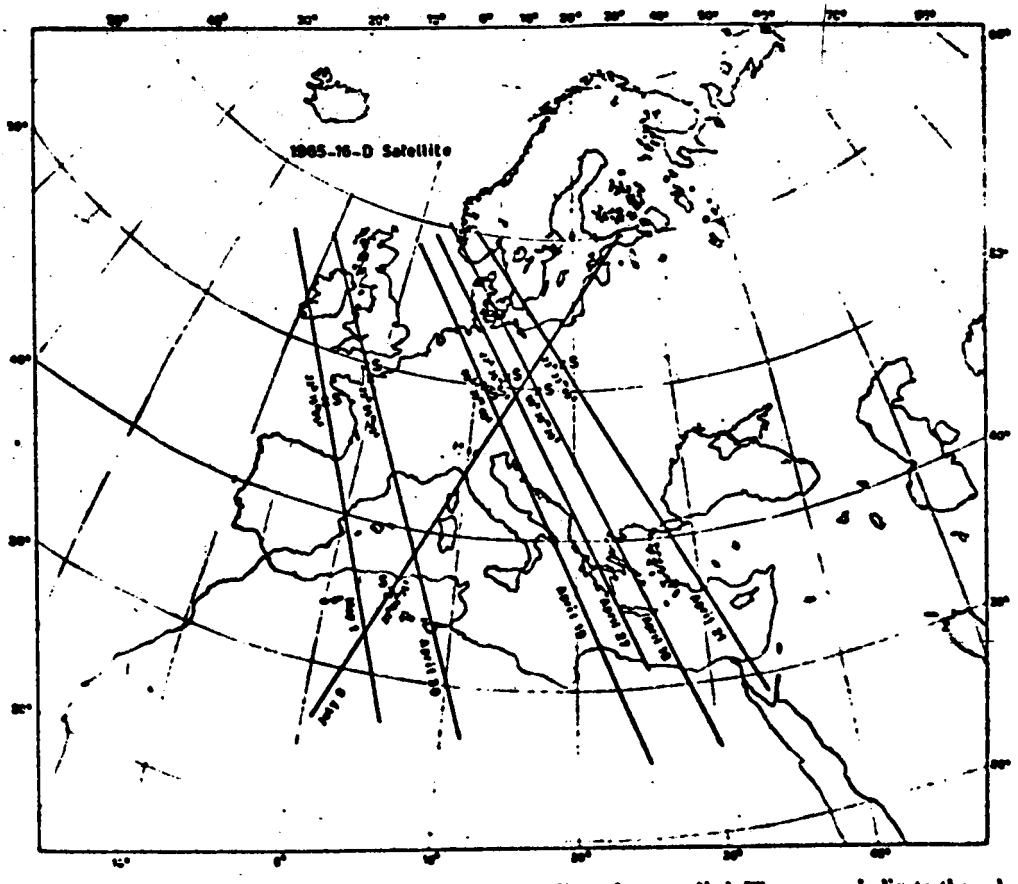


FIG. 3. Map of the orbits within which occurred the eclipses here studied. The crosses indicate the sub-satellite points corresponding to the beginning of the event.

Test #10 (Cont'd)
Reference [21]

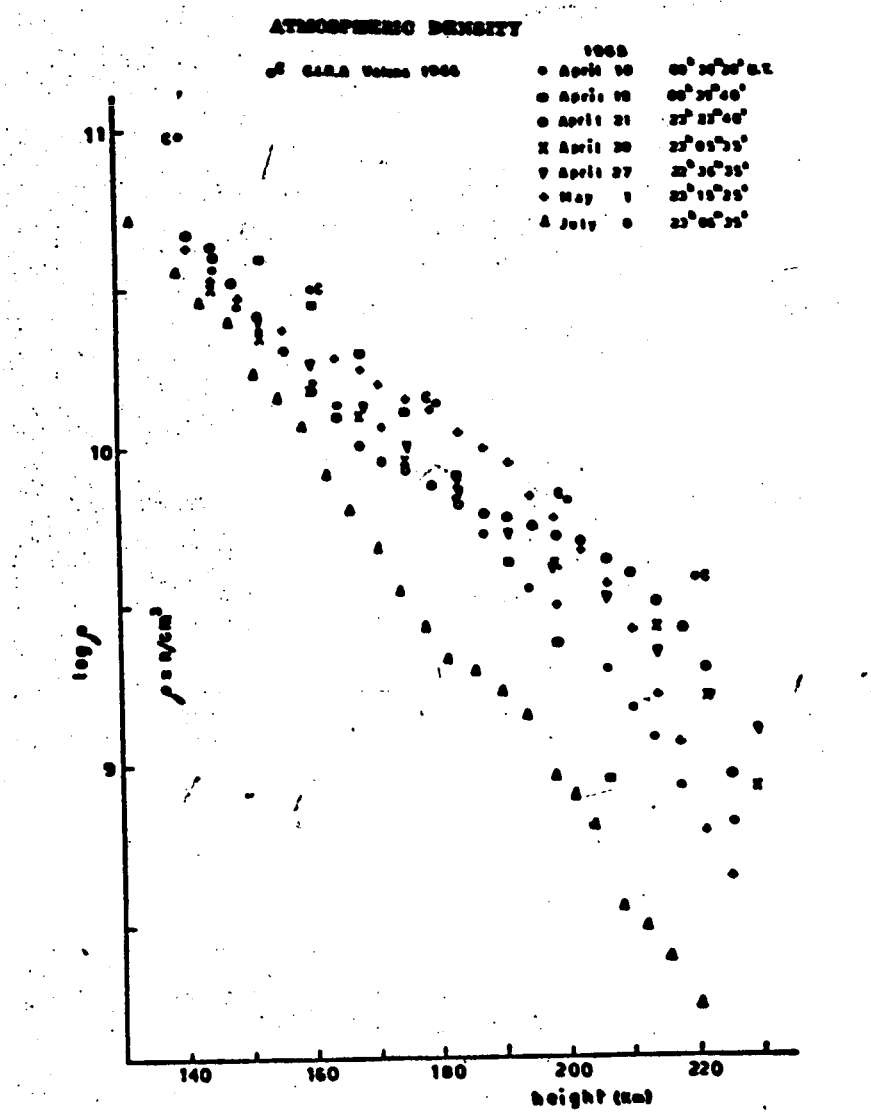


FIG. 8. Logarithm of the number density obtained by several eclipses versus the height.

Test #10 (Cont'd)
Reference [21]

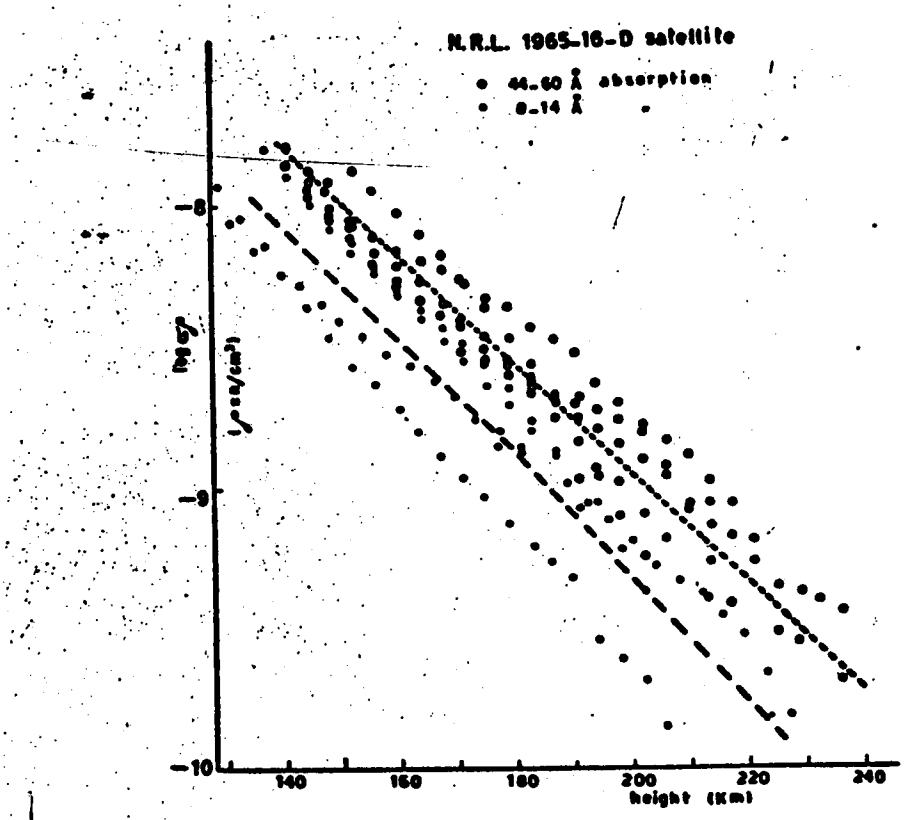


FIG. 4. The values log $\rho\sigma$ at 44–60 Å (open circles) are reported versus the height together with the values log $\rho\sigma$ at 8–14 Å (black circles) for comparison.

Test #10 (Concluded)
Reference [21]

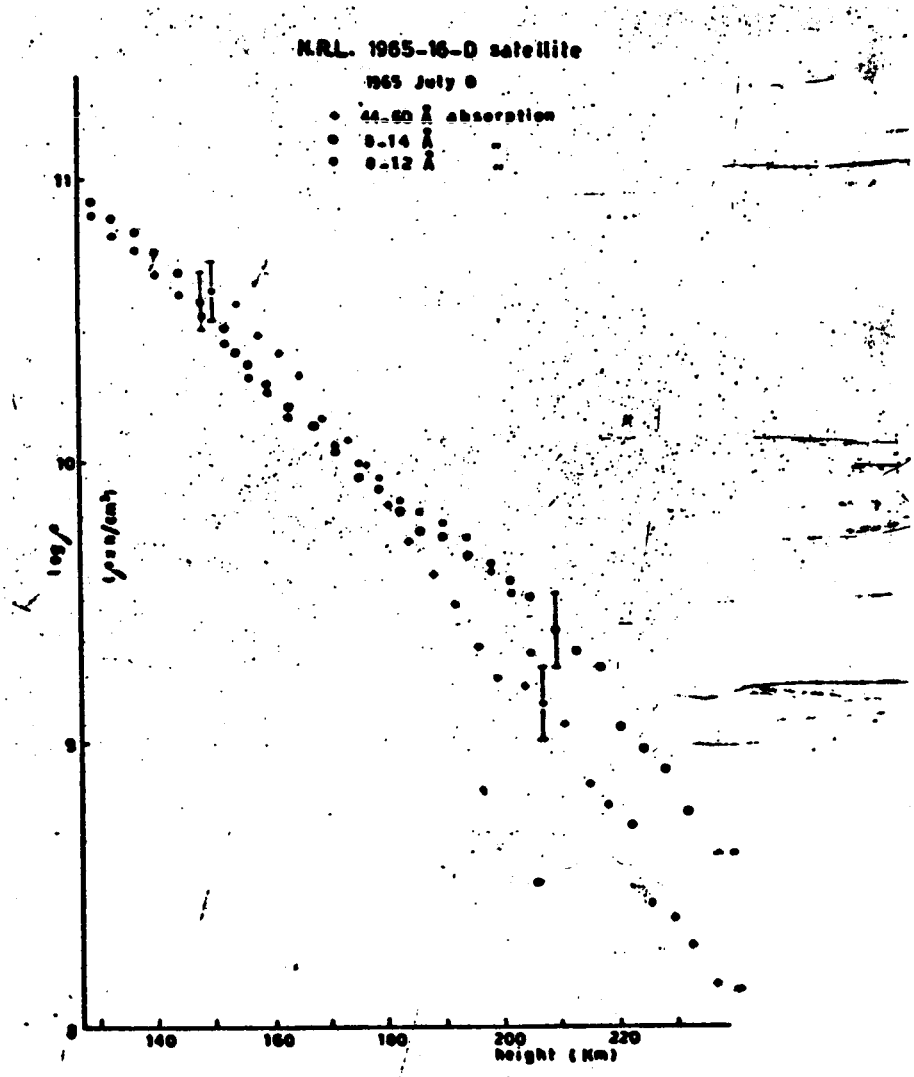


FIG. 6. Values of the density obtained from 44-60, 8-14, 8-12 Å measurements of July 8, 1965. The two vertical lines are the error of the measurements at two different heights.

Reference [4], Test #11.

NASA 18.03
(upleg)

November 9, 1965

19:16 Z

13:16 LOCAL

Fort Churchill, Manitoba

molecular nitrogen

ALTITUDE Km.	DENSITY (part/cc)	TEMPERATURE Kelvin
173	7.50×10^{9}	715
175	6.86	719
180	5.46	729
185	4.35	737
190	3.49	744
195	2.82	751
200	2.27	757
205	1.84	762
210	1.50	767
215	1.22×10^{9}	771
220	9.95×10^{8}	775
225	8.12	779
230	6.63	782
235	5.43	785
240	4.45	788
245	3.64	790
250	2.98	792
255	2.45	794
260	2.02	796
265	1.66	797
270	1.36×10^{8}	799

Reference [4], Test #11 Concluded.

NASA 18.03
(downleg)

November 9, 1965

19:16 Z

13:16 LOCAL

Fort Churchill, Manitoba

molecular nitrogen

ALTITUDE Km.	DENSITY (part/cc)	TEMPERATURE °Kelvin
147	2.68×10^{10}	608
150	2.24	629
155	1.69	652
160	1.29	669
165	1.00×10^{10}	684
170	7.80×10^{9}	696
175	6.15	707
180	4.87	717
185	3.86	726
190	3.08	734
195	2.47	742
200	1.99	748
205	1.60	754
210	1.29	760
215	1.05×10^{9}	766
220	8.52×10^{8}	770
225	6.96	775
230	5.68	779
235	4.67	783
240	3.80	787
245	3.11	790
250	2.55	793
255	2.09	796
256	2.01×10^{8}	797

Test No. 11

[illegible] MODIFIED JACCHIA [illegible] ATMOSPHERE (1967)

DATE NOVEMBER 9,1965 GM TIME 19 HRS 16 MINS LAT 58.73000 DEGS LONG -93.62000 DEGS

F10 82.00000 F10B 77.00000 AP 4.0000 EXOS TEMP 902.4295 HOUR ANG 20.8700

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
69.	110.	2.45946-11	385.0	2.70030-02	26.9	11.6	4.60000+11	7.50000+10	7.60000+10	3.40800+07	0.00000
70.	140.	4.06075-12	892.7	7.31377-03	25.6	19.1	6.39558+10	9.63124+09	2.20522+10	2.10900+07	0.00000
80.	180.	1.28952-12	662.6	2.90528-03	24.5	24.1	1.90219+10	2.52346+09	1.02043+10	1.62566+07	0.00000
97.	180.	5.21038-13	723.8	1.34847-03	23.3	27.9	7.07461+09	8.25212+08	5.58303+09	1.35028+07	0.00000
108.	200.	2.39503-13	758.1	6.83775-04	22.1	31.0	2.91970+09	3.02108+08	3.30083+09	1.16340+07	0.00000
119.	220.	1.19419-13	777.3	3.66256-04	21.0	33.7	1.27264+09	1.17572+08	2.03160+09	1.02072+07	0.00000
130.	240.	6.31391-14	788.2	2.07549-04	19.9	36.1	5.72234+08	4.71741+07	1.27921+09	9.04448+06	0.00000
140.	260.	3.49521-14	794.3	1.21264-04	19.0	38.3	2.62241+08	1.93598+07	8.16313+08	8.05997+06	0.00000
151.	280.	2.00877-14	797.6	7.29456-05	18.3	40.4	1.21697+08	8.05597+06	5.25432+08	7.20738+06	0.00000
162.	300.	1.19078-14	799.8	4.49379-05	17.6	42.2	5.69859+07	3.38601+06	3.40223+08	6.45921+06	0.00000
173.	320.	7.24103-15	800.9	2.82343-05	17.1	43.9	2.66724+07	1.43442+06	2.21264+08	5.78753+06	0.00000
183.	340.	4.49611-15	801.5	1.80366-05	16.6	45.4	1.27469+07	6.11721+05	1.44448+08	5.20985+06	0.00000
194.	360.	2.83985-15	801.9	1.14011-05	16.2	46.9	6.07824+06	2.62428+05	9.45989+07	4.68549+06	0.00000
205.	380.	1.81921-15	802.1	7.67987-06	15.8	48.3	2.91246+06	1.13204+05	6.21166+07	4.21748+06	0.00000
216.	400.	1.17935-15	802.2	5.11097-06	15.4	49.9	1.40200+06	4.90911+04	4.09020+07	3.79893+06	0.00000
227.	420.	7.72564-16	802.3	3.44725-06	15.0	51.7	6.77917+05	2.13971+04	2.70023+07	3.42421+06	0.00000
237.	440.	5.10959-16	802.4	2.35692-06	14.5	53.8	3.29230+05	9.37260+03	1.78709+07	3.08844+06	0.00000
248.	460.	3.41103-16	802.4	1.64023-06	13.9	56.4	1.60578+05	4.12563+03	1.18566+07	2.78732+06	0.00000
259.	480.	2.29905-16	802.4	1.16114-06	13.2	59.6	7.86516+04	1.82498+03	7.88548+06	2.51710+06	0.00000
270.	500.	1.58773-16	802.4	8.32278-07	12.3	64.5	3.86853+04	8.11090+02	5.25695+06	2.27449+06	1.23621+05
281.	520.	1.08070-16	802.4	6.32727-07	11.4	69.9	1.91065+04	3.82192+02	3.51291+06	2.05640+06	1.23553+05
291.	540.	7.84960-17	802.4	4.81106-07	10.9	76.5	9.47536+03	1.62495+02	2.35298+06	1.86035+06	1.20497+05
302.	560.	5.35866-17	802.4	3.79053-07	9.9	84.5	4.71817+03	7.32417+01	1.57971+06	1.68397+06	1.17533+05
313.	580.	3.80822-17	802.4	2.99648-07	8.8	94.1	2.35884+03	3.31644+01	1.06300+06	1.52519+06	1.14689+05
324.	600.	2.84809-17	802.4	2.49033-07	7.8	105.1	1.18401+03	1.50867+01	7.16934+05	1.38216+06	1.11871+05
335.	620.	2.14026-17	802.4	2.04658-07	7.0	117.4	5.96661+02	6.89319+00	4.84626+05	1.25326+06	1.09166+05
345.	640.	1.64612-17	802.4	1.74145-07	6.3	130.7	3.01858+02	3.16388+00	3.28327+05	1.13701+06	1.06542+05
356.	660.	1.29642-17	802.4	1.50554-07	5.7	144.4	1.53508+02	1.45864+00	2.22931+05	1.03212+06	1.03995+05
367.	680.	1.04259-17	802.4	1.31692-07	5.3	158.0	7.81625+01	6.75440-01	1.51701+05	9.37426+05	1.01523+05
378.	700.	8.57071-18	802.4	1.16803-07	4.9	171.2	4.00029+01	3.14139-01	1.03456+05	8.51881+05	9.91227+04
389.	720.	7.10271-18	802.4	1.04351-07	4.6	183.6	2.05508+01	1.46736-01	7.07072+04	7.74561+05	9.67927+04
399.	740.	5.12247-18	802.4	9.38660-08	4.4	194.9	1.05973+01	6.86565-02	4.84287+04	7.04636+05	9.45300+04
410.	760.	5.29306-18	802.4	8.49514-08	4.2	205.0	5.46904+00	3.24293-02	3.32403+04	6.41366+05	9.23126+04
421.	780.	4.63544-18	802.4	7.72204-08	4.0	214.1	2.84949+00	1.53424-02	2.28639+04	5.84064+05	9.01981+04
432.	800.	4.09670-18	802.4	7.04363-08	3.9	222.1	1.48574+00	7.28699-03	1.57590+04	5.32196+05	8.81249+04
443.	820.	3.65360-18	802.4	6.44842-08	3.8	229.4	7.77494-01	3.47730-03	1.08847+04	4.85170+05	8.61097+04
453.	840.	3.27818-18	802.4	5.91729-08	3.7	235.9	4.80332-01	1.66573-03	7.53352+03	4.42826+05	8.41516+04
464.	860.	2.99679-18	802.4	5.44206-08	3.6	241.9	2.15219-01	8.01193-04	5.22474+03	4.03837+05	8.22469+04
475.	880.	2.67818-18	802.4	5.01489-08	3.6	247.4	1.13837-01	3.86925-04	3.63066+03	3.68716+05	8.03992+04
486.	900.	2.43411-18	802.4	4.62945-08	3.5	252.7	6.04244-02	1.87612-04	2.52828+03	3.36819+05	7.86009+04
496.	920.	2.21844-18	802.4	4.28056-08	3.5	257.6	3.21649-02	9.13514-05	1.75403+03	3.07834+05	7.68524+04
507.	940.	2.02655-18	802.4	3.96396-08	3.4	262.8	1.72026-02	4.46570-05	1.23323+03	2.81482+05	7.51521+04
518.	960.	1.85483-18	802.4	3.67604-08	3.4	267.7	9.28615-03	2.19013-05	8.65835+02	2.57512+05	7.34984+04
529.	980.	1.70047-18	802.4	3.41374-08	3.3	272.7	4.96804-03	1.07877-05	6.06262+02	2.35907+05	7.18898+04
540.	1000.	1.56120-18	802.4	3.17440-08	3.3	277.7	2.66095-03	5.33410-06	4.26311+02	2.15638+05	7.03249+04

Reference [4], Test #12.

NASA 18.02
(upleg)

November 10, 1965

07:00 Z

01:00 LOCAL

Fort Churchill, Manitoba

molecular nitrogen

ALTITUDE Km.	DENSITY (part/cc)	TEMPERATURE °Kelvin
144	2.74×10^{10}	565
145	2.59	570
150	1.91	587
155	1.43	598
160	1.09×10^{10}	606
165	8.32×10^{9}	613
170	6.41	618
175	4.98	623
180	3.85	626
185	3.00	630
190	2.33	632
195	1.81	635
200	1.41	637
205	1.09×10^{9}	639
210	8.49×10^{8}	641
215	6.62	643
220	5.17	644
225	4.03	646
230	3.13	647
235	2.45	648
240	1.93	649
245	1.52	650
250	1.20×10^{8}	651
255	9.50×10^{7}	652
260	7.53	653
265	5.97×10^{7}	654

Reference [4], Test #12 Concluded.

NASA 18.02
(downleg)

November 10, 1965

07:00 Z

01:00 LOCAL

Fort Churchill, Manitoba

molecular nitrogen

ALTITUDE Km.	DENSITY (part/cc)	TEMPERATURE °Kelvin
142	3.36×10^{10}	546
145	2.78	560
150	2.04	576
155	1.52	588
160	1.15×10^{10}	598
165	8.74×10^{9}	606
170	6.69	613
175	5.13	619
180	3.95	624
185	3.06	628
190	2.38	632
195	1.86	635
200	1.45	638
205	1.13×10^{9}	641
210	8.80×10^{8}	643
215	6.87	645
220	5.37	647
221	5.13×10^{8}	647

Test No. 12

NSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE NOVEMBER 10,1965 GM TIME 7 HRS 0 MINS LAT 38.75000 DEGS LONG -93.62000 DEGS

F10 85.00000 F10B 77.00000 AP .0000 EXOS TEMP 693.0915 HOUR ANG -165.9562

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
89.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
78.	140.	4.15988-12	503.3	6.81080-03	29.6	17.4	6.49708+10	9.87672+09	2.31629+10	2.21242+07	0.00000
86.	160.	1.21464-12	586.2	2.44662-03	24.2	21.6	1.76431+10	2.27539+09	1.03017+10	1.70907+07	0.00000
97.	180.	4.46978-13	632.6	1.03480-03	22.8	24.9	5.86561+09	6.53427+08	5.31394+09	1.40371+07	0.00000
108.	200.	1.89338-13	656.8	4.83394-04	21.5	27.7	2.15095+09	2.08825+08	2.94363+09	1.19252+07	0.00000
119.	220.	8.74716-14	675.6	2.42369-04	20.2	30.2	8.31575+08	7.07066+07	1.69411+09	1.02994+07	0.00000
130.	240.	4.32509-14	691.9	1.28186-04	19.1	32.5	3.31554+08	2.47653+07	9.96428+08	8.97740+06	0.00000
140.	260.	2.25822-14	686.7	7.06821-05	18.2	34.6	1.34771+08	8.86063+06	5.93945+08	7.86733+06	0.00000
151.	280.	1.22827-14	689.4	4.02359-05	17.5	36.4	5.55040+07	3.21662+06	3.57155+08	6.91757+06	0.00000
162.	300.	6.91586-15	691.0	2.35085-05	16.9	38.0	2.30804+07	1.18037+06	2.16111+08	6.09589+06	0.00000
173.	320.	3.99841-15	691.9	1.40284-05	16.4	39.5	9.67185+06	4.36921+05	1.31598+08	5.38024+06	0.00000
183.	340.	2.36028-15	692.4	8.52821-06	15.9	40.9	4.07980+06	1.62939+05	8.02117+07	4.75435+06	0.00000
194.	360.	1.41675-15	692.7	5.27195-06	15.5	42.4	1.73120+06	6.11753+04	4.91383+07	4.20548+06	0.00000
205.	380.	8.62408-16	692.8	3.31735-06	15.0	44.0	7.36698+05	2.31138+04	3.02004+07	3.72326+06	0.00000
216.	400.	5.31606-16	692.9	2.12766-06	14.4	46.1	3.16877+05	8.78604+03	1.86184+07	3.29899+06	0.00000
227.	420.	3.31720-16	693.0	1.39455-06	13.7	48.7	1.36632+05	3.35945+03	1.15123+07	2.92531+06	0.00000
237.	440.	2.09870-16	693.0	9.37101-07	12.9	52.1	5.92109+04	1.29194+03	7.13901+06	2.59567+06	0.00000
248.	460.	1.34449-16	693.1	6.47796-07	12.0	56.5	2.57872+04	4.99661+02	4.43965+06	2.30519+06	0.00000
259.	480.	8.76737-17	693.1	4.81969-07	10.9	62.1	1.12850+04	1.94329+02	2.76870+06	2.04650+06	0.00000
270.	500.	5.89607-17	693.1	3.77496-07	9.8	75.9	4.96322+03	7.59979+01	1.73143+06	1.82165+06	3.87572+05
281.	520.	4.03427-17	693.1	2.95968-07	7.9	87.5	2.19317+03	2.98642+01	1.08574+06	1.62104+06	3.84517+05
291.	540.	2.63029-17	693.1	2.39252-07	6.8	101.2	9.73738+02	1.18150+01	6.82685+05	1.44350+06	3.73528+05
302.	560.	2.05954-17	693.1	1.99006-07	6.0	116.6	4.34363+02	4.60636+00	4.30411+05	1.28627+06	3.62913+05
313.	580.	1.54367-17	693.1	1.69522-07	5.2	133.3	1.94664+02	1.87672+00	2.72063+05	1.14693+06	3.52659+05
324.	600.	1.19468-17	693.1	1.47209-07	4.7	150.4	8.76442+01	7.53925-01	1.72451+05	1.02336+06	3.42750+05
335.	620.	9.53257-18	693.1	1.29782-07	4.2	167.2	3.96413+01	3.04458-01	1.09589+05	9.13700+05	3.33175+05
345.	640.	7.61338-18	693.1	1.15773-07	3.9	183.0	1.80112+01	1.23589-01	6.98219+04	8.16319+05	3.23919+05
356.	660.	6.95358-18	693.1	1.04224-07	3.6	197.6	8.22037+00	5.04270-02	4.45999+04	7.29786+05	3.14971+05
367.	680.	5.00212-18	693.1	9.44999-08	3.4	210.7	3.76857+00	2.06805-02	2.85616+04	6.52641+05	3.06318+05
378.	700.	4.86198-18	693.1	8.61708-08	3.3	222.7	1.73533+00	8.52415-03	1.83370+04	5.84378+05	2.97951+05
389.	720.	4.27019-18	693.1	7.89392-08	3.1	233.6	8.02582-01	3.53116-03	1.18021+04	5.23422+05	2.89857+05
399.	740.	3.78537-18	693.1	7.25937-08	3.0	243.7	3.72808-01	1.47008-03	7.61905+03	4.69116+05	2.82027+05
410.	760.	3.37969-18	693.1	6.69797-08	2.9	253.2	1.73921-01	6.15042-04	4.92555+03	4.20703+05	2.74451+05
421.	780.	3.03496-18	693.1	6.19807-08	2.8	262.4	8.14648-02	2.56576-04	3.19372+03	3.77517+05	2.67119+05
432.	800.	2.73792-18	693.1	5.75067-08	2.7	271.5	3.83390-02	1.09239-04	2.07502+03	3.38969+05	2.60023+05
443.	820.	2.47830-18	693.1	5.34862-08	2.7	280.5	1.81146-02	4.63713-05	1.35247+03	3.04539+05	2.53153+05
453.	840.	2.25049-18	693.1	4.98611-08	2.6	289.5	8.59465-03	1.97784-05	8.83278+02	2.73770+05	2.46501+05
464.	860.	2.04899-18	693.1	4.65831-08	2.5	298.6	4.09470-03	8.47585-06	5.78221+02	2.46235+05	2.40059+05
475.	880.	1.86988-18	693.1	4.36116-08	2.5	308.2	1.95882-03	3.64930-06	3.79408+02	2.21635+05	2.33820+05
486.	900.	1.71003-18	693.1	4.09120-08	2.4	317.9	9.40878-04	1.57853-06	2.49533+02	1.99592+05	2.27776+05
496.	920.	1.56693-18	693.1	3.84544-08	2.3	327.9	4.53756-04	6.85959-07	1.64494+02	1.79848+05	2.21920+05
507.	940.	1.43850-18	693.1	3.62127-08	2.3	338.2	2.19709-04	2.99452-07	1.08684+02	1.62145+05	2.16246+05
518.	960.	1.32298-18	693.1	3.41641-08	2.2	348.8	1.06806-04	1.31518-07	7.19720+01	1.46269+05	2.10746+05
529.	980.	1.21888-18	693.1	3.22887-08	2.2	359.8	5.21254-05	5.78458-08	4.77661+01	1.32022+05	2.05415+05
540.	1000.	1.12494-18	693.1	3.05687-08	2.1	371.1	2.55387-05	2.55951-08	3.17746+01	1.19229+05	2.00247+05

Reference [5], Test #13.

TABLE 1. Number Densities*, number/cm³

Altitude, km	Molec. Nitrogen	Molec. Oxygen	Atomic Oxygen	Argon	Helium	Total
120.	2.36E + 11†	3.94E + 10	1.30E + 10	7.84E + 08	2.18E + 07	2.89E + 11
125.	1.32E + 11	2.02E + 10	9.60E + 09	4.42E + 08	1.49E + 07	1.62E + 11
130.	8.20E + 10	1.17E + 10	7.18E + 09	2.70E + 08	1.09E + 07	1.01E + 11
135.	5.53E + 10	7.40E + 09	5.47E + 09	1.73E + 08	8.45E + 06	6 83E + 10
140.	3.93E + 10	5.00E + 09	4.27E + 09	1.14E + 08	6.86E + 06	4.87E + 10
145.	2.90E + 10	3.53E + 09	3.42E + 09	7.70E + 07	5.78E + 06	3.60E + 10
150.	2.19E + 10	2.56E + 09	2.81E + 09	5.24E + 07	5.01E + 06	2.73E + 10
155.	1.67E + 10	1.89E + 09	2.36E + 09	3.62E + 07	4.45E + 06	2.10E + 10
160.	1.28E + 10	1.41E + 09	2.02E + 09	2.53E + 07	4.03E + 06	1.63E + 10
165.	9.94E + 09	1.06E + 09	1.74E + 09	1.80E + 07	3.69E + 06	1.28E + 10
170.	7.75E + 09	7.97E + 08	1.51E + 09	1.30E + 07	3.42E + 06	1.01E + 10
175.	6.10E + 09	6.06E + 08	1.30E + 09	9.23E + 06	3.20E + 06	8.01E + 09
180.	4.84E + 09	4.66E + 08	1.12E + 09		3.01E + 06	6.44E + 09
185.	3.88E + 09	3.62E + 08	9.57E + 08		2.85E + 06	5.21E + 09
190.	3.12E + 09	2.85E + 08	8.28E + 08		2.70E + 06	4.24E + 09
195.	2.50E + 09	2.26E + 08	7.37E + 08		2.58E + 06	3.47E + 09
200.	2.06E + 09	1.79E + 08	6.86E + 08		2.52E + 06	2.93E + 09

* Number densities probably accurate to 20% with the following exceptions: argon not reliable above 175 km., helium and atomic oxygen possibly only accurate to within a factor of 1.5.
† Read as 2.36×10^{11}.

Mass Density and Number-Density Ratios*

Altitude, km	Total Mass Density†	Number-Density Ratios			Separation Ratios	
		O/O_2	O/N_2	O_2/N_2	$Ar-N_2$	$HE-N_2$
120.	1.34E-11	0.33	0.055	0.167	0.278	14.
125.	7.48E-12	0.48	0.073	0.153	0.281	17.
130.	4.64E-12	0.61	0.088	0.142	0.275	20.
135.	3.12E-12	0.74	0.099	0.134	0.262	23.
140.	2.22E-12	0.85	0.109	0.127	0.243	26.
145.	1.63E-12	0.97	0.118	0.122	0.222	30.
150.	1.23E-12	1.10	0.129	0.117	0.201	34.
155.	9.41E-13	1.25	0.142	0.113	0.181	40.
160.	7.27E-13	1.43	0.157	0.110	0.165	47.
165.	5.65E-13	1.65	0.175	0.106	0.152	55.
170.	4.43E-13	1.89	0.194	0.103	0.140	66.
175.	3.51E-13	2.15	0.213	0.099	0.127	78.
180.	2.80E-13	2.40	0.231	0.096		93.
185.	2.25E-13	2.64	0.247	0.093		109.
190.	1.82E-13	2.90	0.265	0.091		129.
195.	1.48E-13	3.27	0.295	0.090		153.
200.	1.24E-13	3.84	0.332	0.087		182.

* Mass density probably accurate to 20%, ratios have same accuracy as composition as given in Table 2.
† g/cm³.

Test No. 13

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE APRIL 15, 1969 GM TIME 0 HRS 45 MINS LAT 32.30000 DEGS LONG -106.49000 DEGS

F10 75.00000 F10B 74.00000 AP 5.0000 EXOS TEMP 703.2511 HOUR ANG 220.7480

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(NE)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
70.	130.	4.15259-12	506.0	6.85965-03	25.6	17.6	6.48805+10	9.87403+09	2.30532+10	2.20207+07	0.00000
86.	160.	1.22251-12	593.5	2.48993-03	24.2	21.8	1.77869+10	2.30056+09	1.02958+10	1.69696+07	0.00000
97.	180.	4.85749-13	641.2	1.06316-03	22.9	25.1	5.98598+09	6.69801+08	5.34417+09	1.39856+07	0.00000
108.	200.	1.94078-13	666.1	5.00986-04	21.5	28.0	2.22204+09	2.17167+08	2.98114+09	1.18994+07	0.00000
119.	220.	9.03670-14	683.2	2.53039-04	20.3	30.6	8.70087+08	7.46153+07	1.72792+09	1.02945+07	0.00000
130.	240.	4.49894-14	691.8	1.34711-04	19.2	32.9	3.51370+08	2.65185+07	1.02369+09	8.98885+06	0.00000
140.	260.	2.36122-14	696.7	7.47095-05	18.3	35.0	1.44657+08	9.62716+06	6.14637+08	7.89144+06	0.00000
151.	280.	1.29266-14	699.5	4.27861-05	17.6	36.8	6.03355+07	3.54590+06	3.72279+08	6.95122+06	0.00000
162.	300.	7.31799-15	701.1	2.51383-05	17.0	38.4	2.54077+07	1.32009+06	2.26886+08	6.13652+06	0.00000
173.	320.	4.25375-15	702.0	1.50825-05	16.5	39.9	1.07813+07	4.95683+05	1.38941+08	5.42578+06	0.00000
183.	340.	2.52469-15	702.5	9.21444-06	16.0	41.3	4.60476+06	1.87502+05	8.54219+07	4.80312+06	0.00000
194.	360.	1.52378-15	702.8	5.72478-06	15.6	42.8	1.97829+06	7.14000+04	5.27013+07	4.25613+06	0.00000
205.	380.	9.32891-16	703.0	3.61730-06	15.1	44.4	8.54575+05	2.73566+04	3.26187+07	3.77472+06	0.00000
216.	400.	5.77902-16	703.1	2.32765-06	14.5	46.4	3.71094+05	1.05460+04	2.02502+07	3.35044+06	0.00000
227.	420.	3.62389-16	703.2	1.52864-06	13.9	48.9	1.61965+05	4.08677+03	1.26085+07	2.97609+06	0.00000
237.	440.	2.30099-16	703.2	1.02808-06	13.1	52.1	7.10424+04	1.59427+03	7.87297+06	2.64549+06	0.00000
248.	460.	1.46090-16	703.2	7.10089-07	12.2	56.2	3.13136+04	6.25110+02	4.92980+06	2.35329+06	0.00000
259.	480.	9.67816-17	703.2	5.05206-07	11.2	61.6	1.38691+04	2.46459+02	3.09542+06	2.09481+06	0.00000
270.	500.	6.50173-17	703.2	4.04376-07	9.4	73.8	6.17210+03	9.77008+01	1.94892+06	1.86600+06	3.44596+05
281.	520.	4.44222-17	703.2	3.14423-07	8.3	84.5	2.75973+03	3.69396+01	1.23038+06	1.66331+06	3.42448+05
291.	540.	3.11481-17	703.2	2.52060-07	7.2	97.1	1.23974+03	1.36031+01	7.78840+05	1.48362+06	3.32600+05
302.	560.	2.24852-17	703.2	2.07995-07	6.3	111.7	5.59507+02	6.26526+00	4.94316+05	1.32423+06	3.23478+05
313.	580.	1.67419-17	703.2	1.75904-07	5.6	127.6	2.53673+02	2.54517+00	3.14558+05	1.18273+06	3.14468+05
324.	600.	1.28621-17	703.3	1.51790-07	5.0	144.1	1.15536+02	1.03602+00	2.00690+05	1.05704+06	3.05758+05
335.	620.	1.01625-17	703.3	1.33100-07	4.5	160.5	5.26593+01	4.23894-01	1.28372+05	9.45318+05	2.97357+05
345.	640.	8.20479-18	703.3	1.18190-07	4.1	176.2	2.42921+01	1.74327-01	8.23237+04	8.45944+05	2.89195+05
356.	660.	6.90303-18	703.3	1.05984-07	3.8	190.7	1.12134+01	7.20565-02	5.29272+04	7.57495+05	2.81320+05
367.	680.	5.88734-18	703.3	9.57703-08	3.6	203.9	5.19892+00	2.99339-02	3.41135+04	6.78721+05	2.73702+05
378.	700.	5.06821-18	703.3	8.70675-08	3.4	215.8	2.42094+00	1.24972-02	2.20419+04	6.08517+05	2.66332+05
389.	720.	4.43438-18	703.3	7.95438-08	3.3	226.7	1.13222+00	5.24337-03	1.42773+04	5.45911+05	2.59201+05
399.	740.	3.91898-18	703.3	7.29645-08	3.1	236.6	5.31786-01	2.21071-03	9.27061+03	4.90047+05	2.52299+05
410.	760.	3.49071-18	703.3	6.71594-08	3.0	245.9	2.50835-01	9.36618-04	6.03425+03	4.40166+05	2.45618+05
421.	780.	3.12839-18	703.3	6.20017-08	2.8	254.7	1.18814-01	3.98734-04	3.93717+03	3.95600+05	2.39149+05
432.	800.	2.81722-18	703.3	5.73938-08	2.8	263.5	5.65160-02	1.70560-04	2.57502+03	3.55799+05	2.32886+05
443.	820.	2.54695-18	703.3	5.32591-08	2.8	271.7	2.69933-02	7.33037-05	1.68813+03	3.20119+05	2.26821+05
453.	840.	2.31001-18	703.3	4.95358-08	2.7	280.2	1.29459-02	3.16529-05	1.10930+03	2.88219+05	2.20948+05
464.	860.	2.10080-18	703.3	4.61730-08	2.7	288.8	6.23417-03	1.37316-05	7.30640+02	2.59649+05	2.15254+05
475.	880.	1.91504-18	703.3	4.31281-08	2.6	297.6	3.01424-03	5.98461-06	4.82347+02	2.34046+05	2.09740+05
486.	900.	1.74940-18	703.3	4.03648-08	2.5	306.6	1.46324-03	2.62022-06	3.19162+02	2.11068+05	2.04395+05
496.	920.	1.60117-18	703.3	3.78519-08	2.5	315.8	7.13151-04	1.15242-06	2.11664+02	1.90490+05	1.99216+05
507.	940.	1.46817-18	703.3	3.55625-08	2.4	325.4	3.48945-04	5.09144-07	1.40690+02	1.71999+05	1.94194+05
518.	960.	1.34856-18	703.3	3.34730-08	2.4	335.5	1.71487-04	2.25948-07	9.37231+01	1.55390+05	1.89326+05
529.	980.	1.24077-18	703.3	3.15626-08	2.3	345.5	8.45250-05	1.00717-07	6.25758+01	1.40462+05	1.84606+05
540.	1000.	1.14349-18	703.3	2.98130-08	2.2	356.0	4.19418-05	4.50922-08	4.18690+01	1.27038+05	1.80027+05

Reference [6], Test #14.

Altitude, km	Mean Molec. Weight†	Total Mass Density,† g/cm³	Number Density Ratios			Separation Ratios	
			O/O_2†	O/N_2†	O_2/N_2	Ar-N_2	He-N_2
120					0.150	0.416	103
125	27.5	9.60E—12	0.69	0.106	0.153	0.306	139
130	27.1	6.08E—12	1.03	0.150	0.146	0.238	181
135	26.6	4.13E—12	1.46	0.199	0.136	0.197	225
140	26.2	2.95E—12	2.00	0.251	0.126	0.173	272
145	25.7	2.17E—12	2.65	0.308	0.117	0.157	320
150	25.3	1.64E—12	3.39	0.370	0.109	0.146	370
155	24.8	1.26E—12	4.22	0.436	0.103	0.138	424
160	24.4	9.92E—13	5.13	0.506	0.099		483
165	24.1	7.92E—13	6.10	0.577	0.095		550
170	23.7	6.41E—13	7.12	0.650	0.091		626
175	23.4	5.25E—13	8.21	0.723	0.088		713
180	23.1	4.35E—13	9.36	0.796	0.085		812
185	22.8	3.62E—13	10.59	0.871	0.082		924
190	22.5	3.03E—13	11.87	0.947	0.080		1048
195	22.2	2.55E—13	13.17	1.027	0.078		1183
200	22.0	2.15E—13	14.73	1.111	0.075		1331
205	21.7	1.82E—13	16.36	1.199	0.073		1494
210	21.5	1.55E—13	18.12	1.292	0.071		1683
215	21.3	1.32E—13	19.96	1.394	0.070		1916
220	21.0	1.12E—13	21.82	1.515	0.069		2227

• Mass density probably accurate to 25% and mean molecular weight probably accurate to 20%.
† Assuming no wall loss. For $\gamma = 0.14$ (see text) multiply the atomic oxygen by 1.25 and modify the other results accordingly.

Altitude, km	Molecular Nitrogen	Molecular Oxygen	Atomic† Oxygen	Argon	Helium	Total†
120	3.00E + 11	4.51E + 10		1.49E + 09	2.07E + 08	
125	1.66E + 11	2.54E + 10	1.76E + 10	6.10E + 08	1.55E + 08	2.10E + 11
130	1.04E + 11	1.52E + 10	1.56E + 10	2.96E + 08	1.26E + 08	1.35E + 11
135	6.99E + 10	9.50E + 09	1.39E + 10	1.65E + 08	1.06E + 08	9.35E + 10
140	4.91E + 10	6.17E + 09	1.23E + 10	1.01E + 08	8.96E + 07	6.78E + 10
145	3.56E + 10	4.14E + 09	1.10E + 10	6.67E + 07	7.64E + 07	5.08E + 10
150	2.63E + 10	2.87E + 09	9.74E + 09	4.59E + 07	6.54E + 07	3.90E + 10
155	1.98E + 10	2.05E + 09	8.65E + 09	3.27E + 07	5.64E + 07	3.06E + 10
160	1.52E + 10	1.50E + 09	7.68E + 09		4.92E + 07	2.45E + 10
165	1.18E + 10	1.12E + 09	6.83E + 09		4.36E + 07	1.98E + 10
170	9.33E + 09	8.52E + 08	6.06E + 09		3.92E + 07	1.63E + 10
175	7.45E + 09	6.56E + 08	5.39E + 09		3.57E + 07	1.35E + 10
180	6.01E + 09	5.11E + 08	4.79E + 09		3.28E + 07	1.14E + 10
185	4.88E + 09	4.02E + 08	4.25E + 09		3.03E + 07	9.58E + 09
190	3.99E + 09	3.18E + 08	3.78E + 09		2.80E + 07	8.12E + 09
195	3.27E + 09	2.55E + 08	3.36E + 09		2.59E + 07	6.91E + 09
200	2.68E + 09	2.02E + 08	2.98E + 09		2.40E + 07	5.90E + 09
205	2.21E + 09	1.62E + 08	2.65E + 09		2.21E + 07	5.05E + 09
210	1.82E + 09	1.30E + 08	2.35E + 09		2.06E + 07	4.34E + 09
215	1.50E + 09	1.05E + 08	2.09E + 09		1.93E + 07	3.73E + 09
220	1.23E + 09	8.51E + 08	1.86E + 09		1.83E + 07	3.20E + 09

• Number densities probably accurate to 25% with the following exceptions: argon not reliable above 155 km, helium possibly only accurate to within a factor of 1.5.
† Assuming no wall loss. For $\gamma = 0.14$ (see text) multiply the atomic oxygen by 1.25 and modify the other results accordingly.

Test No. 14

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE NOVEMBER 30,1966 GM TIME 10 HRS 45 MINS LAT 32.30000 DEGS LONG -106.49000 DEGS

F10 97.00000 F10B 112.00000 AP 10.0000 EXOS TEMP 802.0313 HOUR ANG -121.3749

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
68.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	4.08102-12	552.5	7.31216-03	25.6	19.1	6.39593+10	9.63145+09	2.20557+10	2.10932+07	0.00000
86.	160.	1.28910-12	662.3	2.90377-03	24.4	24.1	1.90179+10	2.52271+09	1.02048+10	1.62391+07	0.00000
97.	180.	5.20813-13	725.5	1.34740-03	23.3	27.9	7.07080+09	8.24655+08	5.58252+09	1.38045+07	0.00000
108.	200.	2.39339-13	757.7	6.83064-04	22.1	31.0	2.91715+09	3.01786+08	3.29979+09	1.16350+07	0.00000
119.	220.	1.19310-13	777.0	3.67796-04	21.0	33.6	1.27107+09	1.17200+08	2.03076+09	1.02076+07	0.00000
130.	240.	6.30685-14	787.8	2.07249-04	19.9	36.1	5.71332+08	4.70880+07	1.27830+09	9.04444+06	0.00000
140.	260.	3.49067-14	793.9	1.21067-04	19.0	38.3	2.61736+08	1.93159+07	8.15575+08	8.05955+06	0.00000
151.	280.	2.00583-14	797.4	7.28156-05	18.3	40.3	1.21420+08	8.03454+06	5.24853+08	7.20664+06	0.00000
162.	300.	1.18685-14	799.4	4.48508-05	17.6	42.2	5.66368+07	3.37567+06	3.39780+08	6.45824+06	0.00000
173.	320.	7.22627-15	800.5	2.81753-05	17.1	43.8	2.67928+07	1.42948+06	2.20953+08	5.79638+06	0.00000
183.	340.	4.46754-15	801.2	1.79964-05	16.6	45.4	1.27048+07	6.09374+05	1.44204+08	5.20826+06	0.00000
194.	360.	2.83402-15	801.5	1.16653-05	16.2	46.8	6.05612+06	2.61319+05	9.44106+07	4.68410+06	0.00000
205.	380.	1.81521-15	801.8	7.66055-06	15.8	48.3	2.90088+06	1.12683+05	6.19877+07	4.21603+06	0.00000
216.	400.	1.17659-15	801.9	5.09748-06	15.4	49.9	1.39596+06	4.86460+04	4.08092+07	3.79744+06	0.00000
227.	420.	7.70837-16	801.9	3.43778-06	14.9	51.7	6.74768+05	2.12821+04	2.69359+07	3.42270+06	0.00000
237.	440.	5.09813-16	802.0	2.35224-06	14.4	53.8	3.27592+05	9.31691+03	1.78236+07	3.08693+06	0.00000
248.	460.	3.40158-16	802.0	1.63548-06	13.9	56.4	1.59726+05	4.10056+03	1.18230+07	2.78583+06	0.00000
259.	480.	2.29240-16	802.0	1.15775-06	13.2	59.6	7.82087+04	1.81310+03	7.86163+06	2.51564+06	0.00000
270.	500.	1.56305-16	802.0	8.49680-07	12.3	64.5	3.84549+04	8.05519+02	5.24007+06	2.27302+06	1.24046+05
281.	520.	1.07739-16	802.0	6.30995-07	11.4	69.9	1.89666+04	3.59570+02	3.50098+06	2.05501+06	1.23979+05
291.	540.	7.52620-17	802.0	4.79842-07	10.5	76.5	9.41284+03	1.61260+02	2.34456+06	1.85901+06	1.20911+05
302.	560.	5.33695-17	802.0	3.74120-07	9.5	84.6	4.68553+03	7.26582+01	1.57376+06	1.68268+06	1.17936+05
313.	580.	3.89425-17	802.0	2.98950-07	8.6	94.2	2.34178+03	3.28682+01	1.05861+06	1.52395+06	1.15050+05
324.	600.	2.83747-17	802.1	2.44503-07	7.7	105.2	1.17507+03	1.49546+01	7.13977+05	1.38098+06	1.12252+05
335.	620.	2.13401-17	802.1	2.04246-07	7.0	117.5	5.91970+02	6.83084+00	4.82540+05	1.25213+06	1.09538+05
345.	640.	1.64154-17	802.1	1.73822-07	6.3	130.8	2.99391+02	3.13414+00	3.26855+05	1.13594+06	1.06902+05
356.	660.	1.29203-17	802.1	1.50295-07	5.7	144.5	1.52007+02	1.44441+00	2.21892+05	1.03110+06	1.04345+05
367.	680.	1.04005-17	802.1	1.31681-07	5.3	158.2	7.74755+01	6.66616-01	1.50968+05	9.36454+05	1.01863+05
378.	700.	8.55136-18	802.1	1.18626-07	4.9	171.4	3.96390+01	3.10855-01	1.02936+05	8.50960+05	9.94544+04
389.	720.	7.16771-18	802.1	1.04201-07	4.6	183.7	2.03576+01	1.45191-01	7.03406+04	7.73690+05	9.71158+04
399.	740.	6.11063-18	802.1	9.37578-08	4.3	195.0	1.04945+01	6.80664-02	4.81691+04	7.03814+05	9.49443+04
410.	760.	5.28552-18	802.1	8.48398-08	4.2	205.1	5.43018+00	3.20568-02	3.30564+04	6.40589+05	9.26369+04
421.	780.	4.62760-18	802.1	7.71224-08	4.0	214.2	2.82014+00	1.51610-02	2.27331+04	5.83352+05	9.04960+04
432.	800.	4.09214-18	802.1	7.03693-08	3.9	222.2	1.47000+00	7.20032-03	1.58665+04	5.31506+05	8.84146+04
443.	820.	3.64801-18	802.1	6.44066-08	3.8	229.4	7.69026-01	3.43383-03	1.08190+04	4.84520+05	8.63922+04
453.	840.	3.27333-18	802.1	5.91030-08	3.7	236.0	4.03765-01	1.64435-03	7.46674+03	4.41915+05	8.44270+04
464.	860.	2.95253-18	802.1	5.43579-08	3.6	241.9	2.12749-01	7.90642-04	5.19142+03	4.03262+05	8.25170+04
475.	880.	2.67439-18	802.1	5.00923-08	3.6	247.5	1.12498-01	3.81702-04	3.60710+03	3.68178+05	8.06604+04
486.	900.	2.43071-18	802.1	4.62433-08	3.5	252.8	5.96960-02	1.85017-04	2.51132+03	3.36311+05	7.88555+04
496.	920.	2.21537-18	802.1	4.27592-08	3.5	257.9	3.17878-02	9.00367-05	1.75191+03	3.07357+05	7.71006+04
507.	940.	2.02375-18	802.1	3.95976-08	3.4	262.9	1.69854-02	4.39907-05	1.22455+03	2.81034+05	7.53940+04
518.	960.	1.85227-18	802.1	3.67224-08	3.4	267.8	9.10706-03	2.15771-05	8.57615+02	2.57092+05	7.37342+04
529.	980.	1.69812-18	802.1	3.41030-08	3.3	272.8	4.89956-03	1.06246-05	6.01799+02	2.35303+05	7.21197+04
540.	1000.	1.55904-18	802.1	3.17130-08	3.3	277.8	2.64484-03	5.25173-06	4.23104+02	2.15465+05	7.05490+04

Reference [6], Test #15.

Altitude, km	Mean Molec. Weight†	Total Mass Density,† g/cm³	Number Density Ratios			Separation Ratios	
			O/O_2†	O/N_2†	O_2/N_2	Ar-N_2	He-N_2
120	27.8	1.61E—11	0.46	0.060	0.132	0.353	263
125	27.6	9.76E—12	0.69	0.084	0.122	0.233	309
130	27.3	6.18E—12	0.97	0.113	0.116	0.203	366
135	26.9	4.11E—12	1.30	0.145	0.111	0.187	422
140	26.6	2.85E—12	1.70	0.179	0.105	0.169	469
145	26.3	2.06E—12	2.14	0.211	0.099	0.150	507
150	26.1	1.55E—12	2.62	0.242	0.092	0.136	539
155	25.8	1.19E—12	3.13	0.270	0.086	0.127	572
160	25.6	9.30E—13	3.65	0.297	0.081		609
165	25.4	7.37E—13	4.18	0.322	0.077		656
170	25.2	5.89E—13	4.71	0.349	0.074		716
175	25.0	4.72E—13	5.26	0.377	0.072		787
180	24.8	3.80E—13	5.83	0.407	0.070		870
185	24.6	3.07E—13	6.44	0.438	0.068		962
190	24.4	2.50E—13	7.11	0.469	0.066		1061
195	24.2	2.06E—13	7.83	0.499	0.064		1168
200	24.1	1.71E—13	8.60	0.524	0.061		1286
205	23.9	1.43E—13	9.41	0.546	0.058		1423
210	23.8	1.20E—13	10.28	0.568	0.055		1589
215	23.6	1.00E—13	11.26	0.601	0.053		1784
220	23.3	8.08E—14	12.58	0.667	0.053		1976

* Mass density probably accurate to 25%, ratios and mean molecular weight probably accurate to 20%.
† Assuming no wall loss. For $\gamma = 0.14$ (see text) multiply the atomic oxygen by 1.25 and modify the other results accordingly.

Altitude, km	Molecular Nitrogen	Molecular Oxygen	Atomic† Oxygen	Argon	Helium	Total†
120	2.91E + 11‡	3.84E + 10	1.76E + 10	1.23E + 09	5.13E + 08	3.49E + 11
125	1.76E + 11	2.15E + 10	1.48E + 10	4.91E + 08	3.65E + 08	2.13E + 11
130	1.11E + 11	1.29E + 10	1.25E + 10	2.69E + 08	2.72E + 08	1.37E + 11
135	7.28E + 10	8.09E + 09	1.06E + 10	1.63E + 08	2.06E + 08	9.18E + 10
140	5.01E + 10	5.28E + 09	8.95E + 09	1.01E + 08	1.58E + 08	6.45E + 10
145	3.59E + 10	3.55E + 09	7.59E + 09	6.46E + 07	1.22E + 08	4.72E + 10
150	2.67E + 10	2.47E + 09	6.45E + 09	4.32E + 07	9.65E + 07	3.57E + 10
155	2.03E + 10	1.76E + 09	5.50E + 09	3.09E + 07	7.80E + 07	2.77E + 10
160	1.58E + 10	1.29E + 09	4.69E + 09		6.46E + 07	2.19E + 10
165	1.24E + 10	9.60E + 08	4.01E + 09		5.48E + 07	1.75E + 10
170	9.84E + 09	7.28E + 08	3.43E + 09		4.73E + 07	1.41E + 10
175	7.82E + 09	5.60E + 08	2.94E + 09		4.13E + 07	1.14E + 10
180	6.22E + 09	4.34E + 08	2.53E + 09		3.63E + 07	9.23E + 09
185	4.97E + 09	3.38E + 08	2.18E + 09		3.21E + 07	7.52E + 09
190	4.00E + 09	2.64E + 08	1.88E + 09		2.85E + 07	6.17E + 09
195	3.25E + 09	2.07E + 08	1.62E + 09		2.55E + 07	5.11E + 09
200	2.68E + 09	1.63E + 08	1.40E + 09		2.31E + 07	4.27E + 09
205	2.23E + 09	1.29E + 08	1.22E + 09		2.13E + 07	3.60E + 09
210	1.86E + 09	1.03E + 08	1.06E + 09		1.98E + 07	3.04E + 09
215	1.53E + 09	8.17E + 07	9.20E + 08		1.83E + 07	2.55E + 09
220	1.20E + 09	6.38E + 07	8.02E + 08		1.59E + 07	2.09E + 09

* Number densities probably accurate to 25% with the following exceptions: argon not reliable above 155 km, helium possibly only accurate to within a factor of 1.5.
† Assuming no wall loss. For $\gamma = 0.14$ (see text) multiply the atomic oxygen by 1.25 and modify the other results accordingly.
‡ Read as 2.91×10^{11}.

Test No. 15

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE DECEMBER 2, 1966 GM TIME 20 HRS 9 MINS LAT 32.30000 DEGS LONG -106.40000 DEGS

F10 97.00000 F10B 112.00000 AP 4.0000 EXOS TEMP 915.7340 HOUR ANG -340.1734

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	5.99974-12	600.6	7.76949-03	25.7	20.7	6.28615+10	9.75443+09	2.10713+10	2.02028+07	0.00000
96.	160.	1.34415-12	738.0	3.34655-03	24.7	26.7	2.00641+10	2.72373+09	1.00447+10	1.55230+07	0.00000
97.	180.	5.82969-13	815.2	1.67386-03	23.6	31.0	8.13244+09	9.84251+08	5.74544+09	1.29992+07	0.00000
108.	200.	2.86912-13	858.6	9.07293-04	22.6	34.5	3.67476+09	3.99992+08	3.56878+09	1.13148+07	0.00000
119.	220.	1.52326-13	883.2	5.18428-04	21.6	37.1	1.75679+09	1.72784+08	2.31271+09	1.00436+07	0.00000
130.	240.	8.52129-14	897.1	3.08064-04	20.6	39.7	8.66949+08	7.72560+07	1.53439+09	9.01076+06	0.00000
140.	260.	4.96136-14	905.1	1.88868-04	19.8	42.1	4.36097+08	3.52726+07	1.03223+09	8.13334+06	0.00000
151.	280.	2.98450-14	909.6	1.16817-04	19.0	44.2	2.22108+08	1.63255+07	7.00500+08	7.36806+06	0.00000
162.	300.	1.84542-14	912.2	7.63841-05	18.3	46.3	1.14110+08	7.62932+06	4.78188+08	6.69006+06	0.00000
173.	320.	1.16816-14	913.7	5.00118-05	17.7	48.2	5.90152+07	3.59184+06	3.27838+08	6.08381+06	0.00000
183.	340.	7.54354-15	914.5	3.32594-05	17.2	49.9	3.06879+07	1.70141+06	2.25528+08	5.53867+06	0.00000
194.	360.	4.95440-15	915.0	2.24185-05	16.8	51.5	1.60337+07	8.10278+05	1.55595+08	5.04678+06	0.00000
205.	380.	3.30074-15	915.3	1.52921-05	16.4	53.1	8.41362+06	3.87798+05	1.07625+08	4.60195+06	0.00000
216.	400.	2.22583-15	915.5	1.03449-05	16.1	54.6	4.43336+06	1.86469+05	7.46229+07	4.19905+06	0.00000
227.	420.	1.51663-15	915.6	7.34675-06	15.7	56.1	2.34525+06	9.00661+04	5.18593+07	3.83573+06	0.00000
237.	440.	1.04280-15	915.7	5.17099-06	15.4	57.6	1.24541+06	4.36940+04	3.61196+07	3.50220+06	0.00000
248.	460.	7.22981-16	915.7	3.67800-06	15.0	59.7	6.63856+05	2.12888+04	2.52116+07	3.20110+06	0.00000
259.	480.	5.04892-16	915.7	2.64542-06	14.5	61.8	3.55180+05	1.04166+04	1.76352+07	2.92746+06	0.00000
270.	500.	3.55327-16	915.7	1.93201-06	14.0	64.5	1.90729+05	5.11819+03	1.23618+07	2.67862+06	4.81632+04
281.	520.	2.51094-16	915.7	1.42693-06	13.4	67.6	1.02792+05	2.52528+03	8.68299+06	2.45222+06	4.78720+04
291.	540.	1.79967-16	915.7	1.06958-06	12.8	71.3	5.55985+04	1.25108+03	6.11162+06	2.24611+06	4.68329+04
302.	560.	1.29666-16	915.7	8.14758-07	12.1	75.8	3.01795+04	6.22337+02	4.31049+06	2.05836+06	4.58221+04
313.	580.	9.42960-17	915.7	6.31425-07	11.4	81.3	1.64396+04	3.10826+02	3.04629+06	1.88727+06	4.48367+04
324.	600.	6.92887-17	915.7	4.98229-07	10.6	87.8	8.98646+03	1.55863+02	2.15717+06	1.73126+06	4.38819+04
335.	620.	5.15073-17	915.7	4.00392-07	9.8	95.5	4.92935+03	7.84670+01	1.53058+06	1.58893+06	4.29508+04
345.	640.	3.87866-17	915.7	3.27642-07	9.0	104.3	2.71320+03	3.96584+01	1.08813+06	1.45902+06	4.20446+04
356.	660.	2.96254-17	915.7	2.72806-07	8.3	114.4	1.49849+03	2.01221+01	7.75085+05	1.34038+06	4.11626+04
367.	680.	2.29785-17	915.7	2.30858-07	7.6	125.5	8.30405+02	1.02491+01	5.53167+05	1.23198+06	4.03038+04
378.	700.	1.81153-17	915.7	1.98254-07	7.0	137.5	4.61721+02	5.24036+00	3.95542+05	1.13269+06	3.94678+04
389.	720.	1.45232-17	915.7	1.72490-07	6.4	150.1	2.57579+02	2.68956+00	2.83370+05	1.04227+06	3.86536+04
399.	740.	1.18417-17	915.7	1.51783-07	5.9	162.9	1.44168+02	1.38559+00	2.03390+05	9.59340+05	3.78607+04
410.	760.	9.81588-18	915.7	1.34658-07	5.5	175.6	8.09554+01	7.18486-01	1.46257+05	8.83424+05	3.70884+04
421.	780.	8.26525-18	915.7	1.20800-07	5.2	187.8	4.58064+01	3.71865-01	1.05367+05	8.13891+05	3.63360+04
432.	800.	7.06132-18	915.7	1.08949-07	4.9	199.4	2.57751+01	1.93711-01	7.60484+04	7.50179+05	3.56030+04
443.	820.	6.11236-18	915.7	9.88070-08	4.7	210.1	1.46135+01	1.01275-01	5.49875+04	6.91761+05	3.48887+04
453.	840.	5.35260-18	915.7	9.00296-08	4.5	219.8	8.31149+00	5.31395-02	3.98310+04	6.38163+05	3.41926+04
464.	860.	4.73462-18	915.7	8.23472-08	4.4	228.6	4.74201+00	2.79823-02	2.89038+04	5.89018+05	3.35141+04
475.	880.	4.22410-18	915.7	7.55601-08	4.3	236.4	2.71389+00	1.47873-02	2.10115+04	5.43881+05	3.28527+04
486.	900.	3.79603-18	915.7	6.95162-08	4.2	243.3	1.55797+00	7.84191-03	1.53011+04	5.02424+05	3.22080+04
496.	920.	3.43208-18	915.7	6.40979-08	4.1	249.5	8.97117-01	4.17320-03	1.11621+04	4.64330+05	3.15793+04
507.	940.	3.11869-18	915.7	5.92136-08	4.0	255.1	5.18148-01	2.22853-03	8.15683+03	4.29309+05	3.09662+04
518.	960.	2.84576-18	915.7	5.47902-08	4.0	260.1	3.00167-01	1.19414-03	5.97091+03	3.97100+05	3.03683+04
529.	980.	2.60570-18	915.7	5.07689-08	3.9	264.6	1.74407-01	6.42053-04	4.37822+03	3.67464+05	2.97851+04
540.	1000.	2.39273-18	915.7	4.71014-08	3.9	268.8	1.01636-01	3.46379-04	3.21579+03	3.40182+05	2.92162+04

Reference [7], Test #16.

Altitude, km	Mean Molec. Weight†	Total Mass Density,† g/cm³	Number Density Ratios			Separation Ratios	
			O/O₂†	O/N₂†	O₂/N₂	Ar-N₂	He-N₂
120	27.8	1.53E − 11	0.55	0.070	0.129	0.260	
125	27.4	9.22E − 12	0.85	0.099	0.116	0.265	
130	27.1	6.15E − 12	1.30	0.126	0.097	0.242	6
135	26.8	4.39E − 12	1.84	0.150	0.082	0.216	7
140	26.6	3.27E − 12	2.39	0.173	0.073	0.198	8
145	26.4	2.49E − 12	2.88	0.196	0.068	0.190	8
150	26.2	1.93E − 12	3.31	0.219	0.066	0.187	9
155	26.0	1.52E − 12	3.72	0.243	0.065	0.187	11
160	25.8	1.20E − 12	4.15	0.266	0.064	0.186	12
165	25.6	9.65E − 13	4.67	0.289	0.062	0.180	13
170	25.5	7.82E − 13	5.32	0.312	0.059	0.170	15
175	25.3	6.39E − 13	6.09	0.333	0.055		16
180	25.1	5.27E − 13	6.97	0.353	0.051		18
185	25.0	4.37E − 13	7.88	0.373	0.047		20
190	24.9	3.66E − 13	8.74	0.393	0.045		22
195	24.7	3.08E − 13	9.49	0.411	0.043		25
200	24.7	2.62E − 13	10.12	0.428	0.042		28
205	24.6	2.26E − 13	10.77	0.437	0.041		32
210	24.7	2.01E − 13	11.69	0.432	0.037		34

* Mass density probably accurate to 25%; ratios and mean molecular weight probably accurate to ±20%.
† Assuming no wall loss. For $\gamma = 0.14$ (see text), multiply the atomic oxygen by the factor 1.2 and modify the other results accordingly.

TABLE 2. Number Densities* (number/cm³) for Flight NASA 4.179 UA (1249 MST)

Altitude, km	Molec. Nitrogen	Molec. Oxygen	Atomic†† Oxygen	Argon	Helium	Total
120	2.76E + 11†	3.56E + 10	1.94E + 10	8.60E + 08		3.32E + 11
125	1.66E + 11	1.93E + 10	1.65E + 10	5.27E + 08		2.02E + 11
130	1.12E + 11	1.08E + 10	1.41E + 10	3.22E + 08	1.29E + 08	1.37E + 11
135	7.98E + 10	6.52E + 09	1.20E + 10	2.06E + 08	3.58E + 08	9.86E + 10
140	5.93E + 10	4.30E + 09	1.03E + 10	1.41E + 08	3.01E + 08	7.40E + 10
145	4.49E + 10	3.05E + 09	8.80E + 09	1.02E + 08	2.56E + 08	5.69E + 10
150	3.45E + 10	2.28E + 09	7.56E + 09	7.74E + 07	2.20E + 08	4.44E + 10
155	2.68E + 10	1.75E + 09	6.50E + 09	6.01E + 07	1.91E + 08	3.50E + 10
160	2.11E + 10	1.35E + 09	5.61E + 09	4.68E + 07	1.67E + 08	2.81E + 10
165	1.68E + 10	1.04E + 09	4.85E + 09	3.61E + 07	1.48E + 08	2.27E + 10
170	1.35E + 10	7.90E + 08	4.20E + 09	2.74E + 07	1.32E + 08	1.85E + 10
175	1.10E + 10	5.98E + 08	3.65E + 09		1.19E + 08	1.52E + 10
180	8.98E + 09	4.55E + 08	3.17E + 09		1.08E + 08	1.26E + 10
185	7.41E + 09	3.51E + 08	2.76E + 09		9.96E + 07	1.05E + 10
190	6.15E + 09	2.76E + 08	2.41E + 09		9.26E + 07	8.86E + 09
195	5.14E + 09	2.23E + 08	2.11E + 09		8.70E + 07	7.49E + 09
200	4.34E + 09	1.83E + 08	1.85E + 09		8.26E + 07	6.39E + 09
205	3.73E + 09	1.51E + 08	1.63E + 09		7.92E + 07	5.53E + 09
210	3.32E + 09	1.23E + 08	1.44E + 09		7.68E + 07	4.91E + 09

* Number densities probably accurate to 25% with the following exceptions: argon not reliable above 170 km, helium only accurate to within a factor of 1.5.
† Read 2.76×10^{11}.
†† Assuming no wall loss. For $\gamma = 0.14$ (see text) multiply the atomic oxygen by the factor 1.2 and modify other results accordingly.

Test No. 16

NSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JUNE 21, 1967 GM TIME 18 HRS 49 MINS LAT 32.30000 DEGS LONG -106.49000 DEGS

F10 110.00000 F10B 131.00000 AP 4.0000 EXOS TEMP 994.8124 HOUR ANG -3.0911

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.94646-12	630.9	6.04030-03	25.8	21.7	6.21188+10	9.69065+09	2.04923+10	1.98913+07	0.00000
86.	160.	1.37011-12	787.1	3.62193-03	24.8	28.3	2.05769+10	2.82934+09	9.91336+09	1.50981+07	0.00000
97.	180.	6.17247-13	875.9	1.88690-03	23.8	33.0	8.73029+09	1.07837+09	5.80181+09	1.26802+07	0.00000
108.	200.	3.15475-13	926.5	1.06349-03	22.9	36.6	4.14212+09	4.63650+08	3.69896+09	1.10915+07	0.00000
119.	220.	1.73980-13	955.4	6.28926-04	21.9	39.5	2.08240+09	2.12214+08	2.46429+09	9.90410+06	0.00000
130.	240.	1.00358-13	972.0	3.85547-04	21.0	42.2	1.08156+09	1.00621+08	1.68231+09	8.94383+06	0.00000
140.	260.	6.02149-14	981.6	2.43195-04	20.2	44.6	5.72863+08	4.87376+07	1.16511+09	8.12873+06	0.00000
151.	280.	3.72260-14	987.1	1.57085-04	19.5	46.9	3.07272+08	2.39353+07	8.14206+08	7.41631+06	0.00000
162.	300.	2.36065-14	990.3	1.03528-04	18.8	49.0	1.66259+08	1.18685+07	5.72414+08	6.78261+06	0.00000
173.	320.	1.52996-14	992.2	6.94191-05	18.2	51.0	9.05499+07	5.92810+06	4.04167+08	6.21297+06	0.00000
183.	340.	1.01053-14	993.3	4.72458-05	17.7	52.9	4.95772+07	2.97855+06	2.86331+08	5.69764+06	0.00000
194.	360.	6.78478-15	993.9	3.25732-05	17.2	54.6	2.72677+07	1.50425+06	2.03417+08	5.22961+06	0.00000
205.	380.	4.62008-15	994.3	2.27139-05	16.8	56.3	1.50590+07	7.63233+05	1.44868+08	4.80346+06	0.00000
216.	400.	3.18446-15	994.5	1.60009-05	16.5	57.9	8.34860+06	3.88947+05	1.03405+08	4.41478+06	0.00000
227.	420.	2.21801-15	994.6	1.13760-05	16.1	59.4	4.64542+06	1.99040+05	7.39670+07	4.05987+06	0.00000
237.	440.	1.55898-15	994.7	8.16303-06	15.8	61.0	2.59408+06	1.02271+05	5.30186+07	3.73548+06	0.00000
248.	460.	1.10459-15	994.7	5.90789-06	15.5	62.7	1.45363+06	5.27589+04	3.80793+07	3.43878+06	0.00000
259.	480.	7.88307-16	994.8	4.31389-06	15.1	64.5	8.17363+05	2.73236+04	2.74034+07	3.16722+06	0.00000
270.	500.	5.66408-16	994.8	3.18316-06	14.7	66.7	4.61152+05	1.42055+04	1.97588+07	2.91854+06	2.78282+04
281.	520.	4.09359-16	994.8	2.37029-06	14.3	69.1	2.61051+05	7.41372+03	1.42741+07	2.69067+06	2.76211+04
291.	540.	2.98022-16	994.8	1.78414-06	13.8	71.8	1.48266+05	3.88380+03	1.03313+07	2.48177+06	2.70667+04
302.	560.	2.18265-16	994.8	1.35860-06	13.3	75.1	8.44856+04	2.04222+03	7.49168+06	2.29016+06	2.65305+04
313.	580.	1.60940-16	994.8	1.04610-06	12.7	79.1	4.82985+04	1.07786+03	5.44262+06	2.11433+06	2.60059+04
324.	600.	1.19539-16	994.8	8.19538-07	12.1	83.7	2.77001+04	5.70972+02	3.96127+06	1.95290+06	2.54947+04
335.	620.	8.94961-17	994.8	6.50121-07	11.4	89.2	1.59372+04	3.03565+02	2.88637+06	1.80461+06	2.49983+04
345.	640.	6.75927-17	994.8	5.23489-07	10.7	95.7	9.19852+03	1.61979+02	2.10987+06	1.66834+06	2.45104+04
356.	660.	5.15455-17	994.8	4.27964-07	10.0	103.1	5.32579+03	8.67399+01	1.54398+06	1.54305+06	2.40367+04
367.	680.	3.97270-17	994.8	3.55169-07	9.3	111.7	3.09313+03	4.66146+01	1.13185+06	1.42760+06	2.35747+04
378.	700.	3.09764-17	994.8	2.99076-07	8.6	121.3	1.80199+03	2.51393+01	8.31196+05	1.32174+06	2.31242+04
389.	720.	2.44560-17	994.8	2.55329-07	7.9	131.9	1.05301+03	1.36051+01	6.11473+05	1.22409+06	2.26847+04
399.	740.	1.93650-17	994.8	2.20768-07	7.3	143.4	6.17199+02	7.38642+00	4.50612+05	1.13415+06	2.22560+04
410.	760.	1.53606-17	994.8	1.93093-07	6.8	155.5	3.62847+02	4.02617+00	3.32639+05	1.05127+06	2.18378+04
421.	780.	1.30516-17	994.8	1.70621-07	6.3	168.0	2.13951+02	2.20146+00	2.45970+05	9.74858+05	2.14297+04
432.	800.	1.08949-17	994.8	1.52118-07	5.9	180.6	1.26528+02	1.20780+00	1.82190+05	9.04381+05	2.10314+04
443.	820.	9.20130-18	994.8	1.36671-07	5.6	193.0	7.50469+01	6.64863-01	1.35174+05	8.39351+05	2.06427+04
453.	840.	7.87856-18	994.8	1.23603-07	5.3	205.0	4.46415+01	3.67206-01	1.00457+05	7.79320+05	2.02632+04
464.	860.	6.82699-18	994.8	1.12411-07	5.0	216.4	2.66314+01	2.03478-01	7.47799+04	7.23881+05	1.98928+04
475.	880.	5.98052-18	994.8	1.02713-07	4.8	226.9	1.59328+01	1.13120-01	5.57567+04	6.72659+05	1.95312+04
486.	900.	5.29033-18	994.8	9.42236-08	4.6	236.6	9.55910+00	6.30915-02	4.16401+04	6.25315+05	1.91781+04
496.	920.	4.72021-18	994.8	8.67231-08	4.5	245.5	5.75125+00	3.53016-02	3.11475+04	5.81536+05	1.88332+04
507.	940.	4.24316-18	994.8	8.00424-08	4.4	253.4	3.46991+00	1.98153-02	2.33360+04	5.41037+05	1.84964+04
518.	960.	3.83898-18	994.8	7.40504-08	4.3	260.5	2.09929+00	1.11578-02	1.75112+04	5.03558+05	1.81674+04
529.	980.	3.49245-18	994.8	6.86436-08	4.2	266.9	1.27355+00	6.30252-03	1.31608+04	4.68858+05	1.78460+04
540.	1000.	3.19208-18	994.8	6.37401-08	4.1	272.7	7.74715-01	3.57108-03	9.90664+03	4.36719+05	1.75320+04

Reference [7], Test #17.

Altitude, km	Molec. Nitrogen	Molec. Oxygen	Atomic Oxygen‡	Argon	Helium	Total‡
120	1.67E + 11†	2.52E + 10	1.03E + 10		6.09E + 06	2.03E + 11
125	9.38E + 10	9.69E + 09	5.45E + 09	3.03E + 08	3.71E + 06	1.09E + 10
130	6.09E + 10	5.40E + 09	4.13E + 09	1.57E + 08	2.73E + 06	7.66E + 10
135	4.29E + 10	3.50E + 09	3.50E + 09	8.92E + 07	2.21E + 06	5.01E + 10
140	3.17E + 10	2.57E + 09	3.00E + 09	5.95E + 07	1.89E + 06	3.73E + 10
145	2.40E + 10	1.89E + 09	2.52E + 09	4.41E + 07	1.67E + 06	2.85E + 10
150	1.86E + 10	1.40E + 09	2.10E + 09	3.37E + 07	1.51E + 06	2.21E + 10
155	1.46E + 10	1.05E + 09	1.77E + 09	2.54E + 07	1.40E + 06	1.75E + 10
160	1.17E + 10	7.87E + 08	1.54E + 09	1.90E + 07	1.33E + 06	1.40E + 10
165	9.41E + 09	5.97E + 08	1.37E + 09	1.49E + 07	1.27E + 06	1.14E + 10
170	7.67E + 09	4.57E + 08	1.24E + 09	1.32E + 07	1.23E + 06	9.38E + 09
175	6.28E + 09	3.53E + 08	1.13E + 09		1.19E + 06	7.78E + 09
180	5.15E + 09	2.74E + 08	1.02E + 09		1.14E + 06	6.47E + 09
185	4.24E + 09	2.15E + 08	9.07E + 08		1.09E + 06	5.39E + 09
190	3.50E + 09	1.73E + 08	8.02E + 08		1.05E + 06	4.53E + 09
195	2.93E + 09	1.43E + 08	7.22E + 08		1.03E + 06	3.87E + 09
200	2.52E + 09	1.23E + 08	6.75E + 08		1.02E + 06	3.38E + 09

* Number densities probably accurate to 25%, with the following exceptions: argon not reliable above 170 km; helium only accurate to within a factor of 1.5.

† Read 1.67×10^{11}.

‡ Assuming no wall loss. For $\gamma = 0.14$ (see text), multiply the atomic oxygen by the factor 1.2 and modify other results accordingly.

TABLE 7. Mean Molecular Weight, Mass Density, and Number Density Ratios* for NASA 4.212 UA (0200 MST)

Altitude, km	Mean Molec. Weight†	Total Mass Density,† g/cm³	Number Density Ratios			Separation Ratios	
			O/O_2†	O/N_2†	O_2/N_2	Ar–N_2	He–N_2
120	27.9	9.42E − 12	0.41	0.061	0.151		5
125	27.8	5.04E − 12	0.56	0.058	0.103	0.270	6
130	27.6	3.24E − 12	0.77	0.068	0.089	0.215	7
135	27.5	2.28E − 12	0.98	0.082	0.084	0.174	8
140	27.3	1.69E − 12	1.16	0.095	0.081	0.157	9
145	27.2	1.29E − 12	1.33	0.105	0.079	0.154	10
150	27.1	9.97E − 13	1.50	0.113	0.076	0.152	12
155	27.0	7.81E − 13	1.69	0.121	0.072	0.146	14
160	26.9	6.26E − 13	1.95	0.132	0.068	0.137	17
165	26.8	5.07E − 13	2.29	0.146	0.063	0.133	20
170	26.6	4.14E − 13	2.72	0.162	0.060	0.144	24
175	26.5	3.41E − 13	3.21	0.180	0.056		28
180	26.3	2.82E − 13	3.72	0.198	0.053		33
185	26.2	2.35E − 13	4.21	0.214	0.051		38
190	26.1	1.97E − 13	4.65	0.229	0.049		45
195	26.1	1.68E − 13	5.06	0.246	0.049		52
200	25.9	1.46E − 13	5.51	0.268	0.049		60

* Mass density probably accurate to 25% ratios and mean molecular weight probably accurate to ±20%.

† Assuming no wall loss. For $\gamma = 0.14$ (see text), multiply the atomic oxygen by the factor 1.2 and modify other results accordingly.

Test No. 17

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JUNE 20, 1967 GM TIME 8 HRS 0 MINS LAT 32.30000 DEGS LONG -106.40000 DEGS

F10 117.00000 F10B 131.00000 AP 7.0000 EXOS TEMP 868.0523 HOUR ANG -165.7320

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45940-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	4.03337-12	581.0	7.58695-03	25.7	20.0	6.33214+10	9.78950+09	2.14624+10	2.05535+07	0.00000
86.	160.	1.32376-12	706.9	3.16667-03	24.6	25.6	1.96719+10	2.64663+09	1.01172+10	1.58077+07	0.00000
97.	180.	5.58702-13	777.3	1.53844-03	23.5	29.7	7.71501+09	9.20443+08	5.69000+09	1.32046+07	0.00000
108.	200.	2.67770-13	816.7	8.12588-04	22.4	32.9	3.36680+09	3.59339+08	3.46827+09	1.14499+07	0.00000
119.	220.	1.38706-13	838.9	4.53494-04	21.3	35.7	1.55326+09	1.49005+08	2.20361+09	1.01188+07	0.00000
130.	240.	7.58803-14	851.5	2.63894-04	20.4	38.2	7.39446+08	6.39344+07	1.43278+09	9.03530+06	0.00000
140.	260.	4.33013-14	858.6	1.58733-04	19.5	40.5	3.58781+08	2.80095+07	9.44407+08	8.11550+06	0.00000
151.	280.	2.55788-14	862.6	9.81087-05	18.7	42.6	1.76256+08	1.24398+07	6.27903+08	7.31515+06	0.00000
162.	300.	1.55539-14	864.9	6.20227-05	18.0	44.6	8.73517+07	5.57896+06	4.19936+08	6.60854+06	0.00000
173.	320.	9.69133-15	866.3	3.99578-05	17.5	46.4	4.35847+07	2.52102+06	2.82074+08	5.97928+06	0.00000
183.	340.	6.16323-15	867.0	2.61580-05	17.0	48.0	2.18690+07	1.14641+06	1.90132+08	5.41598+06	0.00000
194.	360.	3.98702-15	867.4	1.73628-05	16.6	49.6	1.10272+07	5.24236+05	1.28540+08	4.91009+06	0.00000
205.	380.	2.61629-15	867.7	1.16662-05	16.2	51.1	5.58565+06	2.40965+05	8.71344+07	4.45481+06	0.00000
216.	400.	1.73758-15	867.8	7.93203-06	15.8	52.6	2.84151+06	1.11303+05	5.92147+07	4.04447+06	0.00000
227.	420.	1.16598-15	867.9	5.45514-06	15.4	54.2	1.45153+06	5.16554+04	4.03378+07	3.67423+06	0.00000
237.	440.	7.89593-16	868.0	3.79231-06	15.0	56.0	7.44489+05	2.40640+04	2.75427+07	3.33987+06	0.00000
248.	460.	5.39220-16	868.0	2.66976-06	14.6	58.0	3.83368+05	1.12800+04	1.88491+07	3.03770+06	0.00000
259.	480.	3.71230-16	868.0	1.90475-06	14.1	60.5	1.98186+05	5.30681+03	1.29285+07	2.76444+06	0.00000
270.	500.	2.57788-16	868.0	1.38751-06	13.4	63.8	1.02851+05	2.50770+03	8.88722+06	2.51715+06	6.98359+04
281.	520.	1.80512-16	868.0	1.02332-06	12.7	67.6	5.35806+04	1.19019+03	6.12259+06	2.29324+06	6.95691+04
291.	540.	1.27598-16	868.0	7.68568-07	12.0	72.3	2.80189+04	5.67334+02	4.22712+06	2.09039+06	6.79770+04
302.	560.	9.11483-17	868.0	5.88660-07	11.2	78.0	1.47070+04	2.71595+02	2.92473+06	1.90650+06	6.64302+04
313.	580.	6.58881-17	868.1	4.60183-07	10.3	84.8	7.74840+03	1.30573+02	2.02792+06	1.73971+06	6.49271+04
324.	600.	4.82705-17	868.1	3.67271-07	9.5	92.9	4.09733+03	6.30392+01	1.40906+06	1.58835+06	6.34664+04
335.	620.	3.58980-17	868.1	2.99119-07	8.7	102.3	2.17459+03	3.05621+01	9.81106+05	1.45092+06	6.20466+04
345.	640.	2.71419-17	868.1	2.48333-07	7.9	113.0	1.15831+03	1.48783+01	6.84544+05	1.32807+06	6.06664+04
356.	660.	2.08909-17	868.1	2.09831-07	7.2	124.8	6.19205+02	7.27288+00	4.78605+05	1.21258+06	5.93246+04
367.	680.	1.63838-17	868.1	1.80101-07	6.6	137.3	3.32192+02	3.56965+00	3.35303+05	1.10936+06	5.80197+04
378.	700.	1.30969-17	868.1	1.56704-07	6.0	150.3	1.78845+02	1.75913+00	2.35382+05	1.01545+06	5.67508+04
389.	720.	1.06891-17	868.1	1.37935-07	5.6	163.4	9.66239+01	8.70375-01	1.65568+05	9.29949+05	5.55165+04
399.	740.	8.84972-18	868.1	1.22598-07	5.2	176.0	5.23841+01	4.32352-01	1.16693+05	8.52071+05	5.43158+04
410.	760.	7.46477-18	868.1	1.09842-07	4.9	188.0	2.84976+01	2.15614-01	8.24067+04	7.81096+05	5.31476+04
421.	780.	6.39253-18	868.1	9.90626-08	4.7	199.1	1.55561+01	1.07947-01	5.83081+04	7.16306+05	5.20109+04
432.	800.	5.54762-18	868.1	8.98218-08	4.5	209.2	8.52041+00	5.42527-02	4.13366+04	6.57353+05	5.09046+04
443.	820.	4.86983-18	868.1	8.18012-08	4.3	218.3	4.68250+00	2.73715-02	2.93612+04	6.03474+05	4.98278+04
453.	840.	4.31644-18	868.1	7.47655-08	4.2	226.4	2.58191+00	1.38621-02	2.08948+04	5.54274+05	4.87796+04
464.	860.	3.85693-18	868.1	6.85385-08	4.1	233.5	1.42836+00	7.04683-03	1.48978+04	5.09325+05	4.77591+04
475.	880.	3.46943-18	868.1	6.29863-08	4.0	239.9	7.92781-01	3.59571-03	1.06416+04	4.68240+05	4.67654+04
486.	900.	3.13797-18	868.1	5.80057-08	3.9	245.6	4.41448-01	1.84156-03	7.61583+03	4.30669+05	4.57977+04
496.	920.	2.85090-18	868.1	5.35156-08	3.8	250.8	2.46606-01	9.46639-04	5.46030+03	3.96295+05	4.48551+04
507.	940.	2.59959-18	868.1	4.94510-08	3.8	255.5	1.38202-01	4.88391-04	3.92200+03	3.64831+05	4.39370+04
518.	960.	2.37756-18	868.1	4.57593-08	3.8	260.0	7.76959-02	2.52884-04	2.82218+03	3.36017+05	4.30425+04
529.	980.	2.17990-18	868.1	4.23971-08	3.7	264.1	4.38174-02	1.31412-04	2.03442+03	3.09617+05	4.21710+04
540.	1000.	2.00280-18	868.1	3.93280-08	3.7	268.1	2.47883-02	6.85318-05	1.46916+03	2.85419+05	4.13217+04

Reference [7], Test #18.

Altitude, km	Molec. Nitrogen	Molec. Oxygen	Atomic Oxygen‡	Argon	Helium	Total‡
123	2.19E + 11†	2.78E + 10	1.14E + 10	8.13E + 08	1.70E + 07	2.59E + 11
125	1.69E + 11	2.22E + 10	8.50E + 09	6.24E + 08	1.42E + 07	2.01E + 11
130	9.70E + 10	1.21E + 10	5.44E + 09	3.46E + 08	1.02E + 07	1.15E + 11
135	6.26E + 10	6.95E + 09	4.31E + 09	2.11E + 08	8.11E + 06	7.10E + 10
140	4.45E + 10	4.47E + 09	3.68E + 09	1.39E + 08	6.68E + 06	5.28E + 10
145	3.39E + 10	3.20E + 09	3.16E + 09	9.85E + 07	5.60E + 06	4.01E + 10
150	2.71E + 10	2.46E + 09	2.70E + 09	7.36E + 07	4.79E + 06	3.21E + 10
155	2.22E + 10	1.95E + 09	2.31E + 09	5.73E + 07	4.20E + 06	2.65E + 10
160	1.83E + 10	1.55E + 09	1.98E + 09	4.59E + 07	3.79E + 06	2.19E + 10
165	1.51E + 10	1.23E + 09	1.72E + 09	3.74E + 07	3.52E + 06	1.81E + 10
170	1.23E + 10	9.55E + 08	1.52E + 09	3.06E + 07	3.33E + 06	1.48E + 10
175	9.99E + 09	7.41E + 08	1.35E + 09		3.16E + 06	1.21E + 10
180	8.08E + 09	5.80E + 08	1.20E + 09		2.99E + 06	9.88E + 09
185	6.55E + 09	4.62E + 08	1.05E + 09		2.80E + 06	8.08E + 09
190	5.34E + 09	3.74E + 08	9.24E + 08		2.61E + 06	6.65E + 09
195	4.39E + 09	3.05E + 08	8.10E + 08		2.45E + 06	5.51E + 09
200	3.65E + 09	2.48E + 08	7.18E + 08		2.36E + 06	4.62E + 09
205	3.08E + 09	1.98E + 08	6.47E + 08			3.93E + 09
210	2.64E + 09	1.61E + 08	5.83E + 08			3.39E + 09

* Number densities probably accurate to 25% with the following exceptions: argon not reliable above 170 km; helium only accurate to within a factor of 1.5.

† Read 2.19×10^{11}.

‡ Assuming no wall loss. For $\gamma = 0.14$ (see text), multiply the atomic oxygen by the factor 1.2 and modify other results accordingly.

TABLE 5. Mean Molecular Weight, Mass Density, and Number Density Ratios* for Flight NASA 4.211 UA (1224 MST)

Altitude, km	Mean Molec. Weight†	Total Mass Density,† g/cm³	Number Density Ratios			Separation Ratios	
			O/O_2†	O/N_2†	O_2/N_2	$Ar-N_2$	$He-N_2$
123	27.9	1.20E − 11	0.41	0.052	0.127	0.310	12
125	28.0	9.32E − 12	0.38	0.050	0.131	0.308	12
130	27.9	5.32E − 12	0.45	0.056	0.124	0.298	16
135	27.7	3.41E − 12	0.62	0.069	0.111	0.282	19
140	27.5	2.41E − 12	0.82	0.083	0.101	0.262	22
145	27.4	1.84E − 12	0.99	0.093	0.094	0.243	25
150	27.3	1.47E − 12	1.10	0.100	0.091	0.227	26
155	27.3	1.20E − 12	1.18	0.104	0.088	0.216	28
160	27.2	9.89E − 13	1.28	0.108	0.085	0.210	31
165	27.1	8.14E − 13	1.41	0.115	0.081	0.208	35
170	27.0	6.65E − 13	1.59	0.123	0.078	0.208	40
175	26.9	5.41E − 13	1.82	0.135	0.074		47
180	26.8	4.40E − 13	2.06	0.148	0.072		55
185	26.7	3.58E − 13	2.28	0.161	0.071		61
190	26.6	2.93E − 13	2.47	0.173	0.070		73
195	26.5	2.42E − 13	2.65	0.185	0.070		83
200	26.3	2.02E − 13	2.90	0.197	0.068		96
205	26.2	1.71E − 13	3.26	0.210	0.065		
210	26.1	1.47E − 13	3.63	0.220	0.061		

* Mass density probably accurate to 25%; ratios and mean molecular weight probably accurate to 20%.

† Assuming no wall loss. For $\gamma = 0.14$ (see text), multiply the atomic oxygen by the factor 1.2 and modify the other results accordingly.

Test No. 18

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JUNE 20, 1967 GM TIME 10 HRS 24 MINS LAT 32.30000 DEGS LONG -106.49000 DEGS

F10 117.00000 F10B 131.00000 AP 5.0000 EXOS TEMP 975.7115 HOUR ANG -9.3049

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
70.	140.	3.95899-12	623.9	7.97864-03	25.7	21.5	6.22948+10	9.70650+09	2.06243+10	1.98070+07	0.00000
86.	160.	1.36469-12	775.6	3.55026-03	24.7	27.9	2.04679+10	2.80630+09	9.94601+09	1.51955+07	0.00000
97.	180.	6.09648-13	861.5	1.83832-03	23.8	32.5	8.59682+09	1.05705+09	5.79189+09	1.27548+07	0.00000
108.	200.	3.08967-13	910.3	1.02614-03	22.8	36.0	4.03480+09	4.48815+08	3.67147+09	1.11451+07	0.00000
119.	220.	1.68632-13	938.1	6.02095-04	21.8	39.0	2.00576+09	2.02782+08	2.45099+09	9.93917+06	0.00000
130.	240.	9.67660-14	954.0	3.66472-04	20.9	41.6	1.02987+09	9.48896+07	1.64901+09	8.96260+06	0.00000
140.	260.	5.78599-14	963.2	2.29654-04	20.1	44.0	5.39180+08	4.53537+07	1.13462+09	8.13332+06	0.00000
151.	280.	3.54235-14	968.4	1.47440-04	19.3	46.3	2.85845+08	2.19774+07	7.87682+08	7.40873+06	0.00000
162.	300.	2.23319-14	971.5	9.66180-05	18.7	48.4	1.52865+08	1.07527+07	5.50098+08	6.78470+06	0.00000
173.	320.	1.43950-14	973.2	6.44329-05	18.1	50.3	8.22866+07	5.29937+06	3.85834+08	6.18642+06	0.00000
183.	340.	9.45879-15	974.3	4.36211-05	17.6	52.2	4.45301+07	2.62735+06	2.71531+08	5.66396+06	0.00000
194.	360.	6.31884-15	974.9	2.99195-05	17.1	53.9	2.42086+07	1.30936+06	1.91627+08	5.19014+06	0.00000
205.	380.	4.28152-15	975.2	2.07586-05	16.7	55.5	1.32157+07	6.55617+05	1.35573+08	4.75936+06	0.00000
216.	400.	2.93652-15	975.4	1.45519-05	16.4	57.1	7.24278+06	3.29735+05	9.61358+07	4.36709+06	0.00000
227.	420.	2.03520-15	975.5	1.02969-05	16.0	58.6	3.98420+06	1.66543+05	6.83186+07	4.00945+06	0.00000
237.	440.	1.42338-15	975.6	7.35574-06	15.7	60.2	2.19963+06	8.44666+04	4.86522+07	3.68310+06	0.00000
248.	460.	1.00351-15	975.6	5.30156-06	15.4	61.9	1.21871+06	4.30133+04	3.47178+07	3.38508+06	0.00000
259.	480.	7.12656-16	975.7	3.85679-06	15.0	63.8	6.77591+05	2.19914+04	2.48240+07	3.11275+06	0.00000
270.	500.	5.09601-16	975.7	2.83771-06	14.6	66.1	3.78035+05	1.12879+04	1.77847+07	2.86375+06	3.15479+04
281.	520.	3.66778-16	975.7	2.10799-06	14.1	68.6	2.11629+05	5.81651+03	1.27665+07	2.63597+06	3.13143+04
291.	540.	2.65725-16	975.7	1.58417-06	13.6	71.5	1.18873+05	3.00876+03	9.18188+06	2.42747+06	3.06759+04
302.	560.	1.93829-16	975.7	1.20565-06	13.0	75.1	6.69951+04	1.56232+03	6.61640+06	2.23654+06	3.00541+04
313.	580.	1.42413-16	975.7	9.30216-07	12.4	79.3	3.78826+04	8.14317+02	4.77677+06	2.06160+06	2.94464+04
324.	600.	1.05461-16	975.7	7.26266-07	11.7	84.3	2.14912+04	4.26036+02	3.45509+06	1.90123+06	2.88582+04
335.	620.	7.87740-17	975.7	5.78975-07	11.0	90.3	1.22319+04	2.23724+02	2.50376+06	1.75416+06	2.82832+04
345.	640.	5.94069-17	975.7	4.67599-07	10.3	97.2	6.98433+03	1.17917+02	1.81771+06	1.61920+06	2.77228+04
356.	660.	4.52772-17	975.7	3.83672-07	9.6	105.3	4.00078+03	6.23776+01	1.32206+06	1.49532+06	2.71766+04
367.	680.	3.49115-17	975.7	3.19722-07	8.9	114.4	2.29901+03	3.31171+01	9.63302+05	1.38153+06	2.66441+04
378.	700.	2.72609-17	975.7	2.70399-07	8.2	124.6	1.32525+03	1.76455+01	7.03159+05	1.27699+06	2.61251+04
389.	720.	2.15763-17	975.7	2.31956-07	7.6	135.8	7.66321+02	9.43542+00	5.14182+05	1.18086+06	2.56189+04
399.	740.	1.73206-17	975.7	2.01316-07	7.0	147.7	4.44491+02	5.06315+00	3.76656+05	1.09246+06	2.51254+04
410.	760.	1.41061-17	975.7	1.78767-07	6.5	160.1	2.58610+02	2.72647+00	2.76399+05	1.01112+06	2.46441+04
421.	780.	1.16603-17	975.7	1.58743-07	6.0	172.7	1.50920+02	1.47328+00	2.03179+05	9.36246+05	2.41746+04
432.	800.	9.77602-18	975.7	1.40170-07	5.7	185.3	8.83391+01	7.99852-01	1.49613+05	8.67286+05	2.37166+04
443.	820.	8.30904-18	975.7	1.26260-07	5.3	197.8	5.18629+01	4.34638-01	1.10357+05	8.03749+05	2.32697+04
453.	840.	7.15301-18	975.7	1.14428-07	5.1	209.1	3.08384+01	2.37279-01	8.15391+04	7.45181+05	2.28337+04
464.	860.	6.23029-18	975.7	1.04240-07	4.8	219.9	1.80348+01	1.29971-01	6.03476+04	6.91170+05	2.24082+04
475.	880.	5.48375-18	975.7	9.53697-08	4.7	229.8	1.08817+01	7.14298-02	4.47380+04	6.41341+05	2.19930+04
486.	900.	4.87160-18	975.7	8.75689-08	4.5	238.8	6.34486+00	3.93883-02	3.32207+04	5.95350+05	2.15878+04
496.	920.	4.36277-18	975.7	8.06490-08	4.4	247.0	3.77962+00	2.17887-02	2.47088+04	5.52883+05	2.11919+04
507.	940.	3.93421-18	975.7	7.44644-08	4.3	254.3	2.25791+00	1.20928-02	1.84077+04	5.13654+05	2.08055+04
518.	960.	3.56873-18	975.7	6.89012-08	4.2	260.8	1.35266+00	6.73321-03	1.37356+04	4.77400+05	2.04283+04
529.	980.	3.25337-18	975.7	6.38697-08	4.1	266.6	8.12616-01	3.76100-03	1.02657+04	4.43882+05	2.00599+04
540.	1000.	2.97835-18	975.7	5.92981-08	4.1	271.9	4.88535-01	2.10746-03	7.66450+03	4.12880+05	1.97001+04

Reference [8], Test #19.

Altitude, km	Number Densities, cm^{-3}				Total Mass Density, g/cm^3
	N_2	O_2	O	Ar	
115	4.43E 11*	8.47E 10	8.50E 10	2.47E 09	2.75E-11
120	2.16E 11	3.65E 10	5.68E 10	1.07E 09	1.36E-11
125	1.25E 11	2.02E 10	3.94E 10	5.86E 08	7.96E-12
130	7.30E 10	1.13E 10	2.71E 10	3.26E 08	4.73E-12
135	5.60E 10	9.31E 09	2.11E 10	2.64E 08	3.67E-12
140	3.14E 10	4.63E 09	1.60E 10	1.39E 08	2.14E-12
145	1.64E 10	2.20E 09	1.32E 10	(6.86E 07)	1.23E-12
150	1.16E 10	1.49E 09	1.10E 10	(4.11E 07)	9.14E-13
155	9.02E 09	1.14E 09	9.07E 09		7.21E-13

* 1.00E 10 = 1×10^{10}

Altitude, km	Number Density Ratios			Mean Molecular Weight
	$n(O), n(O_2)$	$n(O), n(N_2)$	$100 \times n(Ar)/n(N_2)$	
115	1.00	0.19	0.56	26.94
120	1.56	0.26	0.50	26.32
125	1.95	0.32	0.47	25.92
130	2.40	0.37	0.45	25.53
135	2.26	0.38	0.47	25.55
140	3.46	0.51	0.44	24.71
145	6.01	0.81	(0.42)	23.33
150	7.33	0.94	(0.35)	22.82
155	7.97	1.01		22.58
sea level			1.19	28.96

Several assumptions concerning the molecule-wall interactions have been made in Hedin's model, the most important being that of complete thermal accommodation ($\alpha = 1$) of all atoms and molecules at the ion source walls. This assumption has been made in our data evaluation as well, although it is not absolutely sure whether it holds for all atmospheric species. Indeed a recent measurement of accommodation coefficients α by *Groszer* [1966] indicates that α may be well below 1 for N_2 and O_2, and hence the respective density values in Table 1 might be somewhat low (10%).

Test No. 19

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE DECEMBER 11, 1965 GM TIME 4 HRS 43 MINS LAT 39.60000 DEGS LONG 9.40000 DEGS

F10 70.00000 F10B 70.00000 AP 16.0000 EXOS TEMP 721.2706 HOUR ANG -97.3880

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
70.	140.	4.13965-12	516.2	6.94535-03	25.6	17.9	6.47179+10	9.86842+09	2.28619+10	2.18408+07	0.00000
80.	160.	1.23600-12	606.0	2.56654-03	24.3	22.5	1.80342+10	2.34422+09	1.02836+10	1.68285+07	0.00000
90.	180.	4.68273-13	656.3	1.11423-03	22.9	25.7	6.19132+09	6.98712+08	5.39505+09	1.38951+07	0.00000
100.	200.	2.02464-13	684.5	5.32734-04	21.6	28.5	2.34875+09	2.32182+08	3.04525+09	1.18529+07	0.00000
110.	220.	9.55593-14	700.4	2.72521-04	20.4	31.1	9.39901+08	8.17852+07	1.78675+09	1.02837+07	0.00000
120.	240.	4.81371-14	709.4	1.46728-04	19.4	33.5	3.87918+08	2.98000+07	1.07168+09	9.00628+06	0.00000
130.	260.	2.55301-14	714.5	8.22216-05	18.4	35.8	1.63208+08	1.10904+07	6.51446+08	7.93081+06	0.00000
131.	280.	1.41118-14	717.4	4.75537-05	17.7	37.5	6.95591+07	4.18697+06	3.99462+08	7.00727+06	0.00000
140.	300.	8.06302-15	719.0	2.82069-05	17.1	39.1	2.99277+07	1.69748+06	2.46458+08	6.20490+06	0.00000
150.	320.	4.72992-15	720.0	1.70810-05	16.6	40.6	1.29733+07	6.14658+05	1.52776+08	5.50295+06	0.00000
160.	340.	2.83330-15	720.5	1.05266-05	16.1	42.0	5.65978+06	2.38213+05	9.50730+07	4.88620+06	0.00000
170.	360.	1.72598-15	720.8	6.59569-06	15.7	43.5	2.48336+06	9.29235+04	5.93666+07	4.34281+06	0.00000
180.	380.	1.06618-15	721.0	4.19832-06	15.2	45.1	1.09548+06	3.64693+04	3.71868+07	3.86314+06	0.00000
190.	400.	6.66869-16	721.1	2.71773-06	14.7	47.0	4.85719+05	1.45965+04	2.33020+07	3.43914+06	0.00000
200.	420.	4.21660-16	721.2	1.79250-06	14.1	49.3	2.16430+05	5.71535+03	1.47196+07	3.06393+06	0.00000
210.	440.	2.69769-16	721.2	1.20770-06	13.4	52.2	9.69066+04	2.28155+03	9.29991+06	2.73160+06	0.00000
220.	460.	1.74743-16	721.2	8.33647-07	12.6	55.9	4.35973+04	9.15762+02	5.89181+06	2.43699+06	0.00000
230.	480.	1.14789-16	721.3	5.91241-07	11.6	60.7	1.97065+04	3.69546+02	3.74272+06	2.17563+06	0.00000
240.	500.	7.71116-17	721.3	4.59752-07	10.1	70.7	8.94905+03	1.49921+02	2.38387+06	1.94360+06	2.81138+05
241.	520.	5.26292-17	721.3	3.52885-07	8.9	80.0	4.00267+03	6.11418+01	1.52237+06	1.73747+06	2.80358+05
251.	540.	3.67498-17	721.3	2.79126-07	7.9	91.2	1.87107+03	2.50655+01	9.74737+05	1.55420+06	2.72654+05
302.	560.	2.63378-17	721.3	2.27300-07	6.9	104.2	8.61386+02	1.03290+01	6.25716+05	1.39117+06	2.65204+05
313.	580.	1.94163-17	721.3	1.89882-07	6.1	118.7	3.98335+02	4.27817+00	4.02696+05	1.24803+06	2.57999+05
324.	600.	1.47415-17	721.3	1.62069-07	5.5	134.2	1.85023+02	1.78099+00	2.59824+05	1.11675+06	2.51030+05
335.	620.	1.15233-17	721.3	1.40778-07	4.9	150.0	8.63204+01	7.45154-01	1.68065+05	1.00150+06	2.44287+05
345.	640.	9.25854-18	721.3	1.24007-07	4.5	165.4	4.04477+01	3.13325-01	1.08980+05	8.98714+05	2.37762+05
356.	660.	7.62495-18	721.3	1.10445-07	4.1	179.9	1.90349+01	1.32400-01	7.08423+04	8.06971+05	2.31447+05
367.	680.	6.41484-18	721.3	9.92202-08	3.9	193.2	8.99639+00	5.62224-02	4.61639+04	7.25056+05	2.25334+05
378.	700.	5.49344-18	721.3	8.97466-08	3.7	205.3	4.25155+00	2.39904-02	3.01555+04	6.51819+05	2.19416+05
389.	720.	4.77260-18	721.3	8.16207-08	3.5	216.1	2.03528+00	1.02863-02	1.97459+04	5.86546+05	2.13686+05
399.	740.	4.19414-18	721.3	7.45599-08	3.4	225.9	9.74158-01	4.43150-03	1.29605+04	5.27765+05	2.08136+05
410.	760.	3.71919-18	721.3	6.83614-08	3.3	234.9	4.68203-01	1.91822-03	8.52702+03	4.75310+05	2.02760+05
421.	780.	3.32144-18	721.3	6.28758-08	3.2	243.3	2.25955-01	8.34229-04	5.62329+03	4.28334+05	1.97553+05
432.	800.	2.98278-18	721.3	5.79904-08	3.1	251.2	1.09491-01	3.64496-04	3.71701+03	3.86219+05	1.92507+05
443.	820.	2.69053-18	721.3	5.36178-08	3.0	259.0	5.32707-02	1.59994-04	2.46264+03	3.48446+05	1.87616+05
453.	840.	2.43560-18	721.3	4.96884-08	2.9	266.6	2.60218-02	7.05510-05	1.63531+03	3.14547+05	1.82877+05
464.	860.	2.21132-18	721.3	4.61457-08	2.9	274.2	1.27618-02	3.12517-05	1.08839+03	2.84106+05	1.78282+05
475.	880.	2.01270-18	721.3	4.29430-08	2.8	281.9	6.28342-03	1.39059-05	7.26017+02	2.56757+05	1.73827+05
486.	900.	1.83588-18	721.3	4.00409-08	2.8	289.8	3.10582-03	6.21529-06	4.85376+02	2.32169+05	1.69507+05
496.	920.	1.67761-18	721.3	3.74058-08	2.7	297.9	1.54113-03	2.79027-06	3.25216+02	2.10052+05	1.65318+05
507.	940.	1.53606-18	721.3	3.50087-08	2.6	306.2	7.67661-04	1.25817-06	2.18382+02	1.90147+05	1.61254+05
518.	960.	1.40859-18	721.3	3.28243-08	2.6	314.8	3.83844-04	5.69800-07	1.46963+02	1.72221+05	1.57311+05
529.	980.	1.29372-18	721.3	3.08305-08	2.5	323.7	1.92656-04	2.59168-07	9.91149+01	1.56070+05	1.53486+05
540.	1000.	1.19002-18	721.3	2.90079-08	2.5	332.9	9.70590-05	1.18586-07	6.69882+01	1.41309+05	1.49773+05

Reference [9], Test #20.

Altitude, km	% Composition			Mean Mol. Wt.	Total No. Dens./cc				Mass Dens., g/cc			
	N_2	O_2	O		$T_i = T_e$		$T_i = T_i$		$T_i = T_e$		$T_i = T_i$	
110	80.7	13.6	5.7	27.9	8.8	+11*	9.4	+11*	4.1	−11*	4.4	−11*
120	78.3	12.2	9.5	27.4	2.6	+11	2.4	+11	1.19	−11	1.09	−11
130	75.8	10.1	14.1	26.7	9.9	+10	6.4	+10	4.4	−12	2.8	−12
140	73.2	8.2	18.6	26.1	4.8	+10	3.0	+10	2.07	−12	1.31	−12
150	70.5	6.8	22.7	25.6	2.7	+10	1.54	+10	1.14	−12	6.5	−13
160	66.4	5.7	27.9	24.9	1.69	+10	9.0	+9	7.0	−13	3.7	−13
170	61.6	4.9	33.5	24.2	1.14	+10	5.8	+9	4.6	−13	2.3	−13
180	56.0	4.2	39.8	23.4	8.0	+9	4.0	+9	3.1	−13	1.57	−13
190	52.7	3.8	43.5	22.9	6.0	+9	2.9	+9	2.3	−13	1.12	−13
200	49.8	3.5	46.7	22.5	4.6	+9	2.25	+9	1.72	−13	8.4	−14
210	49.2	3.0	47.8	22.4	3.9	+9	1.86	+9	1.44	−13	6.9	−14

* Power of 10 by which preceding number must be multiplied.

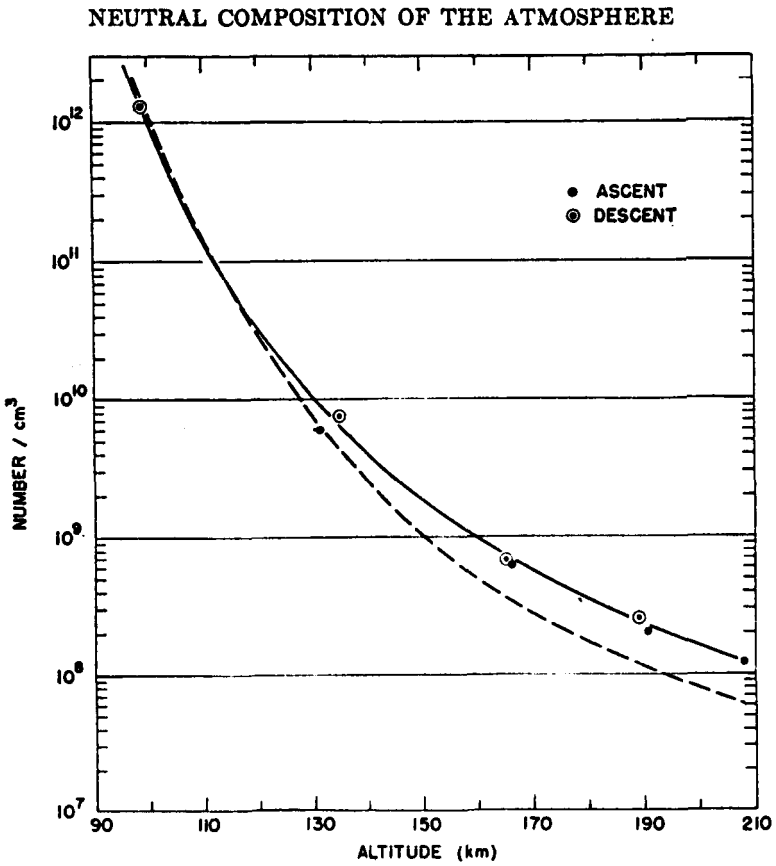


Fig. 6. Variation of O_2 particle density with altitude determined from nodal points of a plot similar to Figure 3 drawn for O_2 peak heights. Solid and dashed curves are based on same assumptions as those in Figure 5.

Reference [9], Test #20 Concluded.

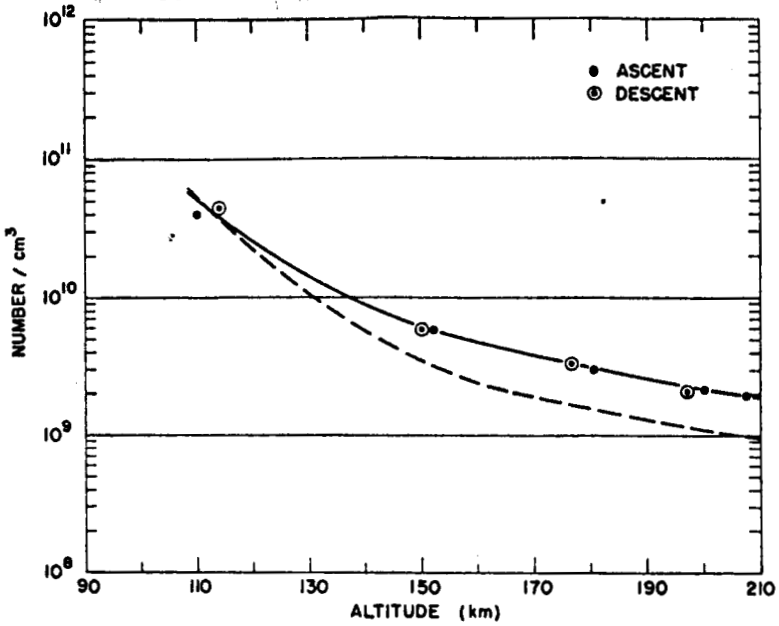


Fig. 7. Variation of O particle density with altitude determined from nodal points of a plot similar to Figure 6 drawn for O peak heights. Solid and dashed curves are based on the same assumptions as those in Figure 5.

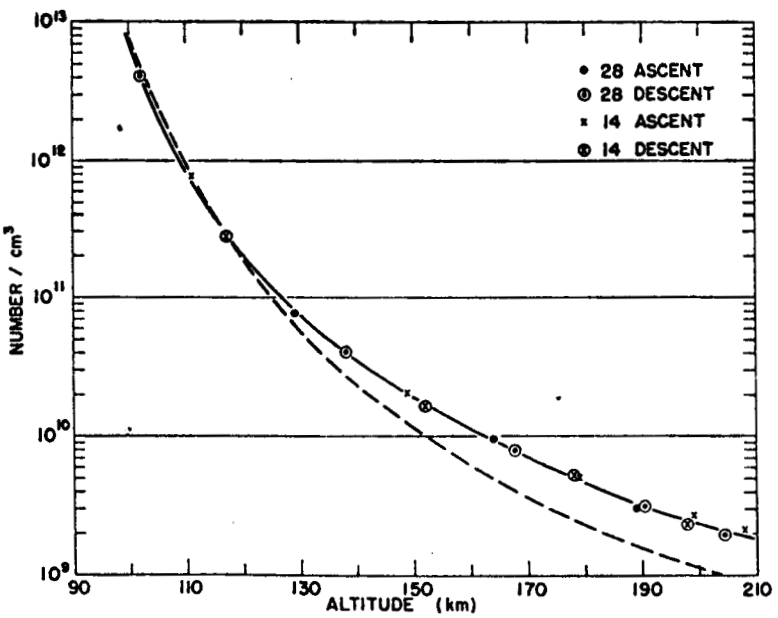


Fig. 5. Variation of N_2 particle density determined from nodal points of Figure 3 and companion plot for N (not reproduced in this paper). Solid curve assumed $n_e = n_i$ in (1). Dashed curve assumes all particles ionized in electron beam have adjusted to temperature of ion source parts.

Test No. 20

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JUNE 6, 1983 GM TIME 13 HRS 30 MINS LAT 32.30000 DEGS LONG -106.40000 DEGS

F10 77.00000 F10B 82.00000 AP 3.0000 EXOS TEMP 669.4985 HOUR ANG -84.2901

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
69.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
78.	140.	4.17654-12	492.4	6.69597-03	25.5	17.1	6.51762+10	9.88160+09	2.34223+10	2.23703+07	0.00000
86.	160.	1.19564-12	569.5	2.34588-03	24.1	21.0	1.72968+10	2.21522+09	1.03126+10	1.72434+07	0.00000
97.	180.	4.31626-13	612.8	9.69058-04	22.7	24.2	5.58714+09	6.15288+08	5.23938+09	1.41580+07	0.00000
108.	200.	1.78329-13	637.2	4.43602-04	21.3	27.0	1.98715+09	1.89850+08	2.85398+09	1.19837+07	0.00000
119.	220.	8.08462-14	651.1	2.18492-04	20.0	29.5	7.44743+08	6.20340+07	1.61396+09	1.03075+07	0.00000
130.	240.	3.93227-14	659.0	1.13758-04	18.9	31.8	2.87823+08	2.09658+07	9.32666+08	8.94602+06	0.00000
140.	260.	2.02148-14	663.4	6.17851-05	18.1	33.8	1.13415+08	7.23929+06	5.46192+08	7.80576+06	0.00000
151.	280.	1.08559-14	666.0	3.46921-05	17.3	35.5	4.52863+07	2.53674+06	3.22698+08	6.83346+06	0.00000
162.	300.	6.03226-15	667.5	1.99959-05	16.7	37.1	1.82614+07	8.98734+05	1.91865+08	5.99550+06	0.00000
173.	320.	3.44160-15	668.3	1.17764-05	16.2	38.5	7.42211+06	3.21253+05	1.14638+08	5.26864+06	0.00000
183.	340.	2.00480-15	668.8	7.06874-06	15.8	39.9	3.03715+06	1.15716+05	6.87767+07	4.63560+06	0.00000
194.	360.	1.18738-15	669.1	4.32145-06	15.3	41.4	1.25045+06	4.19724+04	4.14127+07	4.08281+06	0.00000
205.	380.	7.13303-16	669.3	2.69322-06	14.7	43.2	5.17794+05	1.53239+04	2.50197+07	3.59920+06	0.00000
216.	400.	4.34159-16	669.4	1.71498-06	14.1	45.5	2.15591+05	5.62976+03	1.51639+07	3.17552+06	0.00000
227.	420.	2.67775-16	669.4	1.11951-06	13.5	48.4	9.02441+04	2.08091+03	9.21881+06	2.80392+06	0.00000
237.	440.	1.67980-16	669.5	7.52019-07	12.4	52.3	3.79727+04	7.73752+02	5.62133+06	2.47770+06	0.00000
248.	460.	1.06810-16	669.5	5.21694-07	11.4	57.4	1.60603+04	2.89399+02	3.43780+06	2.19106+06	0.00000
259.	480.	6.92008-17	669.5	3.74695-07	10.3	63.9	6.82710+03	1.08870+02	2.10854+06	1.93900+06	0.00000
270.	500.	4.68426-17	669.5	3.26464-07	8.0	82.7	2.91671+03	4.11909+01	1.29696+06	1.71716+06	5.15467+05
281.	520.	3.22951-17	669.5	2.61610-07	6.9	96.8	1.25229+03	1.56732+01	8.00023+05	1.52179+06	5.07664+05
291.	540.	2.29469-17	669.5	2.16042-07	5.9	113.0	5.40314+02	5.99720+00	4.94878+05	1.34959+06	4.98672+05
302.	560.	1.69108-17	669.5	1.83274-07	5.1	130.6	2.34262+02	2.30757+00	3.06973+05	1.19771+06	4.78185+05
313.	580.	1.29095-17	669.5	1.58657-07	4.5	149.4	1.02059+02	8.92801-01	1.90941+05	1.06366+06	4.64205+05
324.	600.	1.01699-17	669.5	1.40022-07	4.1	167.8	4.46762+01	3.47317-01	1.19093+05	9.45255+05	4.50709+05
335.	620.	8.29727-18	669.5	1.25021-07	3.7	185.3	1.96498+01	1.35847-01	7.44612+04	8.40600+05	4.37660+05
345.	640.	6.91382-18	669.5	1.12735-07	3.4	201.4	8.68321+00	5.34198-02	4.67061+04	7.48033+05	4.25099+05
356.	660.	5.88858-18	669.5	1.02438-07	3.2	216.1	3.85500+00	2.11187-02	2.93667+04	6.66103+05	4.12948+05
367.	680.	5.09869-18	669.5	9.36433-08	3.0	229.4	1.71938+00	8.39309-03	1.85133+04	5.93538+05	4.01210+05
378.	700.	4.47206-18	669.5	8.60219-08	2.9	241.7	7.70367-01	3.35312-03	1.17016+04	5.29223+05	3.89870+05
389.	720.	3.96127-18	669.5	7.93415-08	2.8	253.1	3.46750-01	1.34657-03	7.41543+03	4.72164+05	3.78911+05
399.	740.	3.53573-18	669.5	7.34346-08	2.7	263.9	1.56775-01	5.43552-04	4.71132+03	4.21564+05	3.68320+05
410.	760.	3.17481-18	669.5	6.81758-08	2.6	274.4	7.11993-02	2.20530-04	3.00093+03	3.76610+05	3.58082+05
421.	780.	2.86432-18	669.5	6.34689-08	2.5	284.8	3.24785-02	8.99271-05	1.91632+03	3.36662+05	3.48184+05
432.	800.	2.59429-18	669.5	5.92377-08	2.4	295.1	1.48806-02	3.68549-05	1.22678+03	3.01141+05	3.38612+05
443.	820.	2.35735-18	669.5	5.54206-08	2.4	305.5	6.84755-03	1.51792-05	7.87313+02	2.69534+05	3.29354+05
453.	840.	2.14817-18	669.5	5.19664-08	2.3	316.1	3.18463-03	6.28277-06	5.06521+02	2.41394+05	3.20389+05
464.	860.	1.96255-18	669.5	4.88322-08	2.2	327.0	1.46882-03	2.61321-06	3.26670+02	2.16324+05	3.11735+05
475.	880.	1.79717-18	669.5	4.59812-08	2.2	338.1	6.84633-04	1.09221-06	2.11191+02	1.93975+05	3.03352+05
486.	900.	1.64935-18	669.5	4.33821-08	2.1	349.5	3.20460-04	4.58694-07	1.36862+02	1.74040+05	2.95238+05
496.	920.	1.51689-18	669.5	4.10074-08	2.1	361.2	1.50627-04	1.93558-07	8.89055+01	1.56246+05	2.87384+05
507.	940.	1.39793-18	669.5	3.88332-08	2.0	373.2	7.10931-05	8.20646-08	5.78895+01	1.40555+05	2.79780+05
518.	960.	1.29088-18	669.5	3.68385-08	2.0	385.5	3.36927-05	3.49572-08	3.77825+01	1.26154+05	2.72417+05
529.	980.	1.19436-18	669.5	3.50047-08	1.9	398.0	1.60329-05	1.49602-08	2.47167+01	1.13455+05	2.65287+05
540.	1000.	1.10725-18	669.5	3.33157-08	1.9	410.8	7.66022-06	6.43195-09	1.62067+01	1.02094+05	2.58381+05

Reference [10], Test #21.

Altitude, km	$\rho(N_2)$, g cm^{-3}		$n(N_2)$, particles cm^{-3}		T_{N_2}, °K		T_e, °K		N_e, No. cm^{-3}	
	Upleg	Downleg	Upleg	Downleg	Upleg	Downleg	Upleg	Downleg	Upleg	Downleg
110							628		2.33 + 4	
120							749		3.12 + 4	1.37 + 4
130		3.65 − 12		7.77 + 10		470	823		3.84 + 4	1.77 + 4
140	1.14 − 12	1.72 − 12	2.43 + 10	3.66 + 10	569	528	860		4.34 + 4	2.78 + 4
150	6.22 − 13	8.40 − 13	1.33 + 10	1.79 + 10	623	620	887	866	4.63 + 4	3.47 + 4
160	3.50 − 13	4.59 − 13	7.46 + 9	9.78 + 9	674	712	908	908	4.91 + 4	3.53 + 4
170	2.13 − 13	2.71 − 13	4.54 + 9	5.77 + 9	719	779	913	939	5.34 + 4	4.06 + 4
180	1.33 − 13	1.75 − 13	2.84 + 9	3.73 + 9	757	820	924	966	7.55 + 4	7.03 + 4
190	8.43 − 14	1.18 − 13	1.80 + 9	2.51 + 9	786	845	945	992	2.14 + 5	1.22 + 5
200	5.39 − 14	8.00 − 14	1.15 + 9	1.70 + 9	807	855	960	1013	3.25 + 5	1.97 + 5
210	3.47 − 14	5.50 − 14	7.40 + 8	1.17 + 9	822	860	982	1045	3.79 + 5	2.99 + 5
220	2.28 − 14	3.82 − 14	4.86 + 8	8.14 + 8	834	862	1018	1071	4.08 + 5	3.66 + 5
230	1.50 − 14	2.66 − 14	3.20 + 8	5.67 + 8	843	865	1082	1092	4.16 + 5	3.98 + 5
240	9.80 − 15	1.86 − 14	2.09 + 8	3.96 + 8	848	867	1145	1119	4.04 + 5	4.03 + 5
250		1.31 − 14		2.79 + 8		870	1214	1140	3.77 + 5	3.90 + 5
260		9.15 − 15		1.95 + 8		874	1293	1187	3.49 + 5	3.62 + 5
270							1383	1230	3.22 + 5	3.37 + 5
280							1462	1277	2.93 + 5	3.13 + 5
290							1520	1325	2.67 + 5	2.90 + 5
300							1557	1388	2.43 + 5	2.71 + 5
310							1583	1467	2.22 + 5	2.52 + 5
320							1599	1536	2.02 + 5	2.34 + 5
330							1615	1588	1.83 + 5	2.17 + 5
340							1620	1625	1.67 + 5	2.02 + 5

Test No. 21

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE NOVEMBER 20, 1962 GM TIME 21 HRS 41 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 87.00000 F10B 88.00000 AP 4.0000 EXOS TEMP 837.1546 HOUR ANG -269.2114

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
69.	120.	2.45946-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
78.	140.	4.05557-12	567.9	7.46136-03	25.7	19.6	6.36207+10	9.81024+09	2.17327+10	2.07982+07	0.00000
86.	160.	1.30849-12	686.2	3.04539-03	24.5	24.9	1.93822+10	2.59111+09	1.01804+10	1.60042+07	0.00000
97.	180.	5.41570-13	752.5	1.44030-03	23.4	28.9	7.42263+09	8.76582+08	5.64432+09	1.33428+07	0.00000
108.	200.	2.54708-13	789.2	7.51374-04	22.2	32.0	3.15904+09	3.32481+08	3.39374+09	1.15370+07	0.00000
119.	220.	1.29675-13	810.0	4.12653-04	21.2	34.7	1.42069+09	1.33668+08	2.12581+09	1.01629+07	0.00000
130.	240.	6.98455-14	821.7	2.38655-04	20.2	37.2	6.59182+08	5.57825+07	1.36233+09	9.04351+06	0.00000
140.	260.	3.93060-14	828.4	1.40477-04	19.3	39.5	3.11718+08	2.37296+07	8.84981+08	8.09420+06	0.00000
151.	280.	2.29306-14	832.1	8.57617-05	18.5	41.6	1.49255+08	1.02341+07	5.79867+08	7.26963+06	0.00000
162.	300.	1.37828-14	834.3	5.35851-05	17.8	43.5	7.21023+07	4.45747+06	3.82199+08	6.54395+06	0.00000
173.	320.	8.49392-15	835.5	3.41323-05	17.3	45.2	3.50713+07	1.95645+06	2.53024+08	5.89950+06	0.00000
183.	340.	5.54349-15	836.2	2.20983-05	16.8	46.8	1.71570+07	8.64275+05	1.68101+08	5.32450+06	0.00000
194.	360.	3.41975-15	836.6	1.45108-05	16.4	48.3	8.43594+06	3.83998+05	1.12022+08	4.80986+06	0.00000
205.	380.	2.21990-15	836.8	9.65077-06	16.0	49.8	4.16732+06	1.71521+05	7.48578+07	4.34830+06	0.00000
216.	400.	1.45838-15	837.0	6.49665-06	15.6	51.3	2.06781+06	7.70018+04	5.01527+07	3.93575+06	0.00000
227.	420.	9.68042-16	837.0	4.42661-06	15.2	53.0	1.03045+06	3.47364+04	3.36844+07	3.56103+06	0.00000
237.	440.	6.48956-16	837.1	3.05484-06	14.8	54.9	5.15656+05	1.57469+04	2.26782+07	3.22561+06	0.00000
248.	460.	4.38320-16	837.1	2.13710-06	14.3	57.2	2.59108+05	7.17169+03	1.53044+07	2.92353+06	0.00000
259.	480.	2.98808-16	837.1	1.51813-06	13.7	59.9	1.30726+05	3.28141+03	1.03521+07	2.65130+06	0.00000
270.	500.	2.05693-16	837.1	1.10735-06	12.9	63.9	6.62197+04	1.50830+03	7.01846+06	2.40580+06	9.05353+04
281.	520.	1.42924-16	837.1	8.17945-07	12.2	68.3	3.36770+04	6.96441+02	4.76912+06	2.18426+06	9.03406+04
291.	540.	1.00404-16	837.1	6.16853-07	11.3	73.7	1.71943+04	3.23020+02	3.24796+06	1.98426+06	8.81977+04
302.	560.	7.14174-17	837.2	4.75596-07	10.5	80.4	8.81307+03	1.50469+02	2.21691+06	1.80357+06	8.61176+04
313.	580.	5.19236-17	837.2	3.75045-07	9.6	88.4	4.53465+03	7.04201+01	1.51650+06	1.64024+06	8.40960+04
324.	600.	3.77703-17	837.2	3.02384-07	8.7	97.8	2.34218+03	3.30966+01	1.03965+06	1.49251+06	8.21369+04
335.	620.	2.81844-17	837.2	2.48984-07	7.9	108.5	1.21434+03	1.58225+01	7.14283+05	1.35883+06	8.02325+04
345.	640.	2.14409-17	837.2	2.09003-07	7.1	120.4	6.31967+02	7.40599+00	4.91797+05	1.23778+06	7.83827+04
356.	660.	1.66460-17	837.2	1.78468-07	6.5	133.2	3.30114+02	3.52584+00	3.39333+05	1.12811+06	7.65857+04
367.	680.	1.31947-17	837.2	1.54661-07	5.9	146.4	1.73078+02	1.68568+00	2.34629+05	1.02871+06	7.48397+04
378.	700.	1.06756-17	837.2	1.35710-07	5.5	159.7	9.10752+01	8.09289-01	1.62572+05	9.38551+05	7.31432+04
389.	720.	8.80774-18	837.2	1.20317-07	5.1	172.6	4.80993+01	3.90152-01	1.12879+05	8.56740+05	7.14943+04
399.	740.	7.39868-18	837.2	1.07577-07	4.8	184.8	2.54941+01	1.88864-01	7.85361+04	7.82462+05	6.98917+04
410.	760.	6.31585-18	837.2	9.68503-08	4.5	196.0	1.35810+01	9.17986-02	5.47536+04	7.14999+05	6.83336+04
421.	780.	5.48752-18	837.2	8.78807-08	4.3	206.1	7.23901+00	4.48002-02	3.82503+04	6.53664+05	6.68187+04
432.	800.	4.78984-18	837.2	7.97396-08	4.2	215.1	3.87785+00	2.19515-02	2.67748+04	5.97699+05	6.53456+04
443.	820.	4.23814-18	837.2	7.27868-08	4.1	223.2	2.08455+00	1.07988-02	1.87794+04	5.47183+05	6.39129+04
453.	840.	3.78066-18	837.2	6.66436-08	3.9	230.3	1.12443+00	5.33334-03	1.31976+04	5.00979+05	6.25193+04
464.	860.	3.39559-18	837.2	6.11750-08	3.9	236.7	6.08611-01	2.64436-03	9.29297+03	4.58910+05	6.11838+04
475.	880.	3.06622-18	837.2	5.62773-08	3.8	242.5	3.30537-01	1.31621-03	6.55628+03	4.20592+05	5.99445+04
486.	900.	2.78104-18	837.2	5.18691-08	3.7	247.8	1.80120-01	6.57661-04	4.63442+03	3.85651+05	5.85610+04
496.	920.	2.53143-18	837.2	4.78857-08	3.7	252.7	9.84809-02	3.29864-04	3.28217+03	3.53783+05	5.73117+04
507.	940.	2.31099-18	837.2	4.42743-08	3.6	257.4	5.40232-02	1.66077-04	2.32889+03	3.24701+05	5.60956+04
518.	960.	2.11484-18	837.2	4.09914-08	3.6	261.8	2.97327-02	8.39293-05	1.65558+03	2.98149+05	5.49121+04
529.	980.	1.93923-18	837.2	3.80005-08	3.6	266.1	1.64173-02	4.25730-05	1.17913+03	2.73896+05	5.37596+04
540.	1000.	1.78123-18	837.2	3.52705-08	3.5	270.4	9.09435-03	2.16749-05	8.41342+02	2.51733+05	5.26374+04

Reference [10], Test #22.

Altitude, km	$\rho(N_2)$, g cm^{-3}		$n(N_2)$, particles cm^{-3}		T_{N_2}, °K		T_e, °K		N_e, No. cm^{-3}	
	Upleg	Downleg	Upleg	Downleg	Upleg	Downleg	Upleg	Downleg	Upleg	Downleg
100								897		
110								924		8.40 + 4
120								939		1.02 + 5
130								971		1.17 + 5
140							924	1029	1.65 + 5	1.35 + 5
150							1050	1103	1.90 + 5	1.58 + 5
160	5.81 − 13	4.94 − 13	1.24 + 10	1.05 + 10	666	686	1208	1182	2.10 + 5	1.85 + 5
170	3.44 − 13	2.97 − 13	7.34 + 9	6.33 + 9	716	736	1351	1277	2.28 + 5	2.08 + 5
180	2.12 − 13	1.83 − 13	4.52 + 9	3.90 + 9	760	781	1467	1372	2.48 + 5	2.30 + 5
190	1.36 − 13	1.18 − 13	2.90 + 9	2.52 + 9	799	821	1573	1467	2.75 + 5	2.55 + 5
200	8.88 − 14	7.87 − 14	1.89 + 9	1.68 + 9	832	840	1668	1573	3.12 + 5	2.95 + 5
210	5.93 − 14	5.31 − 14	1.26 + 9	1.13 + 9	864	873	1747	1694	3.70 + 5	3.50 + 5
220	4.01 − 14	3.63 − 14	8.55 + 8	7.74 + 8	890	893	1784	1773	4.35 + 5	4.30 + 5
230	2.77 − 14	2.53 − 14	5.91 + 8	5.39 + 8	905	908	1794	1831	5.15 + 5	5.15 + 5
240	1.98 − 14	1.77 − 14	4.22 + 8	3.77 + 8	914	917	1800	1858	5.90 + 5	5.90 + 5
250	1.42 − 14	1.26 − 14	3.03 + 8	2.69 + 8	920	924	1794	1863	6.50 + 5	6.50 + 5
260	1.01 − 14	9.12 − 15	2.15 + 8	1.95 + 8	924	928	1789	1852	7.00 + 5	7.00 + 5
270	7.20 − 15	6.55 − 15	1.54 + 8	1.40 + 8	926	932	1768	1842	7.40 + 5	7.40 + 5
280	5.12 − 15	4.68 − 15	1.09 + 8	9.98 + 7	929	935	1747	1815	7.75 + 5	7.75 + 5
290	3.67 − 15	3.36 − 15	7.83 + 7	7.16 + 7	930	938	1726	1773	8.00 + 5	8.00 + 5
300					931	941	1699	1731	8.30 + 5	8.30 + 5
310							1668	1689	8.40 + 5	8.40 + 5
320							1641	1647	8.40 + 5	8.40 + 5
330							1598	1598		

Test No. 22

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1987)

DATE APRIL 18, 1993 GM TIME 21 HRS 4 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 88.00000 F10B 79.00000 AP 10.0000 EXOS TEMP 945.1342 HOUR ANG 62.1918

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
69.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	5.40000+07	0.00000
78.	140.	3.97952-12	612.2	7.87493-03	25.7	21.1	6.25815+10	9.73135+09	2.08459+10	2.00026+07	0.00000
86.	160.	1.38490-12	756.7	3.45249-03	24.7	27.3	2.02740+10	2.78618+09	9.99718+09	1.53583+07	0.00000
97.	180.	5.98881-13	838.1	1.75545-03	23.7	31.7	8.36864+09	1.02102+09	5.77125+09	1.28774+07	0.00000
108.	200.	2.98022-13	884.1	9.65763-04	22.7	35.2	3.85542+09	4.24312+08	3.62231+09	1.12314+07	0.00000
119.	220.	1.60454-13	910.2	5.59265-04	21.7	38.0	1.88019+09	1.87529+08	2.37331+09	9.99362+06	0.00000
130.	240.	9.09184-14	925.1	3.36367-04	20.8	40.6	9.46741+08	8.58099+07	1.59247+09	8.98933+06	0.00000
140.	260.	5.35547-14	933.6	2.08502-04	19.9	43.0	4.85998+08	4.00993+07	1.08364+09	8.13621+06	0.00000
151.	280.	3.25578-14	938.5	1.32514-04	19.2	45.2	2.52608+08	1.89965+07	7.43915+08	7.39134+06	0.00000
162.	300.	2.03280-14	941.3	8.60142-05	18.5	47.3	1.32444+08	9.08628+06	5.13727+08	6.73029+06	0.00000
173.	320.	1.29855-14	942.9	5.68406-05	17.9	49.2	6.98999+07	4.37809+06	3.56295+08	6.13790+06	0.00000
183.	340.	8.45924-15	943.8	3.81422-05	17.4	51.0	3.70894+07	2.12228+06	2.47943+08	5.60592+06	0.00000
194.	360.	5.60372-15	944.4	2.59366-05	17.0	52.7	1.97720+07	1.03421+06	1.73034+08	5.12084+06	0.00000
205.	380.	3.78541-15	944.7	1.78441-05	16.6	54.3	1.05851+07	5.06420+05	1.21062+08	4.68280+06	0.00000
216.	400.	2.56107-15	944.9	1.24069-05	16.2	55.8	5.68955+06	2.49108+05	8.48995+07	4.28497+06	0.00000
227.	420.	1.76016-15	945.0	8.71214-06	15.9	57.4	3.06992+06	1.23074+05	5.96718+07	3.92324+06	0.00000
237.	440.	1.22072-15	945.0	6.17678-06	15.5	59.0	1.66263+06	6.10648+04	4.20308+07	3.59404+06	0.00000
248.	460.	8.53462-16	945.1	4.42200-06	15.2	60.7	9.03762+05	3.04251+04	2.96674+07	3.29423+06	0.00000
259.	480.	6.01118-16	945.1	3.19804-06	14.8	62.7	4.93033+05	1.52215+04	2.09839+07	3.02101+06	0.00000
270.	500.	4.26432-16	945.1	2.34322-06	14.3	65.2	2.69925+05	7.64626+03	1.48723+07	2.77187+06	3.89176+04
281.	520.	3.04584-16	945.1	1.73483-06	13.8	68.0	1.48296+05	3.85643+03	1.05620+07	2.54456+06	3.86473+04
291.	540.	2.19108-16	945.1	1.30132-06	13.2	71.3	8.17600+04	1.95276+03	7.51582+06	2.33706+06	3.78342+04
302.	560.	1.59804-16	945.1	9.90176-07	12.6	75.3	4.52317+04	9.92710+02	5.35874+06	2.14754+06	3.70428+04
313.	580.	1.16041-16	945.1	7.65113-07	11.9	80.1	2.51090+04	5.06632+02	3.82822+06	1.97435+06	3.62723+04
324.	600.	8.55591-17	945.1	6.00916-07	11.2	85.8	1.39658+04	2.59563+02	2.74014+06	1.81801+06	3.55221+04
335.	620.	6.37172-17	945.1	4.79983-07	10.4	92.5	7.81627+03	1.33493+02	1.96508+06	1.67117+06	3.47916+04
345.	640.	4.79612-17	945.1	3.89973-07	9.7	100.4	4.38287+03	6.89169+01	1.41193+06	1.53861+06	3.40801+04
356.	660.	3.65780-17	945.1	3.22190-07	8.9	109.4	2.48575+03	3.57133+01	1.01640+06	1.41723+06	3.33872+04
367.	680.	2.82617-17	945.1	2.70484-07	8.2	119.6	1.39175+03	1.85782+01	7.33042+05	1.30604+06	3.27121+04
378.	700.	2.21536-17	945.1	2.30486-07	7.6	130.7	7.88098+02	9.69825+00	5.29660+05	1.20413+06	3.20544+04
389.	720.	1.76319-17	945.1	1.99086-07	7.0	142.7	4.47709+02	5.08189+00	3.83410+05	1.11068+06	3.14136+04
399.	740.	1.42539-17	945.1	1.74049-07	6.4	155.2	2.55150+02	2.87263+00	2.78048+05	1.02495+06	3.07890+04
410.	760.	1.17056-17	945.1	1.53768-07	6.0	167.9	1.45870+02	1.41066+00	2.02005+05	9.46270+05	3.01803+04
421.	780.	9.76140-18	945.1	1.37082-07	5.6	180.5	8.36566+01	7.47238-01	1.47021+05	8.74017+05	2.95869+04
432.	800.	8.26020-18	945.1	1.23148-07	5.3	192.7	4.81263+01	3.97227-01	1.07194+05	8.07639+05	2.90084+04
443.	820.	7.08562-18	945.1	1.11340-07	5.0	204.2	2.77718+01	2.11909-01	7.82933+04	7.46631+05	2.84443+04
453.	840.	6.15367-18	945.1	1.01206-07	4.8	214.9	1.60750+01	1.13442-01	5.72846+04	6.90533+05	2.78943+04
464.	860.	5.40347-18	945.1	9.24066-08	4.6	224.7	9.33289+00	6.09405-02	4.19859+04	6.38926+05	2.73579+04
475.	880.	4.79063-18	945.1	8.46852-08	4.4	233.6	5.43482+00	3.28494-02	3.08258+04	5.91430+05	2.68346+04
486.	900.	4.28269-18	945.1	7.78487-08	4.3	241.5	3.17431+00	1.77676-02	2.26707+04	5.47698+05	2.63242+04
496.	920.	3.85577-18	945.1	7.17490-08	4.2	248.6	1.85950+00	9.64269-03	1.67013+04	5.07414+05	2.58262+04
507.	940.	3.49217-18	945.1	6.62710-08	4.1	254.9	1.09249+00	5.25076-03	1.23243+04	4.70289+05	2.53402+04
518.	960.	3.17871-18	945.1	6.13242-08	4.1	260.6	6.43726-01	2.86672-03	9.10950+03	4.36062+05	2.48660+04
529.	980.	2.90549-18	945.1	5.68364-08	4.0	265.7	3.80397-01	1.57249-03	6.74441+03	4.04493+05	2.44032+04
540.	1000.	2.66501-18	945.1	5.27495-08	4.0	270.3	2.25432-01	8.64778-04	5.00153+03	3.75362+05	2.39515+04

Reference [10], Test #23.

Altitude, km	$\rho(N_2)$, g cm^{-3}		$n(N_2)$, particles cm^{-3}		T_{N_2}, °K		T_e, °K		N_e Ionosonde, No. cm^{-3}
	Upleg	Downleg	Upleg	Downleg	Upleg	Downleg	Upleg	Downleg	—
120								660	4.80 + 4
130							627	722	5.60 + 4
140							701	770	6.40 + 4
150		1.20 − 12		2.74 + 10		638	765	817	7.20 + 4
160		7.70 − 13		1.64 + 10		656	817	874	8.00 + 4
170		4.68 − 13		9.99 + 9		667	865	960	8.60 + 4
180		2.94 − 13		6.28 + 9		675	920	1064	9.50 + 4
190		1.83 − 13		3.91 + 9		682	983	1139	1.12 + 4
200		1.14 − 13		2.43 + 9		689	1028	1154	1.30 + 5
210		7.20 − 14		1.54 + 9		694	1020	1150	1.79 + 5
220		4.60 − 14		9.82 + 8		699	998	1131	2.29 + 5
230	2.36 − 14	2.92 − 14	5.04 + 8	6.23 + 8	777	703	988	1116	2.95 + 5
240	1.59 − 14	1.89 − 14	3.40 + 8	4.03 + 8	769	706	998	1112	3.78 + 5
250	1.07 − 14	1.21 − 14	2.28 + 8	2.58 + 8	760	709	1031	1107	4.42 + 5
260	7.36 − 15	7.97 − 15	1.57 + 8	1.70 + 8	746	711	1069	1102	4.80 + 5
270	5.02 − 15	5.12 − 15	1.07 + 8	1.09 + 8	732	713	1102	1093	5.10 + 5
280	3.37 − 15	3.32 − 15	7.19 + 7	7.09 + 7	716	714	1121	1083	5.20 + 5
290	2.22 − 15	2.16 − 15	4.74 + 7	4.61 + 7	711	715	1131	1078	
300							1112	1069	
310							1093	1064	
320							1074	1064	
330							1059	1055	

Test No. 23

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JULY 20, 1963 GM TIME 21 HRS 54 MINS LAT 37.63000 DEGS LONG -75.48000 DEGS

F10 78.00000 F10B 83.00000 AP 10.0000 EXOS TEMP 821.6678 HOUR ANG 73.1133

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
89.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	5.40000+07	0.00000
76.	140.	4.06677-12	561.2	7.39637-03	25.7	19.4	6.37705+10	9.81993+09	2.18731+10	2.09261+07	0.00000
86.	160.	1.30021-12	675.7	2.98337-03	24.5	24.6	1.92261+10	2.56163+09	1.01806+10	1.61063+07	0.00000
97.	180.	5.32578-13	739.6	1.40438-03	23.5	28.4	7.26991+09	8.53929+08	5.61833+09	1.34135+07	0.00000
108.	200.	2.47991-13	775.4	7.21076-04	22.2	31.5	3.05297+09	3.18945+08	3.35552+09	1.15804+07	0.00000
119.	220.	1.25110-13	795.5	3.92642-04	21.1	34.3	1.55446+09	1.26451+08	2.08474+09	1.01834+07	0.00000
130.	240.	6.68417-14	806.8	2.23469-04	20.1	36.7	6.19929+08	5.18665+07	1.32576+09	9.04508+06	0.00000
140.	260.	3.73462-14	813.2	1.31733-04	19.2	39.0	2.89181+08	2.17218+07	8.54578+08	8.08034+06	0.00000
151.	280.	2.18442-14	816.8	7.99059-05	18.4	41.0	1.36592+08	9.22339+06	5.55625+08	7.24355+06	0.00000
162.	300.	1.29309-14	818.9	4.96193-05	17.7	42.9	6.50962+07	3.95547+06	3.63401+08	6.50781+06	0.00000
173.	320.	7.92243-15	820.1	3.14176-05	17.2	44.6	3.12390+07	1.70953+06	2.38733+08	5.85570+06	0.00000
183.	340.	4.95581-15	820.7	2.02223-05	16.7	46.2	1.50785+07	7.43700+05	1.57396+08	5.27488+06	0.00000
194.	360.	3.15397-15	821.1	1.32036-05	16.3	47.7	7.31561+06	3.25423+05	1.04092+08	4.75597+06	0.00000
205.	380.	2.03537-15	821.4	8.73406-06	15.9	49.1	3.56623+06	1.43168+05	6.90327+07	4.29145+06	0.00000
216.	400.	1.32944-15	821.5	5.84989-06	15.5	50.7	1.74635+06	6.33111+04	4.59026+07	3.87502+06	0.00000
227.	420.	8.77390-16	821.6	3.96792-06	15.1	52.4	8.58909+05	2.81369+04	3.05996+07	3.50129+06	0.00000
237.	440.	5.84815-16	821.6	2.72771-06	14.6	54.4	4.24244+05	1.25657+04	2.04484+07	3.16559+06	0.00000
248.	460.	3.92908-16	821.6	1.90288-06	14.1	56.8	2.10429+05	5.63867+03	1.36977+07	2.86383+06	0.00000
259.	480.	2.66501-16	821.6	1.34937-06	13.5	59.7	1.04806+05	2.54224+03	9.19735+06	2.59257+06	0.00000
270.	500.	1.82668-16	821.7	9.86240-07	12.7	64.0	5.24137+04	1.15155+03	6.19003+06	2.34803+06	1.03745+05
281.	520.	1.26459-16	821.7	7.29765-07	11.8	68.9	2.63182+04	5.24025+02	4.17568+06	2.12795+06	1.03603+05
291.	540.	8.85962-17	821.7	5.52082-07	11.0	74.8	1.32680+04	2.39537+02	2.82328+06	1.92960+06	1.01100+05
302.	560.	6.29219-17	821.7	4.27542-07	10.1	82.0	6.71548+03	1.10010+02	1.91323+06	1.75073+06	9.86709+04
313.	580.	4.53673-17	821.7	3.38969-07	9.1	90.7	3.41236+03	5.07466+01	1.29943+06	1.58934+06	9.63139+04
324.	600.	3.33167-17	821.7	2.74929-07	8.3	100.8	1.74070+03	2.35133+01	8.84517+05	1.44363+06	9.40261+04
335.	620.	2.49328-17	821.7	2.27767-07	7.5	112.2	8.91389+02	1.09430+01	6.03417+05	1.31199+06	9.18054+04
345.	640.	1.90494-17	821.7	1.92329-07	6.8	124.7	4.58220+02	5.11515+00	4.12552+05	1.19302+06	8.96493+04
356.	660.	1.48714-17	821.7	1.65131-07	6.2	137.9	2.36444+02	2.40139+00	2.82671+05	1.08542+06	8.75556+04
367.	680.	1.18036-17	821.7	1.43798-07	5.6	151.4	1.22466+02	1.13223+00	1.94096+05	9.88057+05	8.55226+04
378.	700.	9.66442-18	821.7	1.26702-07	5.2	164.7	6.36683+01	5.36114-01	1.33560+05	8.99906+05	8.35477+04
389.	720.	8.02837-18	821.7	1.12721-07	4.9	177.4	3.32228+01	2.54926-01	9.20993+04	8.20053+05	8.16293+04
399.	740.	6.78814-18	821.7	1.01071-07	4.6	189.2	1.73997+01	1.21729-01	6.36422+04	7.47677+05	7.97853+04
410.	760.	5.82908-18	821.7	9.12007-08	4.4	199.9	9.14567+00	5.83679-02	4.40693+04	6.82043+05	7.79540+04
421.	780.	5.01222-18	821.7	8.27158-08	4.2	209.6	4.82475+00	2.81025-02	3.05789+04	6.22491+05	7.61936+04
432.	800.	4.46283-18	821.7	7.53328-08	4.0	218.1	2.55433+00	1.35859-02	2.12615+04	5.68429+05	7.44825+04
443.	820.	3.96270-18	821.7	6.88431-08	3.9	225.8	1.35712+00	6.59469-03	1.48131+04	5.19325+05	7.28191+04
453.	840.	3.54491-18	821.7	6.30910-08	3.8	232.6	7.23579-01	3.21398-03	1.03412+04	4.74701+05	7.12017+04
464.	860.	3.19034-18	821.7	5.79581-08	3.8	238.7	3.87139-01	1.57261-03	7.23369+03	4.34128+05	6.96290+04
475.	880.	2.88525-18	821.7	5.33328-08	3.7	244.3	2.07850-01	7.72533-04	5.07000+03	3.97219+05	6.80993+04
486.	900.	2.61962-18	821.7	4.92026-08	3.6	249.6	1.11975-01	3.80990-04	3.56046+03	3.63625+05	6.66115+04
496.	920.	2.38607-18	821.7	4.54491-08	3.6	254.5	6.05300-02	1.88624-04	2.50523+03	3.33035+05	6.51640+04
507.	940.	2.17904-18	821.7	4.20444-08	3.5	259.2	3.28310-02	9.37466-05	1.76615+03	3.05169+05	6.37557+04
518.	960.	1.99430-18	821.7	3.89487-08	3.5	263.8	1.78669-02	4.67707-05	1.24749+03	2.79761+05	6.23853+04
529.	980.	1.82857-18	821.7	3.61283-08	3.5	268.3	9.75564-03	2.34227-05	8.82811+02	2.56593+05	6.10515+04
540.	1000.	1.67923-18	821.7	3.35543-08	3.4	272.9	5.34430-03	1.17743-05	6.25916+02	2.35454+05	5.97533+04

Reference [4], Test #24.

NASA 18.05

August 26, 1966

18:31 Z

Wallops Is., Va.

molecular nitrogen

ALTITUDE (Km)	TEMPERATURE (°K)	DENSITY (part/cc)
280	982	2.69×10^{8}
275	979	3.16
270	977	3.70
265	974	4.35
260	971	5.10
255	968	6.00
250	964	7.08
245	960	8.30
240	956	9.80×10^{8}
235	952	1.17×10^{9}
230	948	1.37
225	943	1.63
220	938	1.94
215	933	2.30
210	927	2.75
205	920	3.27
200	913	3.90
195	905	4.65
190	896	5.55
185	886	6.70
180	874	8.10
175	860	9.80×10^{9}
170	844	1.20×10^{10}
165	825	1.48
160	804	1.85
155	782	2.33
150	759	2.95
145	734	3.75
140	708	4.85
135	680	6.30×10^{10}

Test No. 24

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE AUGUST 28, 1966 GM TIME 18 HRS 30 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 127.00000 F10B 102.00000 AP 5.0000 EXOS TEMP 990.7680 HOUR ANG 23.2267

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.94909-12	629.4	6.02744-03	25.7	21.6	6.21559+10	9.69402+09	2.05198+10	1.97154+07	0.00000
86.	160.	1.36900-12	784.7	3.80861-03	24.8	28.2	2.05546+10	2.82459+09	9.92031+09	1.51185+07	0.00000
97.	180.	6.15674-13	872.8	1.87028-03	23.8	32.9	8.70261+09	1.07394+09	5.79990+09	1.28959+07	0.00000
108.	200.	3.14117-13	923.0	1.05561-03	22.8	36.5	4.11971+09	4.60541+08	3.69334+09	1.11028+07	0.00000
119.	220.	1.72543-13	951.7	6.23244-04	21.9	39.4	2.06630+09	2.10225+08	2.45741+09	9.91159+06	0.00000
130.	240.	9.96016-14	968.2	3.81494-04	21.0	42.1	1.07064+09	9.94047+07	1.67539+09	8.94793+06	0.00000
140.	260.	5.96750-14	977.7	2.40309-04	20.2	44.5	5.65709+08	4.80154+07	1.15875+09	8.12987+06	0.00000
151.	280.	3.68455-14	983.2	1.55023-04	19.4	46.8	3.02697+08	2.35149+07	8.08646+08	7.41491+06	0.00000
162.	300.	2.33394-14	986.3	1.02047-04	18.8	48.9	1.63385+08	1.16276+07	5.67718+08	6.77904+06	0.00000
173.	320.	1.51067-14	988.2	6.83481-05	18.2	50.9	8.87676+07	5.79160+06	4.00296+08	6.20758+06	0.00000
183.	340.	9.96711-15	989.2	4.64656-05	17.6	52.8	4.84833+07	2.90188+06	2.83196+08	5.69075+06	0.00000
194.	360.	6.68495-15	989.9	3.20008-05	17.2	54.5	2.66015+07	1.46148+06	2.00911+08	5.22149+06	0.00000
205.	380.	4.54759-15	990.2	2.22913-05	16.8	56.1	1.48557+07	7.39486+05	1.42887+08	4.79435+06	0.00000
216.	400.	3.13112-15	990.5	1.56871-05	16.4	57.7	8.10550+06	3.75812+05	1.01851+08	4.40491+06	0.00000
227.	420.	2.17861-15	990.6	1.11436-05	16.1	59.3	4.49939+06	1.91794+05	7.27561+07	4.04941+06	0.00000
237.	440.	1.52970-15	990.7	7.98749-06	15.8	60.9	2.50657+06	9.82808+04	5.20799+07	3.72460+06	0.00000
248.	460.	1.08272-15	990.7	5.77578-06	15.4	62.5	1.40128+06	5.05636+04	3.73547+07	3.42760+06	0.00000
259.	480.	7.71905-16	990.7	4.21411-06	15.1	64.4	7.86077+05	2.61164+04	2.68458+07	3.15587+06	0.00000
270.	500.	5.54066-16	990.7	3.10760-06	14.7	66.5	4.42466+05	1.35417+04	1.93310+07	2.90710+06	2.85673+04
281.	520.	4.00245-16	990.8	2.31281-06	14.5	68.9	2.49892+05	7.04856+03	1.39465+07	2.67924+06	2.63545+04
291.	540.	2.90976-16	990.8	1.74025-06	13.8	71.8	1.41601+05	3.68277+03	1.00809+07	2.47041+06	2.41852+04
302.	560.	2.12923-16	990.8	1.32513-06	13.2	75.1	8.05027+04	1.93144+03	7.30051+06	2.27894+06	2.22304+04
313.	580.	1.56082-16	990.8	1.02214-06	12.6	79.1	4.59166+04	1.01673+03	5.29682+06	2.10328+06	2.06899+04
324.	600.	1.16449-16	990.8	7.99420-07	12.0	83.8	2.62743+04	5.37198+02	3.85016+06	1.94206+06	2.81630+04
335.	620.	8.71383-17	990.8	6.34424-07	11.3	89.4	1.50829+04	2.84873+02	2.80374+06	1.79402+06	2.56495+04
345.	640.	6.57892-17	990.8	5.11151-07	10.6	96.0	8.88588+03	1.51615+02	2.04542+06	1.65802+06	2.51490+04
356.	660.	5.01620-17	990.8	4.18183-07	9.9	103.6	5.01777+03	8.09836+01	1.49469+06	1.53301+06	2.46609+04
367.	680.	3.86631-17	990.8	3.47342-07	9.2	112.2	2.90779+03	4.34109+01	1.09449+06	1.41806+06	2.41850+04
378.	700.	3.01539-17	990.8	2.92746-07	8.5	122.0	1.69028+03	2.33527+01	8.02748+05	1.31251+06	2.37210+04
389.	720.	2.38178-17	990.8	2.50152-07	7.8	132.7	9.65563+02	1.26065+01	5.89806+05	1.21498+06	2.32683+04
399.	740.	1.90672-17	990.8	2.16483-07	7.3	144.5	5.76410+02	6.82910+00	4.34103+05	1.12536+06	2.28266+04
410.	760.	1.54779-17	990.8	1.89501-07	6.7	156.5	3.36133+02	3.71217+00	3.20055+05	1.04260+06	2.23961+04
421.	780.	1.27420-17	990.8	1.67572-07	6.3	169.0	1.98850+02	2.02477+00	2.36374+05	9.66702+05	2.19759+04
432.	800.	1.06388-17	990.8	1.49498-07	5.9	181.8	1.17405+02	1.10814+00	1.74888+05	8.96541+05	2.15658+04
443.	820.	9.00342-18	990.8	1.34391-07	5.5	194.8	6.94870+01	6.08520-01	1.29583+05	8.31621+05	2.11656+04
453.	840.	7.71783-18	990.8	1.21598-07	5.2	205.9	4.12467+01	3.35274-01	9.61659+04	7.72095+05	2.07750+04
464.	860.	6.69499-18	990.8	1.10628-07	5.0	217.1	2.45544+01	1.85336-01	7.15141+04	7.16953+05	2.03937+04
475.	880.	5.87084-18	990.8	1.01113-07	4.8	227.6	1.46593+01	1.02788-01	5.32578+04	6.66022+05	2.00214+04
486.	900.	5.19806-18	990.8	9.27755-08	4.6	237.1	8.77677+00	5.71924-02	3.97265+04	6.18961+05	1.96580+04
496.	920.	4.64165-18	990.8	8.54027-08	4.5	245.8	5.26963+00	3.19251-02	2.98809+04	5.75456+05	1.93031+04
507.	940.	4.17542-18	990.8	7.88309-08	4.4	253.6	3.17278+00	1.78778-02	2.22110+04	5.35223+05	1.89564+04
518.	960.	3.77988-18	990.8	7.29327-08	4.3	260.6	1.91559+00	1.00432-02	1.66475+04	4.98001+05	1.86179+04
529.	980.	3.44030-18	990.8	6.76079-08	4.2	266.9	1.15974+00	5.65976-03	1.24971+04	4.63549+05	1.82872+04
540.	1000.	3.14556-18	990.8	6.27787-08	4.1	272.5	7.04053-01	3.19946-03	9.39614+03	4.31649+05	1.79641+04

Reference [4], Test #25.

NASA 18.22

August 28, 1966

04:03 Z

Wallops Is. , Va.

ALTITUDE (Km)	TEMPERATURE (^{o}K)	molecular nitrogen DENSITY (part/cc)
320	797	2.27×10^{7}
315	797	2.76
310	796	3.34
305	796	4.03
300	795	4.90
295	794	5.92
290	793	7.15
285	792	8.70×10^{7}
280	791	1.05×10^{8}
275	790	1.28
270	789	1.55
265	788	1.89
260	787	2.29
255	786	2.79
250	785	3.39
245	784	4.14
240	782	5.01
235	780	6.15
230	778	7.46
225	776	9.10×10^{8}
220	774	1.12×10^{9}
215	772	1.37
210	770	1.68
205	768	2.06
200	766	2.52
195	764	3.10
190	761	3.81
185	757	4.70
180	753	5.81
175	747	7.20
170	741	8.98×10^{9}
165	737	1.12×10^{10}
160	722	1.41
155	711	1.79
150	696	2.28
145	676	2.93
140	653	3.82
135	624	5.18×10^{10}

Test No. 25

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE AUGUST 28, 1966 GM TIME 4 HRS 3 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 130.00000 F10B 103.00000 AP 3.0000 EXOS TEMP 864.3590 HOUR ANG -194.2300

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
68.	120.	2.45946-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
78.	140.	4.03601-12	579.5	7.57223-03	25.7	20.0	6.33572+10	9.79207+09	2.14940+10	2.05820+07	0.00000
86.	160.	1.32202-12	704.5	3.15236-03	24.6	25.6	1.96367+10	2.64022+09	1.01226+10	1.58307+07	0.00000
97.	180.	5.56711-13	774.3	1.52783-03	23.5	29.6	7.68095+09	9.15299+08	5.66496+09	1.32209+07	0.00000
108.	200.	2.66254-13	813.4	8.05064-04	22.4	32.8	3.34227+09	3.56144+08	3.45976+09	1.14604+07	0.00000
119.	220.	1.37633-13	835.5	4.48554-04	21.3	35.6	1.53741+09	1.47162+08	2.19460+09	1.01243+07	0.00000
130.	240.	7.51971-14	847.9	2.60576-04	20.3	38.1	7.29732+08	6.29379+07	1.42454+09	9.03662+06	0.00000
140.	260.	4.28191-14	855.0	1.56496-04	19.5	40.4	3.53017+08	2.74793+07	9.37399+08	8.11338+06	0.00000
151.	280.	2.52569-14	859.0	9.65872-05	18.7	42.5	1.72910+08	1.21629+07	6.22193+08	7.31021+06	0.00000
162.	300.	1.53374-14	861.3	6.09776-05	18.0	44.5	8.54406+07	5.43639+06	4.15417+08	6.60132+06	0.00000
173.	320.	9.54417-15	862.6	3.92328-05	17.4	46.2	4.25057+07	2.44833+06	2.78570+08	5.97026+06	0.00000
183.	340.	6.08206-15	863.3	2.56504-05	17.0	47.9	2.12651+07	1.10963+06	1.87455+08	5.40556+06	0.00000
194.	360.	3.91670-15	863.8	1.70046-05	16.5	49.4	1.06915+07	5.05728+05	1.26520+08	4.89861+06	0.00000
205.	380.	2.56694-15	864.0	1.14136-05	16.2	50.9	5.39991+06	2.31668+05	8.56229+07	4.44255+06	0.00000
216.	400.	1.70267-15	864.2	7.75004-06	15.8	52.4	2.73911+06	1.06666+05	5.80918+07	4.03168+06	0.00000
227.	420.	1.14111-15	864.2	5.32239-06	15.4	54.0	1.39521+06	4.93413+04	3.95080+07	3.66111+06	0.00000
237.	440.	7.71792-16	864.3	3.69793-06	15.0	55.8	7.13566+05	2.29302+04	2.69322+07	3.32659+06	0.00000
248.	460.	5.26423-16	864.3	2.60132-06	14.5	57.9	3.66404+05	1.07049+04	1.84014+07	3.02440+06	0.00000
259.	480.	3.62000-16	864.3	1.85487-06	14.0	60.4	1.88863+05	5.02003+03	1.26011+07	2.75122+06	0.00000
270.	500.	2.51116-16	864.3	1.35116-06	13.4	63.8	9.77490+04	2.36460+03	8.64834+06	2.50412+06	7.19780+04
281.	520.	1.75074-16	864.4	9.96592-07	12.7	67.7	5.07809+04	1.11871+03	5.94854+06	2.28046+06	7.17173+04
291.	540.	1.24081-16	864.4	7.48759-07	11.9	72.4	2.64814+04	5.31573+02	4.10046+06	2.07791+06	7.00691+04
302.	560.	8.85849-17	864.4	5.73860-07	11.1	78.2	1.38617+04	2.53676+02	2.83263+06	1.89436+06	6.84679+04
313.	580.	6.40137-17	864.4	4.49019-07	10.2	85.2	7.28311+03	1.21577+02	1.96099+06	1.72798+06	6.69122+04
324.	600.	4.66949-17	864.4	3.58755-07	9.4	93.4	3.84082+03	5.85137+01	1.36044+06	1.57702+06	6.54004+04
335.	620.	3.48839-17	864.4	2.92538-07	8.6	103.0	2.03294+03	2.82805+01	9.45788+05	1.44002+06	6.39312+04
345.	640.	2.63902-17	864.4	2.43175-07	7.8	113.8	1.07995+03	1.37253+01	6.58887+05	1.31959+06	6.25031+04
356.	660.	2.03300-17	864.4	2.05725-07	7.1	125.7	5.75772+02	6.66876+00	4.59963+05	1.20254+06	6.11148+04
367.	680.	1.59619-17	864.4	1.76778-07	6.5	138.4	3.08070+02	3.27299+00	3.21753+05	1.09976+06	5.97649+04
378.	700.	1.27765-17	864.4	1.53969-07	6.0	151.4	1.65420+02	1.60806+00	2.25529+05	1.00828+06	5.84522+04
389.	720.	1.04230-17	864.4	1.35647-07	5.5	164.4	8.91361+01	7.93242-01	1.58399+05	9.21206+05	5.71756+04
399.	740.	8.65830-18	864.4	1.20652-07	5.2	177.1	4.81964+01	3.92861-01	1.11473+05	8.43744+05	5.59338+04
410.	760.	7.31369-18	864.4	1.08164-07	4.9	189.0	2.61524+01	1.95338-01	7.86036+04	7.73178+05	5.47257+04
421.	780.	6.27140-18	864.4	9.75958-08	4.6	200.0	1.42390+01	9.75070-02	5.55391+04	7.08860+05	5.35503+04
432.	800.	5.44689-18	864.4	8.85248-08	4.4	210.0	7.77898+00	4.88620-02	3.93129+04	6.50208+05	5.24064+04
443.	820.	4.78738-18	864.4	8.06430-08	4.3	218.9	4.28412+00	2.45798-02	2.78830+04	5.96696+05	5.12932+04
453.	840.	4.24744-18	864.4	7.37226-08	4.1	226.8	2.34524+00	1.24121-02	1.98140+04	5.47850+05	5.02096+04
464.	860.	3.79785-18	864.4	6.75930-08	4.0	233.9	1.29415+00	6.29153-03	1.41068+04	5.03240+05	4.91547+04
475.	880.	3.41805-18	864.4	6.21244-08	4.0	240.2	7.16488-01	3.20109-03	1.00623+04	4.62460+05	4.81277+04
486.	900.	3.09270-18	864.4	5.72166-08	3.9	245.8	3.97968-01	1.63477-03	7.19083+03	4.25220+05	4.71275+04
496.	920.	2.81054-18	864.4	5.27906-08	3.8	250.9	2.21764-01	8.37956-04	5.14826+03	3.91141+05	4.61538+04
507.	940.	2.56325-18	864.4	4.87832-08	3.8	255.7	1.23973-01	4.31098-04	3.69265+03	3.59959+05	4.52048+04
518.	960.	2.34457-18	864.4	4.51429-08	3.7	260.1	6.95254-02	2.22592-04	2.65341+03	3.31413+05	4.42806+04
529.	980.	2.14973-18	864.4	4.18273-08	3.7	264.3	3.91137-02	1.15347-04	1.91009+03	3.05268+05	4.33802+04
540.	1000.	1.97505-18	864.4	3.88007-08	3.7	268.3	2.20736-02	5.99870-05	1.37746+03	2.81312+05	4.25029+04

Reference [4], Test #26.

ALTITUDE (Km)	molecular nitrogen DENSITY (part/cc)
130	9.30×10^{10}
131	8.59
132	7.87
133	7.39
134	6.88
135	6.46
136	6.09
137	5.75
138	5.54
139	5.29
140	4.95
141	4.70
142	4.55
143	4.31
144	4.12
145	3.95
146	3.74
147	3.61
148	3.44
149	3.24
150	3.11
151	2.94
152	2.78
153	2.59
154	2.45
155	2.34×10^{10}
207	3.46×10^{9}
208	3.28
209	3.14
210	3.04
211	2.89
212	2.75
213	2.63
214	2.50
215	2.38
216	2.26
217	2.14
218	2.04
219	1.94
220	1.83
221	1.72
222	1.45
223	1.43×10^{9}

Test No. 26

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE AUGUST 28, 1966 GM TIME 18 HRS 51 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 187.00000 F10B 102.00000 AP 3.0000 EXOS TEMP 992.1975 HOUR ANG 28.2404

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(NE)	N(OE)	N(O)	N(HE)	N(H)
95.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.94816-12	630.0	8.03200-03	25.7	21.7	6.21427+10	9.69263+09	2.05101+10	1.97068+07	0.00000
86.	160.	1.36940-12	785.5	3.61332-03	24.8	28.3	2.05625+10	2.82628+09	9.91766+09	1.51113+07	0.00000
97.	180.	6.16232-13	873.9	1.88204-03	23.8	32.9	8.71243+09	1.07551+09	5.80058+09	1.26903+07	0.00000
108.	200.	3.14597-13	924.3	1.05840-03	22.8	36.5	4.12765+09	4.61642+08	3.69534+09	1.10988+07	0.00000
119.	220.	1.72910-13	953.0	6.25252-04	21.9	39.5	2.07200+09	2.10928+08	2.45985+09	9.90894+06	0.00000
130.	240.	9.98691-14	969.6	3.82926-04	21.0	42.1	1.07450+09	9.98343+07	1.67784+09	8.94649+06	0.00000
140.	260.	5.98659-14	979.1	2.41328-04	20.2	44.5	5.68236+08	4.82703+07	1.16100+09	8.12948+06	0.00000
151.	280.	3.69805-14	984.6	1.55750-04	19.4	46.8	3.04312+08	2.36631+07	8.10614+08	7.41541+06	0.00000
162.	300.	2.34311-14	987.7	1.02569-04	18.8	48.9	1.64398+08	1.17125+07	5.69380+08	6.78032+06	0.00000
173.	320.	1.51748-14	989.6	6.87257-05	18.2	50.9	8.93955+07	5.83963+06	4.01665+08	6.20950+06	0.00000
183.	340.	1.00159-14	990.7	4.67405-05	17.7	52.8	4.88683+07	2.92883+06	2.84304+08	5.69320+06	0.00000
194.	360.	6.72018-15	991.3	3.22024-05	17.2	54.5	2.68358+07	1.47650+06	2.01796+08	5.22437+06	0.00000
205.	380.	4.57302-15	991.7	2.24401-05	16.8	56.2	1.47974+07	7.47819+05	1.43586+08	4.79758+06	0.00000
216.	400.	3.14992-15	991.9	1.57976-05	16.4	57.8	8.19086+06	3.80416+05	1.02399+08	4.40841+06	0.00000
227.	420.	2.19249-15	992.0	1.12262-05	16.1	59.3	4.55062+06	1.94331+05	7.31831+07	4.05312+06	0.00000
237.	440.	1.54001-15	992.1	8.04924-06	15.8	60.9	2.53725+06	9.96772+04	5.24108+07	3.72846+06	0.00000
248.	460.	1.09042-15	992.1	5.82224-06	15.5	62.6	1.41962+06	5.13311+04	3.76100+07	3.43156+06	0.00000
259.	480.	7.77678-16	992.2	4.24919-06	15.1	64.4	7.97028+05	2.65361+04	2.70422+07	3.15989+06	0.00000
270.	500.	5.58409-16	992.2	3.13415-06	14.7	66.6	4.49001+05	1.37734+04	1.94816+07	2.91115+06	2.83033+04
281.	520.	4.03921-16	992.2	2.33300-06	14.3	69.0	2.53791+05	7.17588+03	1.40617+07	2.68329+06	2.60925+04
291.	540.	2.93493-16	992.2	1.75566-06	13.8	71.8	1.43929+05	3.75280+03	1.01690+07	2.47443+06	2.75292+04
302.	560.	2.14801-16	992.2	1.33695-06	13.3	75.1	8.18924+04	1.97000+03	7.36771+06	2.28291+06	2.69804+04
313.	580.	1.58308-16	992.2	1.03125-06	12.7	79.1	4.67470+04	1.03799+03	5.34805+06	2.10719+06	2.64455+04
324.	600.	1.17534-16	992.2	8.06481-07	12.0	83.8	2.67710+04	5.48934+02	3.88918+06	1.94590+06	2.59243+04
335.	620.	8.79661-17	992.2	6.39932-07	11.3	89.3	1.53803+04	2.91362+02	2.83345+06	1.79777+06	2.54162+04
345.	640.	6.64222-17	992.2	5.15480-07	10.6	95.9	8.86422+03	1.55210+02	2.06804+06	1.66167+06	2.49209+04
356.	660.	5.06474-17	992.2	4.21614-07	9.9	103.4	5.12485+03	8.29786+01	1.51210+06	1.53656+06	2.44380+04
367.	680.	3.90368-17	992.2	3.50088-07	9.2	112.0	2.97217+03	4.45203+01	1.10759+06	1.42151+06	2.39671+04
378.	700.	3.04424-17	992.2	2.94967-07	8.5	121.7	1.72905+03	2.39708+01	8.12718+05	1.31569+06	2.35078+04
389.	720.	2.40416-17	992.2	2.51966-07	7.9	132.4	1.00896+03	1.29517+01	5.97396+05	1.21621+06	2.30599+04
399.	740.	1.92417-17	992.2	2.17986-07	7.3	144.0	5.90548+02	7.02231+00	4.39884+05	1.12047+06	2.26230+04
410.	760.	1.56149-17	992.2	1.90762-07	6.8	156.1	3.48693+02	3.82055+00	3.24460+05	1.04579+06	2.21967+04
421.	780.	1.28511-17	992.2	1.68643-07	6.3	168.6	2.04142+02	2.08571+00	2.39731+05	9.69506+05	2.17808+04
432.	800.	1.07251-17	992.2	1.50418-07	5.9	181.2	1.20560+02	1.14248+00	1.77428+05	8.99313+05	2.13749+04
443.	820.	9.0272?-18	992.2	1.35192-07	5.5	193.6	7.14087+01	6.27919-01	1.31538+05	8.34483+05	2.09789+04
453.	840.	7.77418-18	992.2	1.22303-07	5.2	205.6	4.24192+01	3.46260-01	9.76786+04	7.74649+05	2.05922+04
464.	860.	6.74128-18	992.2	1.11255-07	5.0	216.9	2.52713+01	1.91573-01	7.26549+04	7.19401+05	2.02148+04
475.	880.	5.90931-18	992.2	1.01676-07	4.8	227.4	1.50986+01	1.06337-01	5.41304+04	6.68367+05	1.98464+04
486.	900.	5.23045-18	992.2	9.32649-08	4.6	237.0	9.04641+00	5.92171-02	4.03944+04	6.21206+05	1.94868+04
496.	920.	4.66923-18	992.2	8.58672-08	4.5	245.7	5.43551+00	3.30831-02	3.01926+04	5.77604+05	1.91353+04
507.	940.	4.19922-18	992.2	7.92572-08	4.4	253.6	3.27505+00	1.85418-02	2.26034+04	5.37277+05	1.87922+04
518.	960.	3.80064-18	992.2	7.33260-08	4.3	260.6	1.97878+00	1.04249-02	1.69486+04	4.99964+05	1.84570+04
529.	980.	3.45863-18	992.2	6.79724-08	4.2	266.9	1.19886+00	5.87968-03	1.27284+04	4.65424+05	1.81297+04
540.	1000.	3.16192-18	992.2	6.31158-08	4.1	272.6	7.28326-01	3.32651-03	9.57398+03	4.33439+05	1.78098+04

Reference [10], Test #27.

Altitude, km	$\rho(N_2)$, g cm^{-3}		$n(N_2)$, particles cm^{-3}		T_{N_2}, °K	T_e, °K		N_e, No. cm^{-3}	
	Upleg	Downleg	Upleg	Downleg	Downleg	Upleg	Downleg	Upleg	Downleg
110									4.00 + 3
120								6.40 + 3	4.10 + 3
130								6.00 + 3	4.25 + 3
140								5.80 + 3	5.20 + 3
150	4.40 − 13	4.40 − 13	9.38 + 9	9.38 + 9	608			6.20 + 3	6.00 + 3
160	2.41 − 13	2.38 − 13	5.14 + 9	5.08 + 9	638			7.80 + 3	7.20 + 3
170	1.41 − 13	1.40 − 13	3.01 + 9	2.99 + 9	649			1.08 + 4	8.70 + 3
180	8.57 − 14	8.35 − 14	1.83 + 9	1.78 + 9	655	816		1.55 + 4	1.20 + 4
190	5.16 − 14	5.08 − 14	1.10 + 9	1.08 + 9	657	786		2.40 + 4	1.95 + 4
200	3.19 − 14	3.15 − 14	6.80 + 8	6.72 + 8	657	776	833	4.20 + 4	3.65 + 4
210		1.94 − 14		4.14 + 8	657	774	838	6.60 + 4	5.60 + 4
220		1.22 − 14		2.60 + 8	657	772	858	8.20 + 4	7.80 + 4
230					657	772	892	9.50 + 4	9.30 + 4
240						784	912	1.06 + 5	1.00 + 5
250						812	924	1.10 + 5	1.00 + 5
260						843	948	1.10 + 5	1.00 + 5
270						872	1000	1.05 + 5	1.00 + 5
280						910	1072	1.00 + 5	9.70 + 4
290						963	1144	9.60 + 4	9.40 + 4
300						1047	1160	8.80 + 4	9.00 + 4

Test No. 27

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE JANUARY 29, 1964 GM TIME 3 HRS 0 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 70.00000 F10B 70.00000 AP 20.0000 EXOS TEMP 766.6490 HOUR ANG -210.8260

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
89.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	4.10332-12	537.7	7.16421-03	25.6	18.6	6.42777+10	9.84891+09	2.23786+10	2.13907+07	0.00000
86.	160.	1.26860-12	639.2	2.76590-03	24.4	23.4	1.86359+10	2.45242+09	1.02417+10	1.64744+07	0.00000
97.	180.	4.99852-13	695.9	1.25045-03	23.1	27.0	6.71807+09	7.73493+08	5.51272+09	1.36630+07	0.00000
108.	200.	2.24292-13	727.6	6.19528-04	21.9	30.0	2.68308+09	2.72668+08	3.20108+09	1.17266+07	0.00000
119.	220.	1.09429-13	745.4	3.26931-04	20.7	32.6	1.13120+09	1.01974+08	1.93398+09	1.02440+07	0.00000
130.	240.	5.67557-14	755.4	1.80952-04	19.7	35.0	4.91933+08	3.94478+07	1.19485+09	9.03602+06	0.00000
140.	260.	3.08875-14	761.1	1.03994-04	18.8	37.2	2.18050+08	1.55833+07	7.48176+08	8.01518+06	0.00000
151.	280.	1.74797-14	764.3	6.15975-05	18.0	39.2	9.78848+07	6.24294+06	4.72552+08	7.13390+06	0.00000
162.	300.	1.02129-14	766.2	3.73677-05	17.4	40.9	4.43461+07	2.52671+06	3.00270+08	6.36350+06	0.00000
173.	320.	6.12362-15	767.2	2.31536-05	16.9	42.5	2.02359+07	1.03094+06	1.91669+08	5.68500+06	0.00000
183.	340.	3.74974-15	767.8	1.45845-05	16.4	44.0	9.29034+06	4.23536+05	1.22804+08	5.08470+06	0.00000
194.	360.	2.33541-15	768.2	9.32633-06	16.0	45.5	4.28843+06	1.75075+05	7.89369+07	4.55208+06	0.00000
205.	380.	1.47907-15	768.4	6.04907-06	15.6	47.0	1.98955+06	7.27860+04	5.08904+07	4.07854+06	0.00000
216.	400.	9.42850-16	768.5	3.97972-06	15.1	48.6	9.27473+05	3.04265+04	3.29007+07	3.65697+06	0.00000
227.	420.	6.09117-16	768.6	2.65822-06	14.6	50.6	4.34378+05	1.27868+04	2.13276+07	3.28127+06	0.00000
237.	440.	3.97513-16	768.6	1.80550-06	14.1	52.9	2.04368+05	5.40170+03	1.38616+07	2.94612+06	0.00000
248.	460.	2.62086-16	768.6	1.24966-06	13.4	55.9	9.65826+04	2.29360+03	9.03236+06	2.64693+06	0.00000
259.	480.	1.74700-16	768.6	8.83501-07	12.6	59.6	4.58462+04	9.78602+02	5.90046+06	2.37964+06	0.00000
270.	500.	1.18188-16	768.6	6.57644-07	11.5	66.0	2.18576+04	4.19796+02	3.86416+06	2.14066+06	1.71064+05
281.	520.	8.09538-17	768.6	4.92902-07	10.5	72.6	1.04659+04	1.80936+02	2.53686+06	1.92691+06	1.71064+05
291.	540.	5.63822-17	768.6	3.79519-07	9.5	80.8	5.03281+03	7.83669+01	1.66955+06	1.73555+06	1.66654+05
302.	560.	4.00241-17	768.6	3.00318-07	8.5	90.6	2.43043+03	3.41071+01	1.10143+06	1.56414+06	1.62377+05
313.	580.	2.90296-17	768.6	2.43860-07	7.6	102.0	1.17864+03	1.49156+01	7.28574+05	1.41050+06	1.58234+05
324.	600.	2.15576-17	768.6	2.02695-07	6.8	114.8	5.73964+02	6.55396+00	4.82620+05	1.27272+06	1.54220+05
335.	620.	1.64131-17	768.6	1.71940-07	6.1	128.7	2.80660+02	2.89343+00	3.20804+05	1.14907+06	1.50330+05
345.	640.	1.28170-17	768.6	1.48375-07	5.5	143.0	1.37801+02	1.28338+00	2.13654+05	1.03804+06	1.46559+05
356.	660.	1.02586-17	768.6	1.29858-07	5.0	157.3	6.79341+01	5.71883-01	1.42822+05	9.38280+05	1.42903+05
367.	680.	8.40207-18	768.6	1.14935-07	4.7	170.9	3.36255+01	2.56010-01	9.54248+04	8.48596+05	1.39358+05
378.	700.	7.02503-18	768.6	1.02693-07	4.4	183.7	1.67101+01	1.15129-01	6.39919+04	7.67922+05	1.35921+05
389.	720.	5.97964-18	768.6	9.24078-08	4.1	195.3	8.33696+00	5.20063-02	4.30100+04	6.95309+05	1.32587+05
399.	740.	5.18707-18	768.6	8.36363-08	3.9	205.7	4.17578+00	2.35997-02	2.89725+04	6.29915+05	1.29354+05
410.	760.	4.52050-18	768.6	7.60321-08	3.8	215.0	2.09969+00	1.07585-02	1.95600+04	5.70989+05	1.26216+05
421.	780.	3.99461-18	768.6	6.94205-08	3.7	223.3	1.05985+00	4.92431-03	1.32345+04	5.17860+05	1.23172+05
432.	800.	3.55828-18	768.6	6.39695-08	3.6	230.9	5.37028-01	2.26422-03	8.97412+03	4.69930+05	1.20217+05
443.	820.	3.18986-18	768.6	5.93697-08	3.5	237.8	2.73145-01	1.04561-03	6.09843+03	4.26666+05	1.17349+05
453.	840.	2.87413-18	768.6	5.53722-08	3.4	244.3	1.39451-01	4.84941-04	4.15315+03	3.87597+05	1.14569+05
464.	860.	2.60016-18	768.6	4.95493-08	3.4	250.4	7.14608-02	2.25869-04	2.83440+03	3.52290+05	1.11862+05
475.	880.	2.36007-18	768.6	4.57888-08	3.3	256.4	3.67552-02	1.05647-04	1.93848+03	3.20369+05	1.09237+05
486.	900.	2.14790-18	768.6	4.23897-08	3.2	262.2	1.89741-02	4.96224-05	1.32655+03	2.91493+05	1.06688+05
496.	920.	1.95920-18	768.6	3.93097-08	3.2	268.1	9.83068-03	2.34047-05	9.12398+02	2.65356+05	1.04212+05
507.	940.	1.79050-18	768.6	3.65130-08	3.1	274.0	5.11176-03	1.10845-05	6.27901+02	2.41690+05	1.01806+05
518.	960.	1.63905-18	768.6	3.39689-08	3.1	279.9	2.66753-03	5.27113-06	4.32997+02	2.20249+05	9.94643+04
529.	980.	1.50264-18	768.6	3.16511-08	3.0	286.1	1.39698-03	2.51682-06	2.99198+02	2.00805+05	9.71968+04
540.	1000.	1.37945-18	768.6	2.95362-08	3.0	292.4	7.34169-04	1.20655-06	2.07160+02	1.83173+05	9.49891+04

Test #28
Reference #11

Alt	N_2	O_2	O	ρ
156	-	3.5×10^{9}	-	-
200	3×10^{9}	2.5×10^{8}	8×10^{9}	5×10^{-13}
250	6×10^{8}	1.5×10^{7}	3×10^{9}	8.5×10^{-14}
300	8.5×10^{7}	2.0×10^{6}	9×10^{8}	4×10^{-14}
320	5×10^{7}	7.5×10^{5}	7×10^{8}	2.5×10^{-14}
350	1×10^{7}	2.5×10^{5}	4×10^{8}	8×10^{-15}
400	2×10^{6}	3.0×10^{4}	1×10^{8}	4×10^{-15}

Test No. 28

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE MARCH 19, 1967 GM TIME 12 HRS 0 MINS LAT 32.00000 DEGS LONG -107.00000 DEGS

F10 137.00000 F10B 149.00000 AP 20.0000 EXOS TEMP 1009.0589 HOUR ANG -107.9484

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.93727-12	636.0	8.08471-03	25.8	21.9	6.19892+10	9.67871+09	2.03972+10	1.96081+07	0.00000
86.	160.	1.57382-12	795.6	3.66817-03	24.8	28.6	2.06524+10	2.84554+09	9.68876+09	1.50276+07	0.00000
97.	180.	6.22635-13	886.5	1.92598-03	23.8	33.3	8.82531+09	1.09367+09	5.80781+09	1.26257+07	0.00000
108.	200.	3.20155-13	936.4	1.09112-03	22.9	37.0	4.21970+09	4.74455+08	3.71790+09	1.10516+07	0.00000
119.	220.	1.77183-13	968.2	6.48951-04	22.0	40.0	2.13853+09	2.19180+08	2.48778+09	9.87747+06	0.00000
130.	240.	1.02999-13	985.4	3.99878-04	21.1	42.6	1.11990+09	1.04911+08	1.70611+09	8.92688+06	0.00000
140.	260.	6.21109-14	995.3	2.53438-04	20.3	45.1	5.98135+08	5.13039+07	1.18714+09	8.12400+06	0.00000
151.	280.	3.85775-14	1001.0	1.64425-04	19.5	47.4	3.23535+08	2.54392+07	8.33547+08	7.42042+06	0.00000
162.	300.	2.45663-14	1004.3	1.08817-04	18.9	49.5	1.76540+08	1.27365+07	5.88818+08	6.79427+06	0.00000
173.	320.	1.59648-14	1006.3	7.32551-05	18.3	51.5	9.69629+07	6.42326+06	4.17747+08	6.23098+06	0.00000
183.	340.	1.05977-14	1007.4	5.00480-05	17.7	53.4	5.35367+07	3.25853+06	2.97375+08	5.72093+06	0.00000
194.	360.	7.14130-15	1008.1	3.46342-05	17.3	55.2	2.96933+07	1.66149+06	2.12274+08	5.25722+06	0.00000
205.	380.	4.88031-15	1008.5	2.42394-05	16.9	56.9	1.65361+07	8.51095+05	1.51898+08	4.83454+06	0.00000
216.	400.	3.37905-15	1008.7	1.71364-05	16.5	58.5	9.24391+06	4.37858+05	1.08938+08	4.44861+06	0.00000
227.	420.	2.35974-15	1008.9	1.22275-05	16.2	60.0	5.18627+06	2.26196+05	7.82933+07	4.09560+06	0.00000
237.	440.	1.66496-15	1008.9	8.80126-06	15.9	61.6	2.91999+06	1.17321+05	5.63857+07	3.77296+06	0.00000
248.	460.	1.18365-15	1009.0	6.38933-06	15.5	63.3	1.64969+06	6.10907+04	4.06857+07	3.47733+06	0.00000
259.	480.	8.47724-16	1009.0	4.67840-06	15.2	65.1	9.35172+05	3.19338+04	2.94153+07	3.20645+06	0.00000
270.	500.	6.11226-16	1009.0	3.45965-06	14.8	67.1	5.31899+05	1.67564+04	2.13076+07	2.95809+06	2.54109+04
281.	520.	4.43465-16	1009.0	2.58123-06	14.4	69.5	3.03528+05	8.82562+03	1.54638+07	2.73027+06	2.52242+04
291.	540.	3.23737-16	1009.0	1.94558-06	14.0	72.1	1.73774+05	4.66383+03	1.12436+07	2.52117+06	2.47268+04
302.	560.	2.37810-16	1009.1	1.48287-06	13.5	75.3	9.98097+04	2.47561+03	8.19028+06	2.32916+06	2.42420+04
313.	580.	1.75827-16	1009.1	1.14391-06	12.9	79.0	5.75111+04	1.31654+03	5.97704+06	2.15276+06	2.37894+04
324.	600.	1.30901-16	1009.1	8.93919-07	12.3	83.4	3.32436+04	7.04763+02	4.36979+06	1.99063+06	2.33086+04
335.	620.	9.81867-17	1009.1	7.08225-07	11.6	88.6	1.92766+04	3.78054+02	3.20049+06	1.84153+06	2.28594+04
345.	640.	7.42556-17	1009.1	5.69202-07	10.9	94.7	1.12126+04	2.03522+02	2.34825+06	1.70436+06	2.24213+04
356.	660.	5.66674-17	1009.1	4.64219-07	10.2	101.8	6.54216+03	1.09951+02	1.72599+06	1.57810+06	2.19940+04
367.	680.	4.36773-17	1009.1	3.84184-07	9.5	109.9	3.82885+03	5.96090+01	1.27065+06	1.46163+06	2.15772+04
378.	700.	3.40328-17	1009.1	3.22531-07	8.9	119.1	2.24768+03	3.24287+01	9.37354+05	1.35472+06	2.11706+04
389.	720.	2.68313-17	1009.1	2.74497-07	8.2	129.3	1.32345+03	1.77028+01	6.92564+05	1.25600+06	2.07739+04
399.	740.	2.14200-17	1009.1	2.38615-07	7.6	140.4	7.81586+02	9.69697+00	5.12574+05	1.16497+06	2.03868+04
410.	760.	1.73257-17	1009.1	2.08355-07	7.0	152.2	4.62948+02	5.32966+00	3.80004+05	1.08099+06	2.00090+04
421.	780.	1.42038-17	1009.1	1.81857-07	6.6	164.5	2.75019+02	2.93914+00	2.82195+05	1.00349+06	1.96403+04
432.	800.	1.18029-17	1009.1	1.61755-07	6.1	177.1	1.63654+02	1.62624+00	2.09909+05	9.31927+05	1.92804+04
443.	820.	9.93903-18	1009.1	1.45037-07	5.8	189.6	9.79049+01	9.02780-01	1.56398+05	8.65828+05	1.89290+04
453.	840.	8.47716-18	1009.1	1.30948-07	5.4	201.9	5.86672+01	5.02806-01	1.16718+05	8.04746+05	1.85860+04
464.	860.	7.31780-18	1009.1	1.18928-07	5.2	213.6	3.52549+01	2.80949-01	8.72474+04	7.48276+05	1.82510+04
475.	880.	6.38749-18	1009.1	1.08552-07	4.9	224.6	2.12454+01	1.57489-01	6.53227+04	6.96049+05	1.79238+04
486.	900.	5.63179-18	1009.1	9.94992-08	4.7	234.7	1.28388+01	8.85648-02	4.89857+04	6.47726+05	1.76043+04
496.	920.	5.01018-18	1009.1	9.15262-08	4.6	244.1	7.78009+00	4.99626-02	3.67927+04	6.02996+05	1.72921+04
507.	940.	4.49241-18	1009.1	8.44441-08	4.5	252.5	4.72757+00	2.82743-02	2.76780+04	5.61575+05	1.69872+04
518.	960.	4.05578-18	1009.1	7.81070-08	4.4	260.1	2.88054+00	1.60506-02	2.08537+04	5.23203+05	1.66893+04
529.	980.	3.68318-18	1009.1	7.24000-08	4.3	267.0	1.75988+00	9.13964-03	1.57363+04	4.87641+05	1.63982+04
540.	1000.	3.36168-18	1009.1	6.72324-08	4.2	273.1	1.07809+00	5.22033-03	1.18929+04	4.54670+05	1.61137+04

Test #29
Reference #11

Alt	N_2	O_2	O	ρ
156	-	1.0×10^{9}	-	-
200	3.5×10^{9}	2.0×10^{8}	9.0×10^{9}	5.0×10^{-13}
250	6.5×10^{8}	2.5×10^{7}	4.0×10^{9}	1.0×10^{-13}
300	1.5×10^{8}	3.5×10^{6}	1.5×10^{9}	6.0×10^{-14}
320	8.0×10^{7}	1.5×10^{6}	9.5×10^{8}	4.0×10^{-14}
350	4.5×10^{7}	8.0×10^{5}	8.5×10^{8}	2.0×10^{-14}
400	8.0×10^{6}	2.0×10^{5}	4.0×10^{8}	7.5×10^{-15}

Test No. 29

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE MARCH 19, 1967 GM TIME 13 HRS 0 MINS LAT -20.00000 DEGS LONG 82.00000 DEGS

F10 137.00000 F10B 149.00000 AP 22.0000 EXOS TEMP 1176.5750 HOUR ANG -263.8073

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.84141-12	687.4	8.50653-03	25.8	23.6	6.06124+10	9.53869+09	1.94777+10	1.88195+07	0.00000
86.	160.	1.39933-12	884.4	4.12700-03	24.9	31.6	2.12155+10	2.97909+09	9.59661+09	1.43274+07	0.00000
97.	180.	6.69124-13	1001.5	2.31122-03	24.1	37.2	9.66542+09	1.23478+09	5.80388+09	1.20526+07	0.00000
108.	200.	3.63952-13	1071.3	1.39129-03	23.3	41.5	4.98182+09	5.81869+08	3.85342+09	1.06036+07	0.00000
119.	220.	2.12989-13	1113.1	8.75686-04	22.5	44.9	2.71198+09	2.93335+08	2.68415+09	9.54723+06	0.00000
130.	240.	1.30663-13	1138.2	5.66787-04	21.7	47.6	1.53630+09	1.53701+08	1.92144+09	8.70774+06	0.00000
140.	260.	8.29055-14	1153.3	3.78570-04	21.0	50.4	8.89405+08	8.24534+07	1.39808+09	8.00216+06	0.00000
151.	280.	5.40003-14	1162.4	2.57084-04	20.3	52.9	5.22135+08	4.49092+07	1.02774+09	7.36749+06	0.00000
162.	300.	3.59442-14	1167.9	1.77609-04	19.7	55.2	3.09450+08	2.47161+07	7.60640+08	6.83972+06	0.00000
173.	320.	2.43767-14	1171.3	1.24553-04	19.1	57.5	1.84668+08	1.57066+07	5.65629+08	6.34459+06	0.00000
183.	340.	1.68060-14	1173.3	8.85041-05	18.5	59.6	1.10793+08	7.64651+06	4.22104+08	5.89302+06	0.00000
194.	360.	1.17972-14	1174.6	6.36253-05	18.0	61.6	6.67648+07	4.28687+06	3.15883+08	5.47885+06	0.00000
205.	380.	8.33276-15	1175.3	4.62156-05	17.6	63.5	4.03876+07	2.41377+06	2.36953+08	5.09760+06	0.00000
216.	400.	5.97436-15	1175.8	3.36813-05	17.2	65.3	2.45166+07	1.36446+06	1.78119+08	4.74582+06	0.00000
227.	420.	4.32790-15	1176.1	2.50466-05	16.9	67.1	1.49309+07	7.74168+05	1.34151+08	4.42071+06	0.00000
237.	440.	3.16312-15	1176.3	1.86970-05	16.6	68.7	9.12137+06	4.40803+05	1.01219+08	4.11988+06	0.00000
248.	460.	2.33069-15	1176.4	1.39959-05	16.3	70.4	5.58909+06	2.51851+05	7.65055+07	3.84128+06	0.00000
259.	480.	1.72957-15	1176.5	1.05699-05	16.0	72.1	3.43477+06	1.44377+05	5.79239+07	3.58309+06	0.00000
270.	500.	1.29179-15	1176.5	8.03606-06	15.7	73.8	2.11694+06	8.30391+04	4.39281+07	3.34366+06	1.01266+04
281.	520.	9.70368-16	1176.5	6.14817-06	15.4	75.6	1.30844+06	4.79156+04	3.33683+07	3.12153+06	1.01136+04
291.	540.	7.32843-16	1176.5	4.73456-06	15.1	77.5	8.10991+05	2.77374+04	2.53878+07	2.91533+06	9.94233+03
302.	560.	5.56239-16	1176.6	3.67058-06	14.8	79.7	5.04064+05	1.61076+04	1.93467+07	2.72384+06	9.77492+03
313.	580.	4.24213-16	1176.6	2.86583-06	14.5	82.0	3.14159+05	9.38342+03	1.47662+07	2.54593+06	9.61127+03
324.	600.	3.25044-16	1176.6	2.25424-06	14.1	84.7	1.96334+05	5.48331+03	1.12878+07	2.38057+06	9.45127+03
335.	620.	2.50225-16	1176.6	1.78727-06	13.7	87.7	1.23030+05	3.21413+03	8.64211+06	2.22681+06	9.29483+03
345.	640.	1.93540-16	1176.6	1.42904-06	13.3	91.2	7.75021+04	1.88977+03	6.62663+06	2.08377+06	9.14184+03
356.	660.	1.50491-16	1176.6	1.15288-06	12.8	95.2	4.86991+04	1.11448+03	5.08890+06	1.95067+06	8.99222+03
367.	680.	1.17562-16	1176.6	9.38699-07	12.3	99.8	3.07604+04	6.59233+02	3.91388+06	1.82675+06	8.84588+03
378.	700.	9.23730-17	1176.6	7.72209-07	11.7	105.0	1.94802+04	3.91110+02	3.01465+06	1.71134+06	8.70273+03
389.	720.	7.30148-17	1176.6	6.41606-07	11.1	111.0	1.23665+04	2.32723+02	2.32545+06	1.60381+06	8.56266+03
399.	740.	5.80847-17	1176.6	5.38643-07	10.6	117.8	7.87322+03	1.38884+02	1.79844+06	1.50359+06	8.42566+03
410.	760.	4.65279-17	1176.6	4.58926-07	10.0	125.5	5.02447+03	8.31234+01	1.38979+06	1.41015+06	8.29158+03
421.	780.	3.73484-17	1176.6	3.91605-07	9.4	134.0	3.21458+03	4.98936+01	1.07674+06	1.32298+06	8.16037+03
432.	800.	3.03433-17	1176.6	3.38986-07	8.8	143.4	2.06176+03	3.00335+01	8.35391+05	1.24165+06	8.03196+03
443.	820.	2.50552-17	1176.6	2.96250-07	8.3	153.7	1.32565+03	1.81299+01	6.49060+05	1.16573+06	7.90626+03
453.	840.	2.07356-17	1176.6	2.61240-07	7.8	164.8	8.54446+02	1.09749+01	5.04997+05	1.09484+06	7.78321+03
464.	860.	1.73188-17	1176.6	2.32299-07	7.3	176.3	5.52075+02	6.66220+00	3.93456+05	1.02861+06	7.66274+03
475.	880.	1.46017-17	1176.6	2.08151-07	6.9	188.4	3.57570+02	4.05538+00	3.06975+05	9.66724+05	7.54479+03
486.	900.	1.24281-17	1176.6	1.87811-07	6.5	200.8	2.32147+02	2.47534+00	2.39831+05	9.08872+05	7.42929+03
496.	920.	1.06783-17	1176.6	1.70514-07	6.1	213.3	1.51076+02	1.51501+00	1.87627+05	8.54773+05	7.31618+03
507.	940.	9.26013-18	1176.6	1.55666-07	5.8	225.8	9.85490+01	9.29747-01	1.46984+05	8.04163+05	7.20539+03
518.	960.	8.10231-18	1176.6	1.42805-07	5.6	238.1	6.44351+01	5.72103-01	1.15299+05	7.56803+05	7.09688+03
529.	980.	7.14974-18	1176.6	1.31566-07	5.3	249.9	4.22278+01	3.52986-01	9.05636+04	7.12468+05	6.99057+03
540.	1000.	6.35967-18	1176.6	1.21665-07	5.1	261.2	2.77379+01	2.18339-01	7.12284+04	6.70950+05	6.88643+03

Test #30
Reference #12

Alt	ρ	ALT.	N_2
150	9.0×10^{-13}	150	2.0×10^{10}
200	9.0×10^{-14}	160	1.2×10^{10}
250	1.2×10^{-14}	180	4.5×10^{9}
300	2.0×10^{-15}	200	1.7×10^{9}
350	4.0×10^{-16}	250	2.2×10^{8}
400	8.0×10^{-17}	270	1.0×10^{8}

Test No. 30

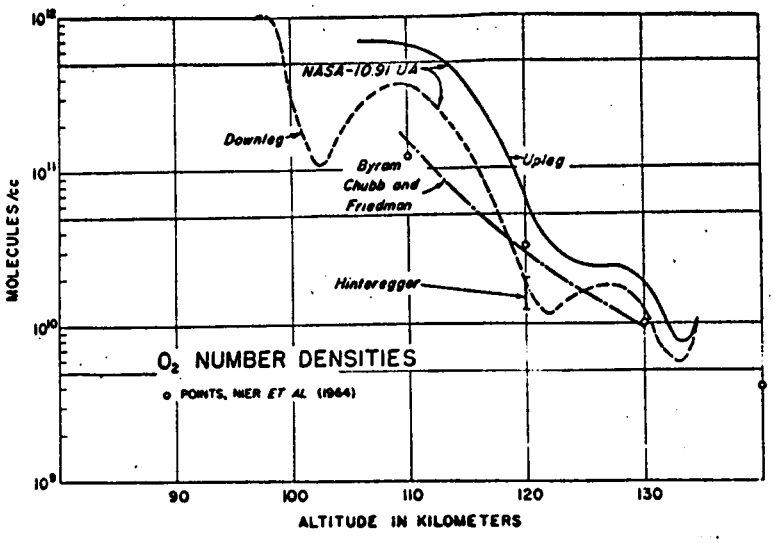
MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE MARCH 2, 1966 GM TIME 18 HRS 0 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 78.00000 F10B 84.00000 AP 5.0000 EXOS TEMP 822.7062 HOUR ANG -347.2925

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
69.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	5.40000+07	0.00000
78.	140.	4.06602-12	561.6	7.40077-03	25.7	19.4	6.37604+10	9.81929+09	2.18636+10	2.09175+07	0.00000
88.	160.	1.30078-12	676.4	2.98755-03	24.5	24.6	1.92368+10	2.56364+09	1.01793+10	1.60994+07	0.00000
97.	180.	5.35189-13	740.5	1.40740-03	23.3	28.5	7.28027+09	8.55461+08	5.62014+09	1.34088+07	0.00000
108.	200.	2.48445-13	776.3	7.23100-04	22.2	31.6	3.08012+09	3.19853+08	3.35628+09	1.15775+07	0.00000
119.	220.	1.25417-13	796.4	3.93975-04	21.1	34.3	1.35889+09	1.26946+08	2.08753+09	1.01820+07	0.00000
130.	240.	6.70425-14	807.8	2.24343-04	20.1	36.7	6.22538+08	5.21253+07	1.32824+09	9.04503+06	0.00000
140.	260.	3.74788-14	814.2	1.32311-04	19.2	39.0	2.90669+08	2.18534+07	8.56628+08	8.08134+06	0.00000
151.	280.	2.17295-14	817.8	8.02915-05	18.4	41.1	1.37422+08	9.28917+06	5.57252+08	7.24539+06	0.00000
162.	300.	1.29873-14	819.9	4.98797-05	17.8	42.9	6.55525+07	3.98789+06	3.64658+08	6.51032+06	0.00000
173.	320.	7.96009-15	821.1	3.15954-05	17.2	44.6	3.14870+07	1.72536+06	2.39685+08	5.85872+06	0.00000
185.	340.	4.98131-15	821.8	2.03448-05	16.7	46.2	1.52121+07	7.51373+05	1.58106+08	5.27829+06	0.00000
196.	360.	3.17103-15	822.2	1.32889-05	16.3	47.7	7.38718+06	3.29123+05	1.04616+08	4.75967+06	0.00000
208.	380.	2.04744-15	822.4	8.79359-06	15.9	49.2	3.60438+06	1.44946+05	6.94161+07	4.29534+06	0.00000
218.	400.	1.33785-15	822.5	5.89177-06	15.5	50.7	1.76662+06	6.41633+04	4.61813+07	3.87902+06	0.00000
227.	420.	8.83292-16	822.6	3.99755-06	15.1	52.4	8.69657+05	2.85448+04	3.08011+07	3.50536+06	0.00000
237.	440.	5.88673-16	822.6	2.74877-06	14.7	54.4	4.29936+05	1.27609+04	2.05936+07	3.16967+06	0.00000
248.	460.	3.93848-16	822.7	1.91793-06	14.1	56.8	2.13440+05	5.73203+03	1.38019+07	2.86788+06	0.00000
259.	480.	2.68587-16	822.7	1.36019-06	13.5	59.7	1.06400+05	2.58693+03	9.27198+06	2.59637+06	0.00000
270.	500.	1.84149-16	822.7	9.93979-07	12.7	64.0	5.32572+04	1.17296+03	6.24338+06	2.35194+06	1.02788+05
281.	520.	1.27515-16	822.7	7.35388-07	11.9	68.8	2.67650+04	5.34301+02	4.21376+06	2.13176+06	1.02642+05
291.	540.	8.93517-17	822.7	5.56205-07	11.0	74.7	1.35049+04	2.44496+02	2.85044+06	1.93330+06	1.00166+05
302.	560.	6.34640-17	822.7	4.30596-07	10.1	81.9	6.84127+03	1.12389+02	1.93258+06	1.75430+06	9.77621+04
313.	580.	4.57779-17	822.7	3.41260-07	9.2	90.5	3.47925+03	5.18944+01	1.31321+06	1.59277+06	9.54297+04
324.	600.	3.35995-17	822.7	2.78672-07	8.3	100.6	1.77633+03	2.40685+01	8.94334+05	1.44692+06	9.31658+04
335.	620.	2.51389-17	822.7	2.29114-07	7.5	111.9	9.10404+02	1.12122+01	6.10406+05	1.31515+06	9.09661+04
345.	640.	1.92008-17	822.7	1.93389-07	6.8	124.4	4.68388+02	5.24602+00	4.17532+05	1.19603+06	8.88344+04
356.	660.	1.49838-17	822.7	1.65979-07	6.2	137.8	2.41893+02	2.46518+00	2.86220+05	1.08829+06	8.67625+04
367.	680.	1.19478-17	822.7	1.44489-07	5.7	151.1	1.25392+02	1.16341+00	1.96626+05	9.90785+05	8.47502+04
378.	700.	9.72839-18	822.7	1.27277-07	5.2	164.4	6.52434+01	5.51398-01	1.35369+05	9.02498+05	8.27956+04
389.	720.	8.07774-18	822.7	1.13206-07	4.9	177.1	3.40727+01	2.62440-01	9.33878+04	8.22511+05	8.08966+04
399.	740.	6.82688-18	822.7	1.01487-07	4.6	188.9	1.78594+01	1.25433-01	6.45826+04	7.50006+05	7.90518+04
410.	760.	5.86005-18	822.7	9.15620-08	4.4	199.7	9.39512+00	6.02001-02	4.47274+04	6.84247+05	7.72590+04
421.	780.	5.09745-18	822.7	8.30335-08	4.2	209.3	4.98024+00	2.90114-02	3.10498+04	6.24574+05	7.55168+04
432.	800.	4.48377-18	822.7	7.56149-08	4.1	217.9	2.62817+00	1.40382-02	2.15989+04	5.70397+05	7.38227+04
443.	820.	3.98039-18	822.7	6.90954-08	3.9	225.6	1.39746+00	6.82045-03	1.50350+04	5.21182+05	7.21761+04
453.	840.	3.56011-18	822.7	6.33182-08	3.8	232.4	7.45682-01	3.32702-03	1.05148+04	4.76453+05	7.05750+04
464.	860.	3.20360-18	822.7	5.81637-08	3.8	238.6	3.99280-01	1.62940-03	7.35848+03	4.35779+05	6.90180+04
475.	880.	2.89697-18	822.7	5.35395-08	3.7	244.2	2.14537-01	8.01145-04	5.15977+03	3.98774+05	6.75037+04
486.	900.	2.63010-18	822.7	4.93725-08	3.6	249.4	1.15668-01	3.95453-04	3.62512+03	3.65090+05	6.60307+04
496.	920.	2.39552-18	822.7	4.56040-08	3.6	254.3	6.25747-02	1.95959-04	2.55166+03	3.34413+05	6.45977+04
507.	940.	2.18763-18	822.7	4.21859-08	3.5	259.1	3.39662-02	9.74778-05	1.79981+03	3.06462+05	6.32033+04
518.	960.	2.00216-18	822.7	3.90780-08	3.5	263.6	1.84969-02	4.86749-05	1.27182+03	2.80980+05	6.18465+04
529.	980.	1.83578-18	822.7	3.62465-08	3.5	268.2	1.01084-02	2.43977-05	9.00428+02	2.57740+05	6.05259+04
540.	1000.	1.68588-18	822.7	3.36624-08	3.4	272.7	5.54177-03	1.22750-05	6.38684+02	2.36832+05	5.92405+04

Reference [14], Test #31.



Smoothed O_2 number densities. Our data are uncorrected for dynamic effects.

TABLE 1. Number Densities in Ion Source

Altitude, km	Velocity, m/sec	Number Densities in Ion Source, in units of 10^{10} per cc			
		O	O_2	N_2	Ar
108 (up)	753	32	72	290	2.5
111 (down)	716	17.4	34.8	152	1.05
123 (up)	530	4.8	2.95	19.0	0.12
127 (down)	452	3.6	1.82	13.0	0.07
133 (up)	301	2.3	0.80	6.4	0.03

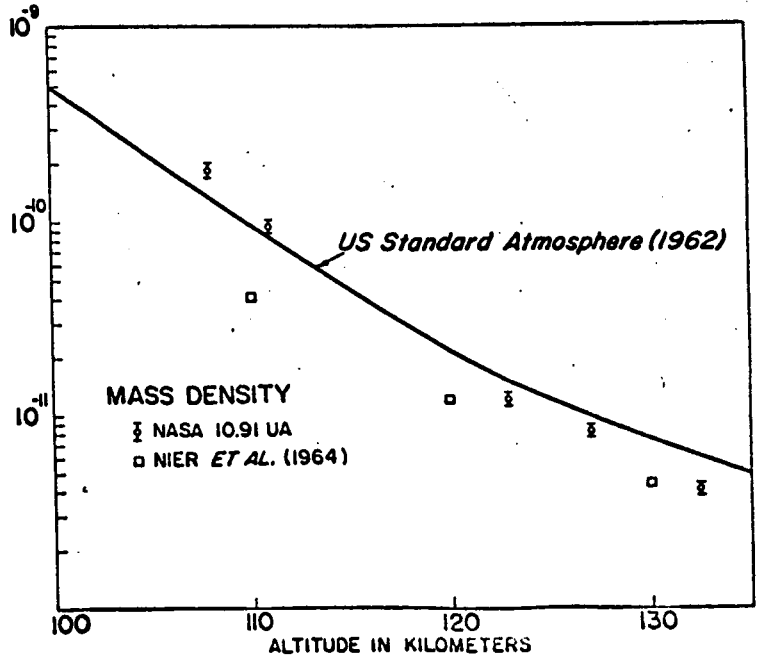


Fig. 7. Total mass density versus altitude.

Test No. 31

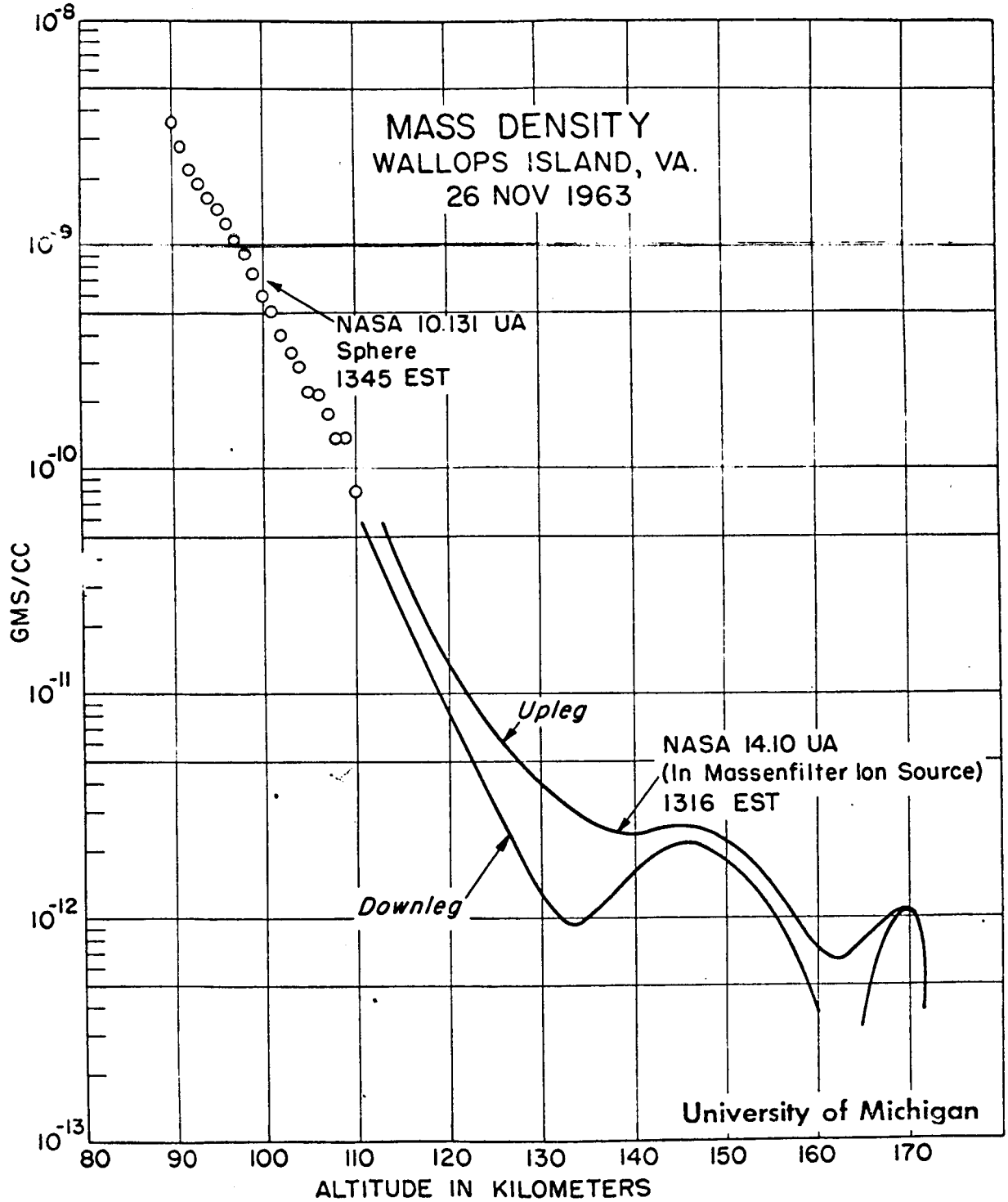
MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE MAY 16, 1962 GM TIME 16 HRS 2 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 94.00000 F10B 97.00000 AP 2.0000 EXOS TEMP 926.6692 HOUR ANG 17.3749

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.99216-12	605.0	7.80943-03	25.7	20.8	6.27567+10	9.74594+09	2.09859+10	2.01268+07	0.00000
86.	160.	1.34832-12	745.0	3.38649-03	24.7	26.9	2.01451+10	2.74000+09	1.00272+10	1.54607+07	0.00000
97.	180.	5.88159-13	823.8	1.70446-03	23.6	31.2	8.22237+09	9.98192+08	5.75577+09	1.29534+07	0.00000
108.	200.	2.91117-13	866.2	9.29109-04	22.6	34.6	3.74296+09	4.09132+08	3.58946+09	1.12837+07	0.00000
119.	220.	1.55382-13	893.3	5.33591-04	21.6	37.5	1.80302+09	1.78280+08	2.33588+09	1.00253+07	0.00000
130.	240.	8.73461-14	907.6	3.18527-04	20.7	40.0	8.96626+08	8.04185+07	1.55645+09	9.00329+06	0.00000
140.	260.	5.10796-14	915.7	1.96097-04	19.8	42.4	4.54523+08	3.70428+07	1.05165+09	8.13509+06	0.00000
151.	280.	3.08499-14	920.4	1.23842-04	19.1	44.6	2.33290+08	1.72973+07	7.16816+08	7.37752+06	0.00000
162.	300.	1.91458-14	923.0	7.99055-05	18.4	46.7	1.20785+08	8.15523+06	4.91482+08	6.70591+06	0.00000
173.	320.	1.21611-14	924.6	5.25012-05	17.8	48.6	6.29508+07	3.87343+06	3.38436+08	6.10485+06	0.00000
183.	340.	7.87928-15	925.5	3.50342-05	17.3	50.3	3.29867+07	1.85096+06	2.33840+08	5.56387+06	0.00000
194.	360.	5.19180-15	926.0	2.36936-05	16.9	51.9	1.73671+07	8.89238+05	1.62035+08	5.07526+06	0.00000
205.	380.	3.47017-15	926.3	1.62144-05	16.5	53.5	9.18304+06	4.29303+05	1.12567+08	4.63293+06	0.00000
216.	400.	2.34774-15	926.4	1.12160-05	16.1	55.0	4.87541+06	2.08218+05	7.83876+07	4.23188+06	0.00000
227.	420.	1.60495-15	926.5	7.83745-06	15.8	56.6	2.59856+06	1.01439+05	5.47101+07	3.86786+06	0.00000
237.	440.	1.10715-15	926.6	5.53144-06	15.4	58.2	1.39029+06	4.96339+04	3.82683+07	3.53714+06	0.00000
248.	460.	7.69963-16	926.6	3.94389-06	15.0	60.1	7.46612+05	2.43892+04	2.68251+07	3.23647+06	0.00000
259.	480.	5.39496-16	926.7	2.84238-06	14.6	62.1	4.02420+05	1.20348+04	1.88433+07	2.96293+06	0.00000
270.	500.	3.80821-16	926.7	2.07815-06	14.1	64.7	2.17690+05	5.96321+03	1.32640+07	2.71393+06	4.44259+04
281.	520.	2.70730-16	926.7	1.53608-06	13.6	67.7	1.18183+05	2.96686+03	9.35583+06	2.48714+06	4.41402+04
291.	540.	1.93916-16	926.7	1.15154-06	13.0	71.3	6.43694+04	1.48211+03	6.61260+06	2.28046+06	4.31935+04
302.	560.	1.40020-16	926.7	8.76676-07	12.3	75.6	3.52046+04	7.43374+02	4.68311+06	2.09200+06	4.22719+04
313.	580.	1.02001-16	926.7	6.78536-07	11.6	80.8	1.93151+04	3.74337+02	3.32324+06	1.92008+06	4.13753+04
324.	600.	7.50376-17	926.7	5.34370-07	10.8	87.0	1.06340+04	1.89248+02	2.36291+06	1.76315+06	4.05027+04
335.	620.	5.58101-17	926.7	4.26364-07	10.0	94.3	5.87463+03	9.60505+01	1.68337+06	1.61984+06	3.96534+04
345.	640.	4.20189-17	926.7	3.49558-07	9.3	102.8	3.25641+03	4.89386+01	1.20159+06	1.48890+06	3.88266+04
356.	660.	3.20643-17	926.7	2.90175-07	8.5	112.4	1.81116+03	2.50307+01	8.59344+05	1.36921+06	3.80216+04
367.	680.	2.48285-17	926.7	2.44807-07	7.8	123.2	1.01071+03	1.28514+01	6.15751+05	1.25975+06	3.72377+04
378.	700.	1.95273-17	926.7	2.09616-07	7.2	134.9	5.65865+02	6.62321+00	4.42043+05	1.15956+06	3.64742+04
389.	720.	1.56091-17	926.7	1.81662-07	6.6	147.2	3.17874+02	3.42621+00	3.17934+05	1.06785+06	3.57306+04
399.	740.	1.26041-17	926.7	1.59662-07	6.1	160.0	1.79141+02	1.77899+00	2.29095+05	9.83856+05	3.50062+04
410.	760.	1.04760-17	926.7	1.41365-07	5.7	172.7	1.01282+02	9.27109-01	1.65385+05	9.06883+05	3.43005+04
421.	780.	8.78648-18	926.7	1.26589-07	5.3	185.1	5.74480+01	4.84927-01	1.19610+05	8.36314+05	3.36128+04
432.	800.	7.48128-18	926.7	1.14005-07	5.1	196.9	3.26081+01	2.54582-01	8.66617+04	7.71586+05	3.29427+04
443.	820.	6.45408-18	926.7	1.03282-07	4.8	208.0	1.86565+01	1.34113-01	6.29022+04	7.12187+05	3.22895+04
453.	840.	5.63487-18	926.7	9.40284-08	4.6	218.1	1.06829+01	7.09083-02	4.57381+04	6.57653+05	3.16528+04
464.	860.	4.97091-18	926.7	8.59519-08	4.5	227.2	6.13504+00	3.76232-02	3.33164+04	6.07564+05	3.10321+04
475.	880.	4.42496-18	926.7	7.88342-08	4.3	235.4	3.53437+00	2.00326-02	2.43107+04	5.61535+05	3.04268+04
486.	900.	3.96922-18	926.7	7.25087-08	4.2	242.7	2.04234+00	1.07035-02	1.77702+04	5.19219+05	2.98367+04
496.	920.	3.58340-18	926.7	6.68476-08	4.1	249.2	1.18373+00	5.73866-03	1.30117+04	4.80298+05	2.92611+04
507.	940.	3.25254-18	926.7	6.17508-08	4.1	255.0	6.88139-01	3.08731-03	9.54378+03	4.44485+05	2.86997+04
518.	960.	2.96546-18	926.7	5.71395-08	4.0	260.3	4.01224-01	1.66656-03	7.01198+03	4.11517+05	2.81520+04
529.	980.	2.71378-18	926.7	5.29503-08	3.9	265.0	2.34626-01	9.02657-04	5.16050+03	3.81154+05	2.76177+04
540.	1000.	2.49113-18	926.7	4.91314-08	3.9	269.3	1.37604-01	4.90537-04	3.80422+03	3.53178+05	2.70964+04

Reference [14], Test #32.



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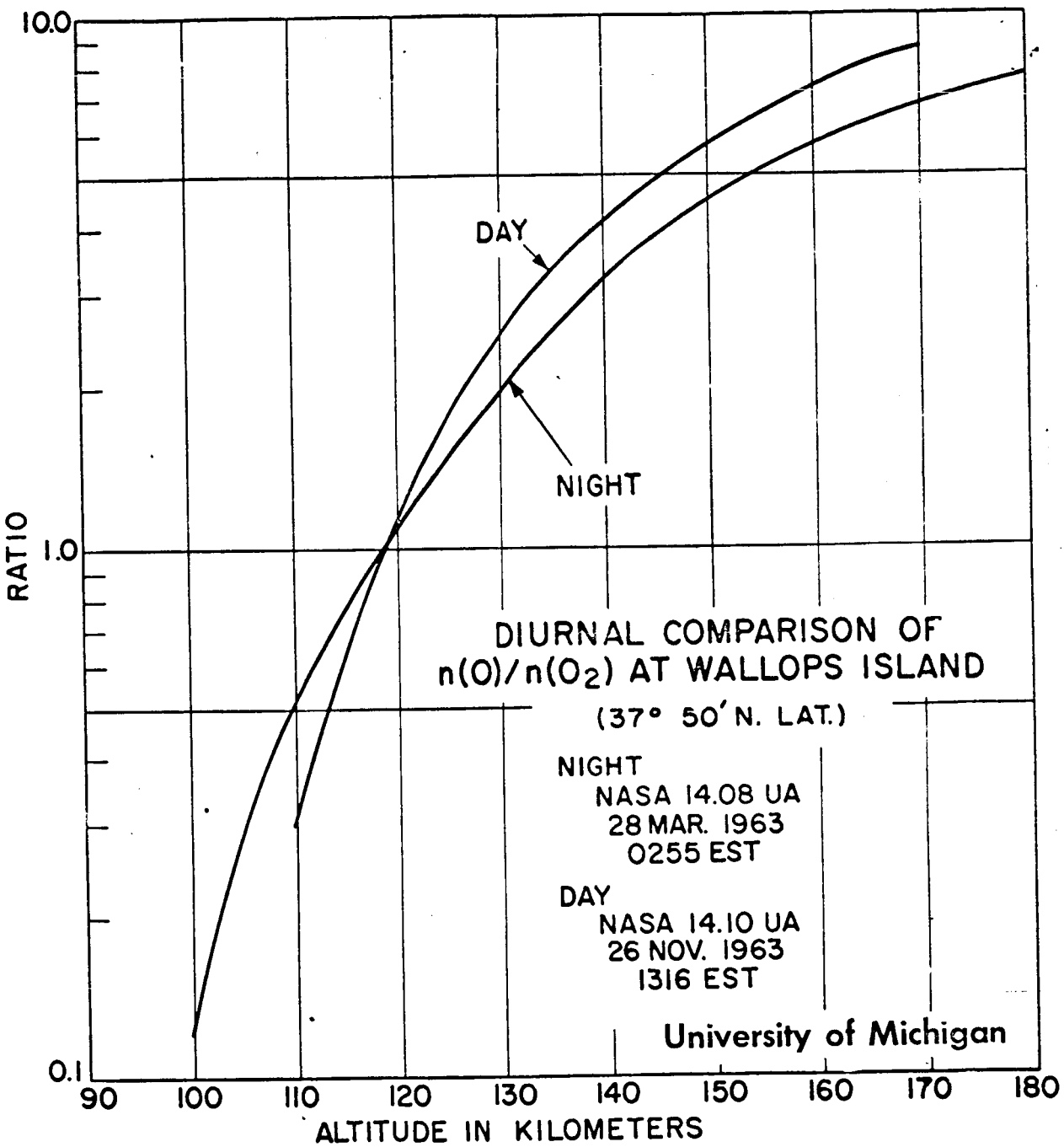

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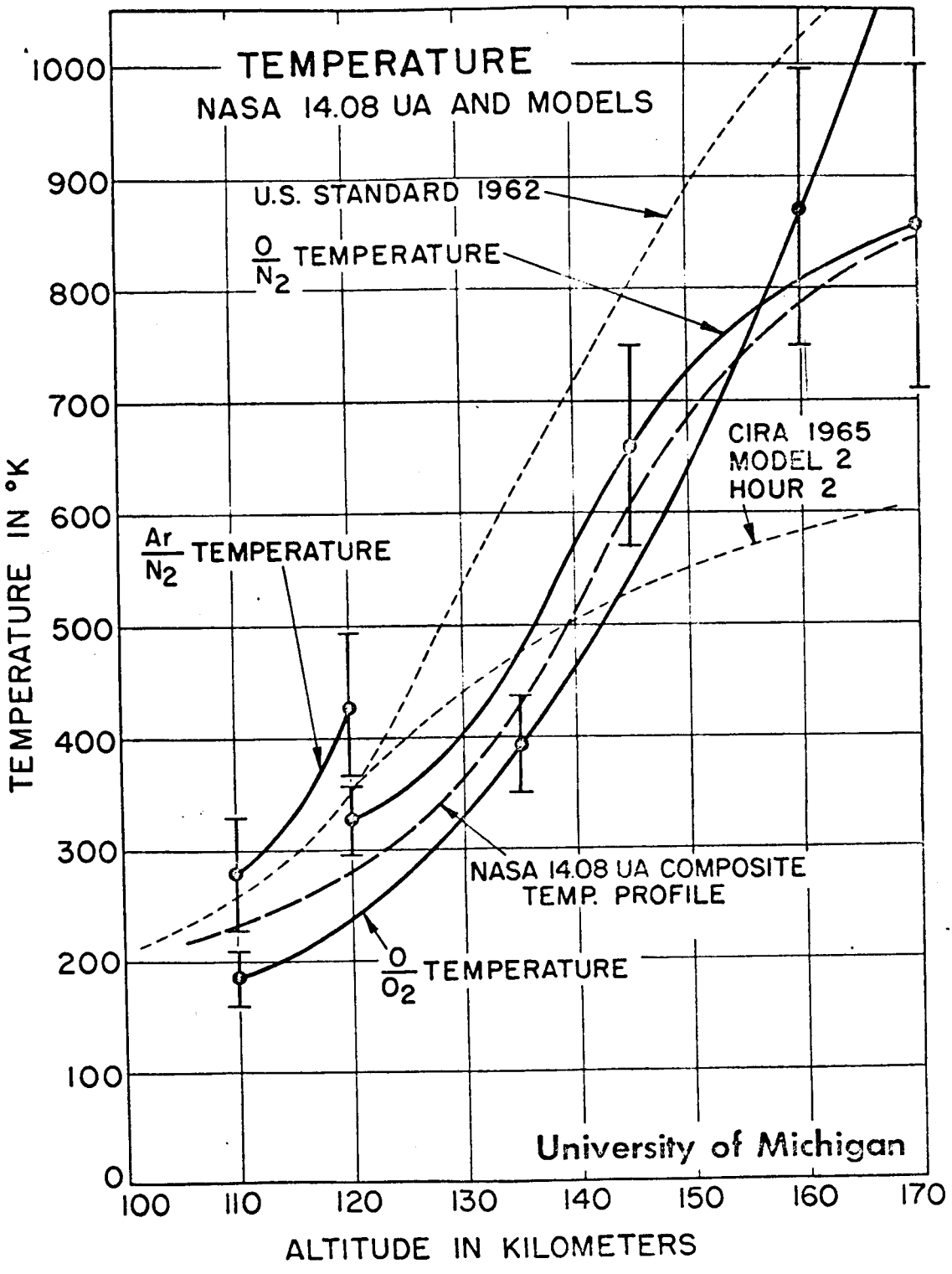


Test No. 32

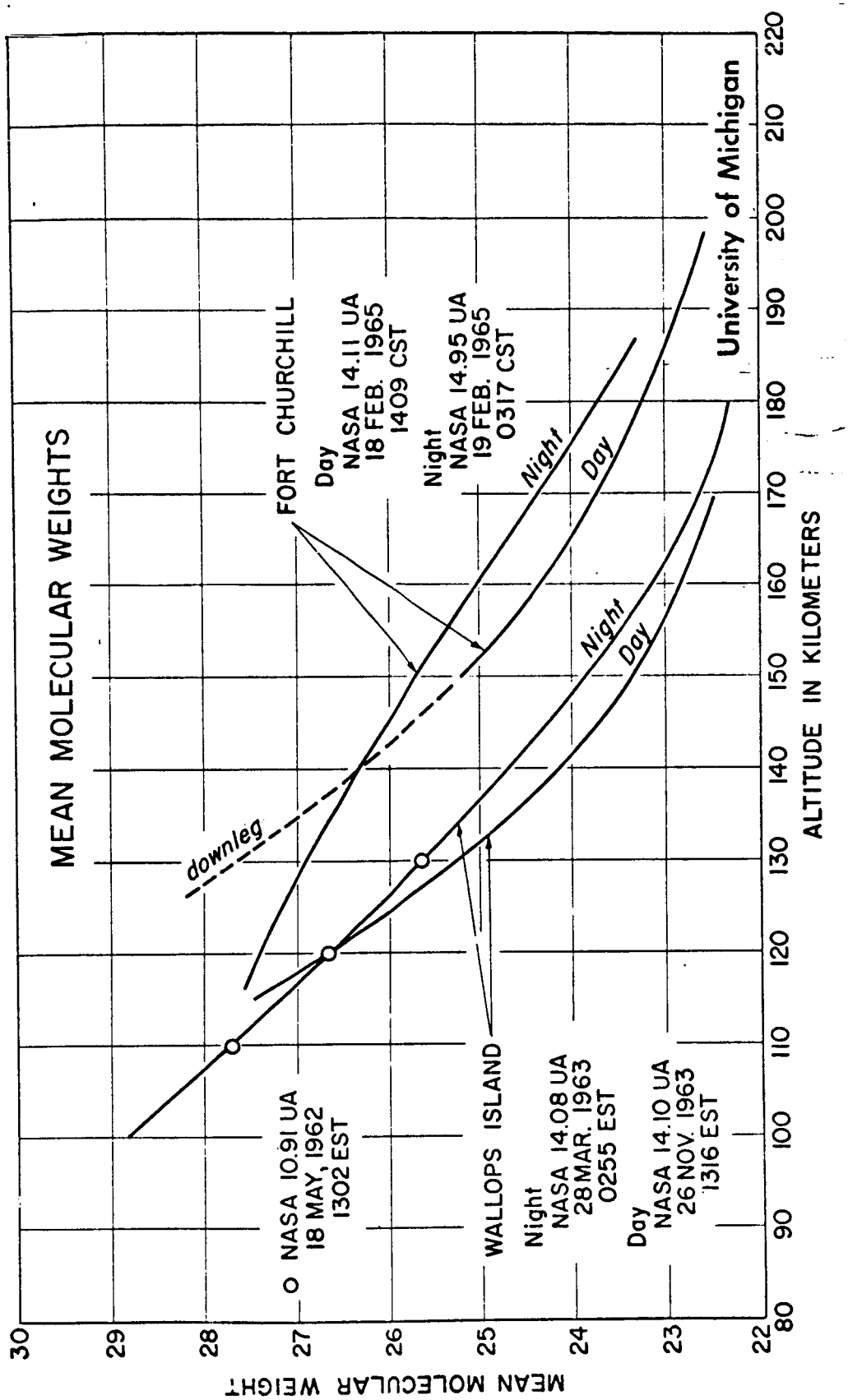
MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE NOVEMBER 26, 1963 GM TIME 18 HRS 16 MINS LAT 37.83000 DEGS LONG -75.48000 DEGS

F10 82.00000 F10B 84.00000 AP 5.0000 EXOS TEMP 832.0171 HOUR ANG 22.9656

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
69.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	5.40000+07	0.00000
78.	140.	4.05928-12	565.6	7.43995-03	25.7	19.5	6.36704+10	9.81351+09	2.17769+10	2.08403+07	0.00000
86.	160.	1.30579-12	682.7	3.02490-03	24.5	24.8	1.93512+10	2.58145+09	1.01672+10	1.60378+07	0.00000
97.	180.	5.38616-13	748.1	1.43441-03	23.4	28.7	7.37241+09	8.69114+08	5.63593+09	1.33662+07	0.00000
108.	200.	2.52491-13	784.6	7.41298-04	22.2	31.8	3.12398+09	3.27994+08	3.38061+09	1.15515+07	0.00000
119.	220.	1.28163-13	805.2	4.05978-04	21.1	34.6	1.59869+09	1.31409+08	2.11233+09	1.01698+07	0.00000
130.	240.	6.88470-14	816.8	2.32245-04	20.1	37.0	6.46080+08	5.44702+07	1.35029+09	9.04423+06	0.00000
140.	260.	3.86540-14	823.3	1.37545-04	19.2	39.3	3.04160+08	2.30531+07	8.74937+08	8.08984+06	0.00000
151.	280.	2.25006-14	827.0	8.37941-05	18.5	41.4	1.44988+08	9.89174+06	5.71634+08	7.26138+06	0.00000
162.	300.	1.34974-14	829.2	5.22499-05	17.8	43.3	6.97307+07	4.28655+06	3.75951+08	6.53224+06	0.00000
173.	320.	8.30185-15	830.4	3.32165-05	17.3	45.0	3.37681+07	1.87194+06	2.48260+08	5.88526+06	0.00000
183.	340.	5.21314-15	831.1	2.14643-05	16.8	46.6	1.64470+07	8.22799+05	1.64523+08	5.30832+06	0.00000
194.	360.	3.33009-15	831.5	1.40682-05	16.4	48.1	8.05155+06	3.63748+05	1.09364+08	4.79226+06	0.00000
205.	380.	2.15764-15	831.7	9.35979-06	16.0	49.6	3.96018+06	1.61670+05	7.29003+07	4.32970+06	0.00000
216.	400.	1.41479-15	831.8	6.27683-06	15.6	51.1	1.95654+06	7.22216+04	4.87207+07	3.91451+06	0.00000
227.	420.	9.37341-16	831.9	4.27043-06	15.2	52.8	9.70819+05	3.24222+04	3.26423+07	3.54143+06	0.00000
237.	440.	6.26825-16	832.0	2.94312-06	14.7	54.7	4.83745+05	1.46254+04	2.19231+07	3.20590+06	0.00000
248.	460.	4.22880-16	832.0	2.05707-06	14.2	57.0	2.42043+05	6.62864+03	1.47589+07	2.90391+06	0.00000
259.	480.	2.87602-16	832.0	1.46037-06	13.8	59.8	1.21602+05	3.01833+03	9.95910+06	2.63191+06	0.00000
270.	500.	1.97833-16	832.0	1.06580-06	12.8	63.9	6.13396+04	1.38073+03	6.73580+06	2.38678+06	9.46756+04
281.	520.	1.37292-16	832.0	7.87652-07	12.1	68.5	3.10652+04	6.34503+02	4.56615+06	2.16571+06	9.44974+04
291.	540.	9.63572-17	832.0	5.94575-07	11.2	74.1	1.57951+04	2.92900+02	3.10236+06	1.96624+06	9.22423+04
302.	560.	6.85005-17	832.0	4.59052-07	10.3	80.9	8.06255+03	1.35815+02	2.11254+06	1.78613+06	9.00534+04
313.	580.	4.94131-17	832.0	3.62617-07	9.4	89.1	4.13149+03	6.32559+01	1.44172+06	1.62343+06	8.79287+04
324.	600.	3.62362-17	832.0	2.92924-07	8.6	98.7	2.12526+03	2.95913+01	9.86082+05	1.47635+06	8.58658+04
335.	620.	2.70629-17	832.0	2.41673-07	7.7	109.7	1.09742+03	1.39033+01	6.75912+05	1.34334+06	8.38627+04
345.	640.	2.06192-17	832.0	2.03260-07	7.0	121.8	5.66818+02	6.56067+00	4.64307+05	1.22296+06	8.19174+04
356.	660.	1.60330-17	832.0	1.73877-07	6.4	134.7	2.95939+02	3.10912+00	3.19632+05	1.11397+06	8.00279+04
367.	680.	1.27346-17	832.0	1.50925-07	5.8	148.1	1.54541+02	1.47969+00	2.20504+05	1.01525+06	7.81924+04
378.	700.	1.03263-17	832.0	1.32615-07	5.4	161.4	8.09998+01	7.07184-01	1.52439+05	9.25754+05	7.64090+04
389.	720.	8.53874-18	832.0	1.17710-07	5.0	174.2	4.26099+01	3.39395-01	1.05605+05	8.44565+05	7.46760+04
399.	740.	7.18821-18	832.0	1.05346-07	4.7	186.2	2.24963+01	1.63560-01	7.33110+04	7.70911+05	7.29918+04
410.	760.	6.14833-18	832.0	9.49140-08	4.5	197.3	1.19198+01	7.91459-02	5.09971+04	7.04042+05	7.13547+04
421.	780.	5.33175-18	832.0	8.59798-08	4.3	207.2	6.33830+00	3.84546-02	3.55472+04	6.43300+05	6.97632+04
432.	800.	4.67777-18	832.0	7.82302-08	4.1	216.1	3.38229+00	1.87594-02	2.48279+04	5.88095+05	6.82156+04
443.	820.	4.14396-18	832.0	7.14360-08	4.0	224.0	1.81121+00	9.10815-03	1.73758+04	5.37896+05	6.67110+04
453.	840.	3.70036-18	832.0	6.54263-08	3.9	231.1	9.73270-01	4.51814-03	1.21846+04	4.92226+05	6.52475+04
464.	860.	3.32571-18	832.0	6.00722-08	3.8	237.4	5.24800-01	2.23049-03	8.56113+03	4.50656+05	6.38240+04
475.	880.	3.00471-18	832.0	5.52739-08	3.8	243.1	2.83947-01	1.10544-03	6.02696+03	4.12797+05	6.24392+04
486.	900.	2.72625-18	832.0	5.09534-08	3.7	248.3	1.54152-01	5.49984-04	4.25115+03	3.78302+05	6.10918+04
496.	920.	2.48216-18	832.0	4.70479-08	3.7	253.2	8.39695-02	2.74683-04	3.00433+03	3.46856+05	5.97806+04
507.	940.	2.26630-18	832.0	4.35065-08	3.6	257.9	4.58923-02	1.37710-04	2.12723+03	3.18175+05	5.85045+04
518.	960.	2.07404-18	832.0	4.02870-08	3.6	262.4	2.51647-02	6.93012-05	1.50904+03	2.92003+05	5.72624+04
529.	980.	1.90178-18	832.0	3.73538-08	3.5	266.8	1.38442-02	3.50059-05	1.07251+03	2.68110+05	5.60533+04
540.	1000.	1.74671-18	832.0	3.46766-08	3.5	271.1	7.64105-03	1.77482-05	7.63674+02	2.46288+05	5.48760+04

Reference [14], **Test #33.**



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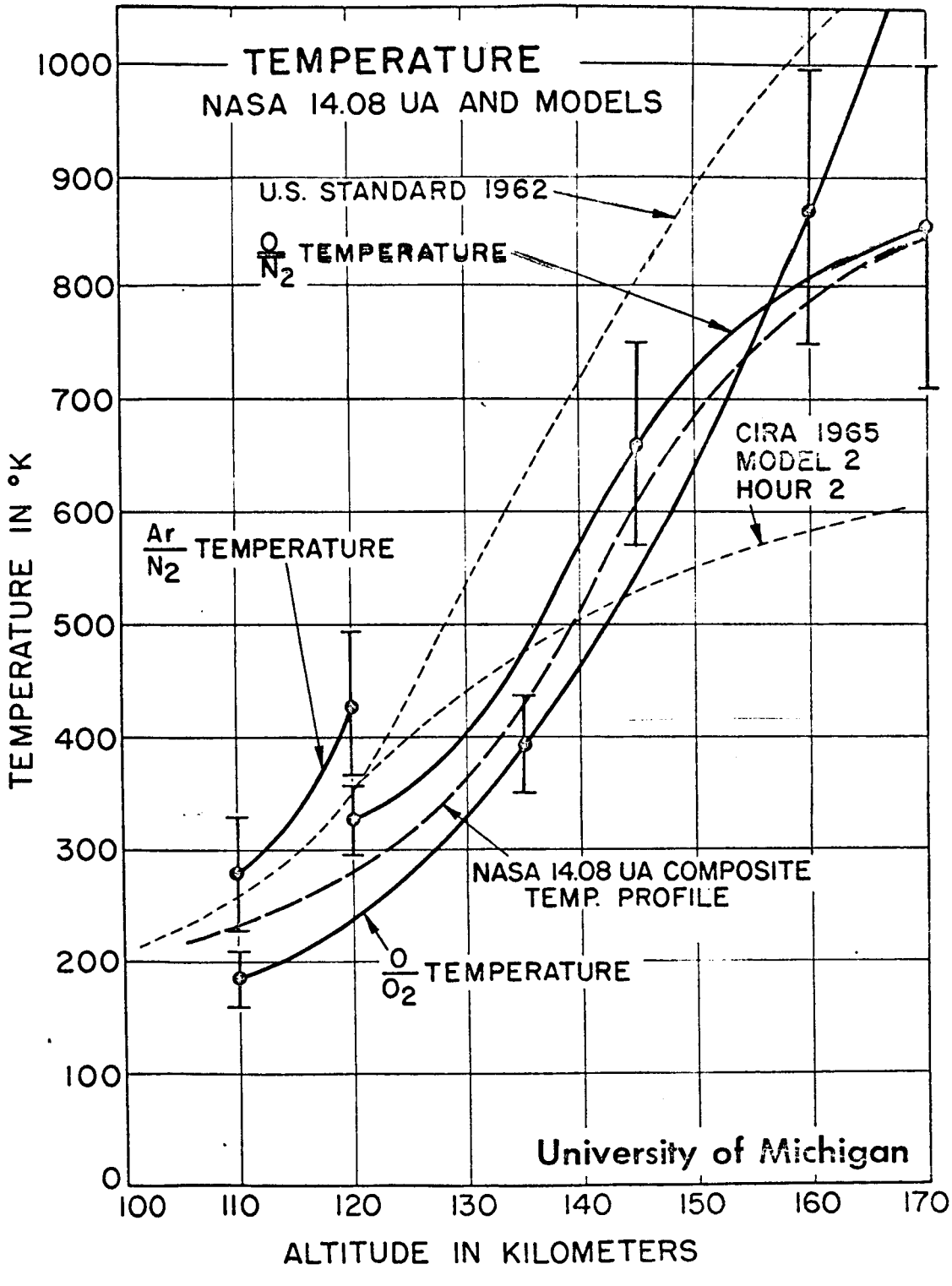


Test No. 33

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE MARCH 20, 1963 GM TIME 7 HRS 55 MINS LAT 37.83000 DEGS LONG -75.46000 DEGS

F10 73.00000 F10B 70.00000 AP .0000 EXOS TEMP 663.3207 HOUR ANG 222.9305

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	5.40000+07	0.00000
70.	140.	4.18088-12	489.6	6.66560-03	25.5	17.0	6.52289+10	9.88256+09	2.34914+10	2.24361+07	0.00000
86.	160.	1.19050-12	565.1	2.31948-03	24.1	20.9	1.72033+10	2.19912+09	1.03148+10	1.72949+07	0.00000
97.	180.	4.27126-13	607.6	9.52097-04	22.7	24.0	5.51349+09	6.05290+08	5.21883+09	1.41900+07	0.00000
108.	200.	1.75451-13	631.6	4.33427-04	21.3	26.8	1.94466+09	1.84982+08	2.82972+09	1.19987+07	0.00000
119.	220.	7.91368-14	645.2	2.12453-04	20.0	29.3	7.22650+08	5.98576+07	1.59262+09	1.03088+07	0.00000
130.	240.	3.83206-14	652.9	1.10119-04	18.9	31.6	2.76914+08	2.00338+07	9.15895+08	8.93665+06	0.00000
140.	260.	1.96216-14	657.3	5.95808-05	18.0	33.5	1.08192+08	6.85054+06	5.33781+08	7.78629+06	0.00000
151.	280.	1.04984-14	659.9	3.33268-05	17.3	35.3	4.28368+07	2.37740+06	3.13648+08	6.81001+06	0.00000
162.	300.	5.81251-15	661.3	1.91378-05	16.7	36.8	1.71289+07	8.34224+05	1.85708+08	5.96778+06	0.00000
173.	320.	3.30440-15	662.2	1.12307-05	16.2	38.2	6.90389+06	2.95357+05	1.10431+08	5.23804+06	0.00000
183.	340.	1.91775-15	662.6	6.71851-06	15.7	39.6	2.80172+06	1.05383+05	6.59390+07	4.60321+06	0.00000
194.	360.	1.13185-15	662.9	4.09495-06	15.2	41.2	1.14403+06	3.78652+04	3.95171+07	4.04951+06	0.00000
205.	380.	6.77381-16	663.1	2.54570-06	14.7	43.0	4.69854+05	1.36955+04	2.37627+07	3.58569+06	0.00000
216.	400.	4.10869-16	663.2	1.61620-06	14.0	45.4	1.94041+05	4.98475+03	1.43351+07	3.14228+06	0.00000
227.	420.	2.52642-16	663.2	1.05547-06	13.2	48.4	8.05673+04	1.82549+03	8.67465+06	2.77134+06	0.00000
237.	440.	1.57685-16	663.3	7.09173-07	12.3	52.4	3.36287+04	6.72555+02	5.26520+06	2.44609+06	0.00000
248.	460.	1.00148-16	663.3	4.92624-07	11.2	57.7	1.41095+04	2.49256+02	3.20529+06	2.16063+06	0.00000
259.	480.	6.49412-17	663.3	3.54616-07	10.1	64.4	5.95023+03	9.29182+01	1.95700+06	1.90989+06	0.00000
270.	500.	4.40889-17	663.3	3.15641-07	7.7	84.9	2.52204+03	3.48389+01	1.19831+06	1.68948+06	5.56896+05
281.	520.	3.04338-17	663.3	2.54515-07	6.6	99.8	1.07434+03	1.31374+01	7.35856+05	1.49557+06	5.47133+05
291.	540.	2.17356-17	663.3	2.11448-07	5.7	116.8	4.59923+02	4.98216+00	4.53153+05	1.32486+06	5.30805+05
302.	560.	1.60953-17	663.3	1.80341-07	4.9	135.3	1.97861+02	1.90003+00	2.79844+05	1.17446+06	5.15054+05
313.	580.	1.23545-17	663.3	1.57042-07	4.3	154.3	8.55360+01	7.28651-01	1.73299+05	1.04185+06	4.99657+05
324.	600.	9.80647-18	663.3	1.38968-07	3.9	173.0	3.71563+01	2.80978-01	1.07615+05	9.24859+05	4.85192+05
335.	620.	8.01783-18	663.3	1.24494-07	3.6	190.7	1.62178+01	1.06943-01	6.70092+04	8.21563+05	4.71038+05
345.	640.	6.71998-18	663.3	1.12580-07	3.3	206.9	7.11231+00	4.24693-02	4.18382+04	7.30299+05	4.57373+05
356.	660.	5.74656-18	663.3	1.02551-07	3.1	221.7	3.13379+00	1.66451-02	2.61926+04	6.49609+05	4.44179+05
367.	680.	4.99231-18	663.3	9.39546-08	2.9	235.1	1.38724+00	6.55857-03	1.64414+04	5.78219+05	4.31436+05
378.	700.	4.39032-18	663.3	8.64824-08	2.8	247.5	6.16936-01	2.59792-03	1.03478+04	5.15014+05	4.19132+05
389.	720.	3.89735-18	663.3	7.99170-08	2.7	259.1	2.75626-01	1.03446-03	6.52969+03	4.59019+05	4.07243+05
399.	740.	3.48496-18	663.3	7.41000-08	2.6	270.2	1.23700-01	4.14095-04	4.13109+03	4.09577+05	3.95755+05
410.	760.	3.13397-18	663.3	6.89128-08	2.5	281.0	5.57668-02	1.66585-04	2.62031+03	3.65339+05	3.84653+05
421.	780.	2.83124-18	663.3	6.42634-08	2.4	291.7	2.52535-02	6.73644-05	1.66629+03	3.26246+05	3.73923+05
432.	800.	2.56740-18	663.3	6.00786-08	2.4	302.4	1.14965-02	2.73793-05	1.06230+03	2.91520+05	3.63949+05
443.	820.	2.33562-18	663.3	5.62988-08	2.3	313.2	5.24764-03	1.11639-05	6.78942+02	2.60655+05	3.53918+05
453.	840.	2.13075-18	663.3	5.28745-08	2.2	324.3	2.40786-03	4.59120-06	4.35009+02	2.33202+05	3.43818+05
464.	860.	1.94861-18	663.3	4.97640-08	2.2	335.6	1.10961-03	1.89410-06	2.79407+02	2.08769+05	3.34435+05
475.	880.	1.78662-18	663.3	4.69315-08	2.1	347.1	5.13538-04	7.85242-07	1.79902+02	1.87011+05	3.25359+05
486.	900.	1.64161-18	663.3	4.43481-08	2.0	358.9	2.38681-04	3.27124-07	1.16116+02	1.67622+05	3.16578+05
496.	920.	1.51162-18	663.3	4.19811-08	2.0	371.0	1.11402-04	1.36934-07	7.51262+01	1.50333+05	3.08077+05
507.	940.	1.39484-18	663.3	3.98131-08	1.9	383.4	5.22133-05	5.75950-08	4.87223+01	1.34908+05	2.99851+05
518.	960.	1.28973-18	663.3	3.78215-08	1.9	396.1	2.45736-05	2.43396-08	3.16732+01	1.21138+05	2.91886+05
529.	980.	1.19496-18	663.3	3.59882-08	1.8	409.0	1.16129-05	1.03343-08	2.06364+01	1.08837+05	2.84178+05
540.	1000.	1.10937-18	663.3	3.42971-08	1.8	422.2	5.51040-06	4.40832-09	1.34794+01	9.78420+04	2.76711+05

Test #34
Reference [15]

ALT.	Number Density (cm^{-3})	
	N_2	He
110	1.78×10^{12}	1.56×10^{8}
120	3.78×10^{11}	1.22×10^{8}
130	1.25×10^{11}	1.02×10^{8}
140	6.24×10^{10}	7.81×10^{7}
150	3.41×10^{10}	6.46×10^{7}
155	2.60×10^{10}	5.76×10^{7}

Test No. 34

NSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE DECEMBER 12, 1966 GM TIME 19 HRS 20 MINS LAT 58.73000 DEGS LONG -93.82000 DEGS

F10 168.00000 F10B 113.00000 AP 2.0000 EXOS TEMP 971.5306 HOUR ANG -340.8498

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	5.40000+07	0.00000
76.	140.	3.96176-12	622.3	7.96462-03	25.7	21.4	6.23337+10	9.70994+09	2.06536+10	1.98330+07	0.00000
86.	160.	1.36343-12	773.0	3.54407-03	24.7	27.9	2.04428+10	2.80105+09	9.95309+09	1.5217E+07	0.00000
97.	180.	6.07927-13	858.3	1.82713-03	23.7	32.4	8.56668+09	1.05226+09	5.78943+09	1.27713+07	0.00000
108.	200.	3.07508-13	906.7	1.01792-03	22.8	35.9	4.01081+09	4.45518+08	3.66513+09	1.11569+07	0.00000
119.	220.	1.67832-13	934.5	5.96227-04	21.8	38.8	1.98878+09	2.00706+08	2.42542+09	9.94675+06	0.00000
130.	240.	9.59730-14	950.1	3.62321-04	20.9	41.5	1.01852+09	9.36400+07	1.64152+09	8.96650+06	0.00000
140.	260.	5.70993-14	959.1	2.26722-04	20.1	43.9	5.31648+08	4.46228+07	1.12781+09	8.13405+06	0.00000
151.	280.	3.50297-14	964.3	1.45361-04	19.3	46.1	2.81219+08	2.15583+07	7.81789+08	7.40674+06	0.00000
162.	300.	2.20350-14	967.3	9.51342-05	18.6	48.2	1.49997+08	1.05160+07	5.45169+08	6.78042+06	0.00000
173.	320.	1.41994-14	969.1	6.33661-05	18.1	50.2	8.05308+07	5.16719+06	3.81806+08	6.18023+06	0.00000
183.	340.	9.31948-15	970.1	4.28482-05	17.5	52.0	4.34661+07	2.55416+06	2.68295+08	5.65821+06	0.00000
194.	360.	6.21878-15	970.7	2.93556-05	17.1	53.7	2.35686+07	1.26910+06	1.89062+08	5.18111+06	0.00000
205.	380.	4.20904-15	971.0	2.03444-05	16.7	55.3	1.28330+07	6.33574+05	1.33561+08	4.74933+06	0.00000
216.	400.	2.88361-15	971.2	1.42460-05	16.3	56.9	7.01489+06	3.17710+05	9.45692+07	4.35628+06	0.00000
227.	420.	1.99030-15	971.4	1.00717-05	16.0	58.5	3.84893+06	1.59999+05	6.71060+07	3.99807+06	0.00000
237.	440.	1.39462-15	971.4	7.18036-06	15.7	60.1	2.11953+06	8.09111+04	4.77195+07	3.67130+06	0.00000
248.	460.	9.82139-16	971.5	5.17475-06	15.3	61.8	1.17135+06	4.10833+04	3.40028+07	3.37501+06	0.00000
259.	480.	6.96711-16	971.5	3.76149-06	15.0	63.7	6.49619+05	2.09441+04	2.42777+07	3.10054+06	0.00000
270.	500.	4.97867-16	971.5	2.76591-06	14.5	65.9	3.61520+05	1.07195+04	1.73665+07	2.85150+06	3.24446+04
281.	520.	3.57820-16	971.5	2.05363-06	14.1	68.5	2.01879+05	5.50791+03	1.24499+07	2.62375+06	3.22056+04
291.	540.	2.58085-16	971.5	1.54284-06	13.6	71.5	1.13116+05	2.84105+03	8.94150+06	2.41536+06	3.15463+04
302.	560.	1.88748-16	971.5	1.17408-06	13.0	75.1	6.35931+04	1.47108+03	6.43410+06	2.22460+06	3.09041+04
313.	580.	1.38572-16	971.5	9.05969-07	12.4	79.4	3.58708+04	7.64616+02	4.63665+06	2.04987+06	3.02786+04
324.	600.	1.02552-16	971.5	7.09526-07	11.7	84.5	2.03003+04	3.98019+02	3.35052+06	1.88976+06	2.96692+04
335.	620.	7.65662-17	971.5	5.64367-07	11.0	90.5	1.15261+04	2.08904+02	2.42461+06	1.74297+06	2.90758+04
345.	640.	5.77255-17	971.5	4.56152-07	10.2	97.6	6.58548+03	1.09803+02	1.75783+06	1.60832+06	2.84969+04
356.	660.	4.39932-17	971.5	3.74604-07	9.5	105.8	3.75185+03	5.79264+01	1.27675+06	1.48476+06	2.79331+04
367.	680.	3.39274-17	971.5	3.12463-07	8.8	115.1	2.15082+03	3.06702+01	9.29025+05	1.37131+06	2.73835+04
378.	700.	2.65034-17	971.5	2.64522-07	8.1	125.4	1.23690+03	1.62975+01	6.77220+05	1.26710+06	2.68477+04
389.	720.	2.09902-17	971.5	2.27039-07	7.5	136.7	7.13547+02	8.69119+00	4.94548+05	1.17133+06	2.63254+04
399.	740.	1.68649-17	971.5	1.97317-07	6.9	148.7	4.12911+02	4.65132+00	3.61790+05	1.08329+06	2.58161+04
410.	760.	1.37905-17	971.5	1.73403-07	6.4	161.2	2.39677+02	2.49803+00	2.65136+05	1.00230+06	2.53194+04
421.	780.	1.13778-17	971.5	1.53876-07	6.0	173.8	1.39547+02	1.34628+00	1.94642+05	9.27768+05	2.48350+04
432.	800.	9.55074-18	971.5	1.37695-07	5.6	186.3	8.14942+01	7.28065-01	1.43138+05	8.59147+05	2.43629+04
443.	820.	8.12754-18	971.5	1.24097-07	5.3	198.4	4.77348+01	3.95088-01	1.05443+05	7.95945+05	2.39015+04
453.	840.	7.00515-18	971.5	1.12517-07	5.0	209.9	2.80437+01	2.15127-01	7.78065+04	7.37705+05	2.34510+04
464.	860.	6.10631-18	971.5	1.02535-07	4.8	220.6	1.65240+01	1.17532-01	5.75105+04	6.84019+05	2.30129+04
475.	880.	5.38195-18	971.5	9.38530-08	4.6	230.4	9.76483+00	6.44274-02	4.25799+04	6.34497+05	2.25846+04
486.	900.	4.78546-18	971.5	8.61736-08	4.5	239.3	5.78727+00	3.54343-02	3.15777+04	5.88808+05	2.21665+04
496.	920.	4.28695-18	971.5	7.93734-08	4.4	247.3	3.43979+00	1.95526-02	2.34569+04	5.46634+05	2.17585+04
507.	940.	3.87015-18	971.5	7.32915-08	4.3	254.4	2.05035+00	1.08243-02	1.74530+04	5.07667+05	2.13601+04
518.	960.	3.51245-18	971.5	6.78174-08	4.2	260.8	1.22561+00	6.01174-03	1.30068+04	4.71706+05	2.09712+04
529.	980.	3.20339-18	971.5	6.28642-08	4.1	266.5	7.34677-01	3.34959-03	9.70879+03	4.38450+05	2.05913+04
540.	1000.	2.93351-18	971.5	5.83621-08	4.1	271.7	4.41619-01	1.87226-03	7.25858+03	4.07701+05	2.02204+04

Test #35

Reference [16]

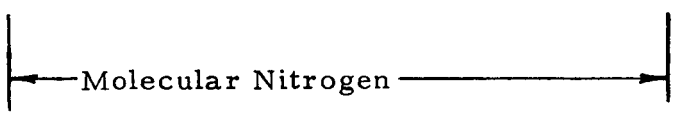
Number Density Ratios at 120 km as Measured by Rocket-Borne Mass Spectrometers

Date of Flight	Time	Latitude	$n(O_1)/n(O_2)$	$n(Ar)/n(N_2)$, $\times 10^{-2}$	$n(He)/n(N_2)$, $\times 10^{-4}$	Reference
Nov. 20, 1956	2321 CST	59°N		0.50		*Meadows and Townsend* [1960]
Feb. 21, 1958	2002 CST	59°N		0.70		*Meadows and Townsend* [1960]
Mar. 22, 1958	1207 CST	59°N		1.13		*Meadows and Townsend* [1960]
July 1959	Sunrise	'middle'		(0.71)*		*Pokhunkov* [1962]
Sept. 23, 1960	0056 LT	'middle'	0.72	(0.63)		*Pokhunkov* [1963*a*, *b*, *c*]
Nov. 15, 1960	1141 EST	38°N		0.58		*Meadows-Reed and Smith* [1964]
May 18, 1962	1302 EST	38°N	(1.2)	0.53		*Schaefer and Nichols* [1964]
Mar. 28, 1963	0255 LT	38°N	1.2	0.52		*Schaefer* [1966]
June 6, 1963	0730 MST	33°N	1.1	0.31		*Hedin et al.* [1964]
Nov. 26, 1963	1316 LT	38°N	1.2	0.47		*Schaefer* [1966]
Feb. 18, 1965	1409 LT	59°N	0.75	0.60		*Schaefer* [1966]
Feb. 19, 1965	0317 LT	59°N	0.75	0.53		*Schaefer* [1966]
Apr. 15, 1965	0345 MST	33°N	0.33	0.33	9.2	*Hedin and Nier* [1966]
Dec. 11, 1965	0505 MET	40°N	1.56	0.50		*Mauersberger et al.* [1967]
Dec. 12, 1966	1320 CST	59°N	0.87	0.37		*Gross et al.* [1967]
Dec. 12, 1966	1320 CST	59°N			25	*Hartmann et al.* [1967]
		Mean value:	0.97	0.56		

* Values in parentheses are calculated by the author from published *ion current* ratios.

Test #36
Reference [17]

	SPEC. II		SPEC. I		
ALT.	Upleg	Downleg	-	Argon	Helium
110	-	1.7×10^{12}	-	-	1.6×10^{8}
115	8.3×10^{11}	5.8×10^{11}	9.2×10^{11}	4.6×10^{9}	1.5×10^{8}
120	4.3×10^{11}	3.1×10^{11}	4.2×10^{11}	1.5×10^{9}	1.3×10^{8}
130	1.4×10^{11}	1.0×10^{11}	1.2×10^{11}	2.3×10^{8}	1.1×10^{8}
140	6.7×10^{10}	5.6×10^{10}	5.7×10^{10}	8.0×10^{7}	7.6×10^{7}
150	3.4×10^{10}	3.3×10^{10}	3.3×10^{10}	3.1×10^{7}	6.3 c 10^{7}
155	2.6×10^{10}	2.6×10^{10}	2.7×10^{10}	-	5.8×10^{7}



Test No. 36

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE DECEMBER 12, 1966 GM TIME 19 HRS 29 MINS LAT 28.73000 DEGS LONG -93.62000 DEGS

F10 162.00000 F10B 113.00000 AP 2.0000 EXOS TEMP 971.5308 HOUR ANG -340.8490

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
66.	120.	2.48948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
76.	140.	3.96176-12	622.3	7.96482-03	25.7	21.4	6.23337+10	9.70994+09	2.06536+10	1.98330+07	0.00000
86.	160.	1.36343-12	773.0	3.54407-03	24.7	27.9	2.04426+10	2.80105+09	9.95309+09	1.52172+07	0.00000
97.	180.	6.07927-13	858.3	1.82713-03	23.7	32.4	8.56668+09	1.05226+09	5.78943+09	1.27715+07	0.00000
108.	200.	3.07908-13	906.7	1.01792-03	22.8	35.9	4.01081+09	4.45518+08	3.66513+09	1.11569+07	0.00000
119.	220.	1.67932-13	934.5	5.96227-04	21.8	38.8	1.98878+09	2.00706+08	2.42342+09	9.94675+06	0.00000
130.	240.	9.99730-14	950.1	3.62321-04	20.9	41.5	1.01852+09	9.36400+07	1.64152+09	8.96650+06	0.00000
140.	260.	6.70993-14	959.1	2.26722-04	20.1	43.9	5.31648+08	4.46228+07	1.12781+09	8.13405+06	0.00000
151.	280.	4.50297-14	964.3	1.45361-04	19.3	46.1	2.81219+08	2.15563+07	7.81789+08	7.40674+06	0.00000
162.	300.	3.20550-14	967.3	9.51342-05	18.6	48.2	1.49997+08	1.05160+07	5.45169+08	6.78042+06	0.00000
173.	320.	1.41894-14	969.1	6.33661-05	18.1	50.2	8.05308+07	5.18719+06	3.81806+08	6.18023+06	0.00000
183.	340.	9.31946-15	970.1	4.28482-05	17.5	52.0	4.34661+07	2.55416+06	2.68295+08	5.65621+06	0.00000
194.	360.	6.21878-15	970.7	2.93556-05	17.1	53.7	2.35686+07	1.28910+06	1.89062+08	5.18111+06	0.00000
205.	380.	4.20904-15	971.0	2.03444-05	16.7	55.3	1.28330+07	6.33574+05	1.33561+08	4.74933+06	0.00000
216.	400.	2.88361-15	971.2	1.42460-05	16.3	56.9	7.01489+06	3.17710+05	9.45692+07	4.35626+06	0.00000
227.	420.	1.99630-15	971.4	1.00717-05	16.0	58.5	3.84893+06	1.59999+05	6.71068+07	3.99807+06	0.00000
237.	440.	1.39468-15	971.4	7.10636-06	15.7	60.1	2.11953+06	8.09111+04	4.77195+07	3.67130+06	0.00000
248.	460.	9.82139-16	971.5	5.17475-06	15.3	61.8	1.17135+06	4.10833+04	3.40028+07	3.37301+06	0.00000
259.	480.	6.96711-16	971.5	3.76149-06	15.0	63.7	6.49619+05	2.09441+04	2.42777+07	3.10054+06	0.00000
270.	500.	4.97667-16	971.5	2.76591-06	14.5	65.9	3.61520+05	1.07195+04	1.73685+07	2.85150+06	3.24446+04
281.	520.	3.57820-16	971.5	2.05383-06	14.1	68.5	2.01879+05	5.50791+03	1.24499+07	2.62375+06	3.22056+04
291.	540.	2.58965-16	971.5	1.54264-06	13.6	71.5	1.13116+05	2.84105+03	8.94150+06	2.41536+06	3.19463+04
302.	560.	1.88748-16	971.5	1.17408-06	13.0	75.1	6.35931+04	1.47108+03	6.43410+06	2.22460+06	3.09041+04
313.	580.	1.38972-16	971.5	9.05969-07	12.4	79.4	3.58708+04	7.64616+02	4.63665+06	2.04987+06	3.02786+04
324.	600.	1.02852-16	971.5	7.09528-07	11.7	84.5	2.03003+04	3.98919+02	3.35052+06	1.88978+06	2.96692+04
335.	620.	7.65662-17	971.5	5.64387-07	11.0	90.5	1.15261+04	2.08904+02	2.42461+06	1.74297+06	2.90755+04
345.	640.	5.77259-17	971.5	4.56152-07	10.2	97.6	6.56548+03	1.09803+02	1.75783+06	1.60852+06	2.84960+04
356.	660.	4.39932-17	971.5	3.74604-07	9.5	105.8	3.79185+03	5.79264+01	1.27675+06	1.48476+06	2.79331+04
367.	680.	3.39274-17	971.5	3.12463-07	8.8	115.1	2.15082+03	3.06702+01	9.29025+05	1.37131+06	2.73835+04
378.	700.	2.65034-17	971.5	2.64522-07	8.1	125.4	1.23690+03	1.62975+01	6.77220+05	1.26710+06	2.68477+04
389.	720.	2.09902-17	971.5	2.27039-07	7.5	136.7	7.13547+02	8.69119+00	4.94548+05	1.17133+06	2.63254+04
399.	740.	1.68648-17	971.5	1.97317-07	6.9	148.7	4.12911+02	4.65132+00	3.61790+05	1.08329+06	2.58161+04
410.	760.	1.37505-17	971.5	1.73403-07	6.4	161.2	2.39677+02	2.49803+00	2.65136+05	1.00230+06	2.53194+04
421.	780.	1.13778-17	971.5	1.53876-07	6.0	173.8	1.39547+02	1.34828+00	1.94642+05	9.27765+05	2.48350+04
432.	800.	9.55074-18	971.5	1.37695-07	5.6	186.3	8.14942+01	7.28065-01	1.43136+05	8.59147+05	2.43625+04
443.	820.	8.12754-18	971.5	1.24097-07	5.3	198.4	4.77548+01	3.95088-01	1.05443+05	7.95943+05	2.39015+04
453.	840.	7.00515-18	971.5	1.12517-07	5.0	209.9	2.80437+01	2.15127-01	7.78065+04	7.37705+05	2.34518+04
464.	860.	6.10831-18	971.5	1.02535-07	4.8	220.6	1.65240+01	1.17632-01	5.75105+04	6.84015+05	2.30129+04
475.	880.	5.38193-18	971.5	9.38330-08	4.6	230.4	9.78483+00	6.44274-02	4.25799+04	6.34497+05	2.25846+04
486.	900.	4.78546-18	971.5	8.61736-08	4.5	239.3	5.78727+00	3.54343-02	3.15777+04	5.88806+05	2.21665+04
496.	920.	4.28895-18	971.5	7.93734-08	4.4	247.3	3.43979+00	1.95526-02	2.34569+04	5.46654+05	2.17585+04
507.	940.	3.87015-18	971.5	7.32915-08	4.3	254.4	2.05035+00	1.08243-02	1.74530+04	5.07687+05	2.13601+04
518.	960.	3.51249-18	971.5	6.78174-08	4.2	260.8	1.22561+00	6.01174-03	1.30068+04	4.71706+05	2.09712+04
529.	980.	3.20339-18	971.5	6.28642-08	4.1	266.5	7.34677-01	3.34959-03	9.70879+03	4.38490+05	2.05913+04
540.	1000.	2.93391-18	971.5	5.83621-08	4.1	271.7	4.41619-01	1.87226-03	7.25858+03	4.07701+05	2.02204+04

Reference [18], Test #37.

TABLE 4. Molecular and Atomic Oxygen Number Densities

Altitude, km	$n(O_2)$, cm^{-3}	$n(O)$, cm^{-3}	$n(O_2)/n(N_2)$	$n(O)/n(O_2)$
	Calculated from raw data:			
120	5.3 E 10	4.5 E 10	0.144	0.86
150	5.8 E 9	1.1 E 10	0.189	1.9
	Corrected for recombination of O to O_2 and CO_2:			
120	4.2 E 10	8.2 E 10	0.116	1.9
150	3.4 E 9	2.0 E 10	(0.109*)	6.0

* Value chosen by authors (see text).

TABLE 2. Nitrogen and Argon Number Densities*

Altitude, km	$n(N_2)$, cm^{-3}	$n(Ar)$, cm^{-3}	$n(Ar)/n(N_2)$
115	8.59 E 11	3.97 E 9	4.62 E-3
120	3.64 E 11	1.44 E 9	3.96 E-3
125	2.21 E 11	6.14 E 8	2.78 E-3
130	1.01 E 11	2.06 E 8	2.04 E-3
135	6.79 E 10	1.16 E 8	1.71 E-3
140	5.15 E 10	7.48 E 7	1.45 E-3
145	3.97 E 10	5.05 E 7	1.27 E-3
150	3.06 E 10		
155	2.35 E 10		

* Number densities probably accurate to ±15%. Read 8.59 E 11 as 8.59 × 10^{11}.

Test No. 37

NASA MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE DECEMBER 12, 1966 GM TIME 19 HRS 20 MINS LAT 58.73000 DEGS LONG -93.82000 DEGS

F10 162.00000 F10B 112.00000 AP 2.0000 EXOS TEMP 971.5306 HOUR ANG -340.8498

ALT (MM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
69.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
78.	140.	5.96176-12	622.3	7.96482-03	25.7	21.4	6.23337+10	9.70994+09	2.06538+10	1.98330+07	0.00000
86.	160.	1.56343-12	773.0	3.54407-03	24.7	27.9	2.04428+10	2.80105+09	9.95309+09	1.52172+07	0.00000
97.	180.	0.07927-13	838.3	1.82713-03	23.7	32.4	8.56668+09	1.05226+09	5.78943+09	1.27713+07	0.00000
108.	200.	5.07808-13	906.7	1.01792-03	22.8	35.9	4.01081+09	4.45516+08	3.66513+09	1.11569+07	0.00000
119.	220.	1.67532-13	934.3	5.96227-04	21.8	38.8	1.98878+09	2.00706+08	2.42342+09	9.94675+06	0.00000
130.	240.	9.99730-14	950.1	3.62321-04	20.9	41.5	1.01852+09	9.36400+07	1.64152+09	8.98650+06	0.00000
140.	260.	5.70995-14	959.1	2.26722-04	20.1	43.9	5.31848+08	4.46228+07	1.12781+09	8.13405+06	0.00000
151.	280.	3.50297-14	964.3	1.45361-04	19.3	46.1	2.81219+08	2.15563+07	7.81789+08	7.40674+06	0.00000
162.	300.	2.20550-14	967.3	9.51342-05	18.6	48.2	1.49997+08	1.05160+07	5.45169+08	6.76042+06	0.00000
173.	320.	1.41994-14	969.1	6.33661-05	18.1	50.2	8.05308+07	5.16719+06	3.81806+08	6.18023+06	0.00000
183.	340.	9.31946-15	970.1	4.28482-05	17.5	52.0	4.34661+07	2.55416+06	2.66295+08	5.65621+06	0.00000
194.	360.	6.21676-15	970.7	2.93556-05	17.1	53.7	2.35686+07	1.26910+06	1.89062+08	5.18111+06	0.00000
205.	380.	4.20904-15	971.0	2.03444-05	16.7	55.3	1.26330+07	6.33574+05	1.33561+08	4.74933+06	0.00000
216.	400.	2.88361-15	971.2	1.42460-05	16.3	56.9	7.01469+06	3.17710+05	9.45692+07	4.35628+06	0.00000
227.	420.	1.99630-15	971.4	1.00717-05	16.0	58.5	3.84893+06	1.59999+05	6.71068+07	3.99807+06	0.00000
237.	440.	1.39468-15	971.4	7.18636-06	15.7	60.1	2.11953+06	8.09111+04	4.77195+07	3.67130+06	0.00000
248.	460.	9.82139-16	971.5	5.17475-06	15.3	61.8	1.17135+06	4.10833+04	3.40028+07	3.37301+06	0.00000
259.	480.	6.96711-16	971.5	3.76149-06	15.0	63.7	6.49619+05	2.09441+04	2.42777+07	3.10054+06	0.00000
270.	500.	4.97687-16	971.5	2.76591-06	14.5	65.9	3.61520+05	1.07195+04	1.73685+07	2.85150+06	3.24448+04
281.	520.	3.57820-16	971.5	2.05363-06	14.1	68.5	2.01879+05	5.50791+03	1.24499+07	2.62375+06	3.22056+04
291.	540.	2.58969-16	971.5	1.54284-06	13.6	71.5	1.13116+05	2.84105+03	8.94150+06	2.41536+06	3.15463+04
302.	560.	1.88746-16	971.5	1.17406-06	13.0	75.1	6.35931+04	1.47108+03	6.43410+06	2.22460+06	3.09041+04
313.	580.	1.38972-16	971.5	9.05969-07	12.4	79.4	3.58708+04	7.64616+02	4.63865+06	2.04987+06	3.02786+04
324.	600.	1.02952-16	971.5	7.09528-07	11.7	84.5	2.03003+04	3.98919+02	3.35052+06	1.88978+06	2.96692+04
335.	620.	7.65662-17	971.5	5.64367-07	11.0	90.5	1.15261+04	2.08904+02	2.42461+06	1.74297+06	2.90755+04
345.	640.	5.77285-17	971.5	4.56152-07	10.2	97.6	6.56548+03	1.09803+02	1.75783+06	1.60832+06	2.84969+04
356.	660.	4.39932-17	971.5	3.74604-07	9.5	105.8	3.75185+03	5.79264+01	1.27875+06	1.48478+06	2.79331+04
367.	680.	3.39274-17	971.5	3.12463-07	8.8	115.1	2.15082+03	3.06702+01	9.29029+05	1.37131+06	2.73833+04
378.	700.	2.65034-17	971.5	2.64522-07	8.1	125.4	1.23690+03	1.62975+01	6.77220+05	1.26710+06	2.68477+04
389.	720.	2.09902-17	971.5	2.27039-07	7.5	136.7	7.13547+02	8.69119+00	4.94548+05	1.17133+06	2.63264+04
399.	740.	1.68645-17	971.5	1.97317-07	6.9	148.7	4.12911+02	4.65132+00	3.61790+05	1.08329+06	2.58181+04
410.	760.	1.37905-17	971.5	1.73403-07	6.4	161.2	2.39677+02	2.49803+00	2.65136+05	1.00230+06	2.53194+04
421.	780.	1.13778-17	971.5	1.53878-07	6.0	173.8	1.39547+02	1.34628+00	1.94642+05	9.27765+05	2.48330+04
432.	800.	9.55874-18	971.5	1.37695-07	5.6	186.3	8.14942+01	7.28065-01	1.43136+05	8.59147+05	2.43625+04
443.	820.	8.12754-18	971.5	1.24097-07	5.3	198.4	4.77348+01	3.95088-01	1.05443+05	7.95945+05	2.39015+04
453.	840.	7.00515-18	971.5	1.12517-07	5.0	209.9	2.80437+01	2.15127-01	7.78065+04	7.37705+05	2.34518+04
464.	860.	6.10631-18	971.5	1.02539-07	4.8	220.6	1.65240+01	1.17532-01	5.75105+04	6.84015+05	2.30129+04
475.	880.	5.38193-18	971.5	9.38330-08	4.6	230.4	9.76483+00	6.44274-02	4.25799+04	6.34497+05	2.25846+04
486.	900.	4.78546-18	971.5	8.61736-08	4.5	239.3	5.78727+00	3.54343-02	3.15777+04	5.88808+05	2.21665+04
496.	920.	4.28695-18	971.5	7.93734-08	4.4	247.3	3.43979+00	1.95526-02	2.34569+04	5.46834+05	2.17585+04
507.	940.	3.87015-18	971.5	7.32915-08	4.3	254.4	2.05035+00	1.08243-02	1.74530+04	5.07887+05	2.13601+04
518.	960.	3.51245-18	971.5	6.78174-08	4.2	260.8	1.22561+00	6.01174-03	1.30068+04	4.71706+05	2.09712+04
528.	980.	3.20339-18	971.5	6.28642-08	4.1	266.5	7.34677-01	3.34959-03	9.70879+03	4.38450+05	2.05913+04
540.	1000.	2.93351-18	971.5	5.83621-08	4.1	271.7	4.41619-01	1.87226-03	7.25658+03	4.07701+05	2.02204+04

Test #38
Reference [19]

ALT.	N_2	O_2	O
115	6.5×10^{11}	1.5×10^{11}	9.8×10^{10}
120	4.0×10^{11}	9.0×10^{10}	7.8×10^{10}
130	1.2×10^{11}	2.9×10^{10}	3.9×10^{10}
140	5.8×10^{10}	1.7×10^{10}	2.8×10^{10}
150	3.4×10^{10}	1.0×10^{10}	1.9×10^{10}
155	2.9×10^{10}	9.0×10^{9}	1.7×10^{10}

Test No. 38

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE DECEMBER 12, 1966 GM TIME 19 HRS 20 MINS LAT 58.73000 DEGS LONG -95.82000 DEGS

F10 162.00000 F10B 113.00000 AP 2.0000 EXOS TEMP 971.5306 HOUR ANG -340.8498

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
60.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
70.	140.	3.96178-12	622.3	7.96482-03	25.7	21.4	6.23337+10	9.70994+09	2.06538+10	1.98330+07	0.00000
80.	160.	1.36343-12	773.0	3.54407-03	24.7	27.9	2.04428+10	2.80105+09	9.95309+09	1.52172+07	0.00000
90.	180.	6.07927-13	858.3	1.82713-03	23.7	32.4	8.56666+09	1.05226+09	5.78943+09	1.27713+07	0.00000
100.	200.	3.07508-13	906.7	1.01792-03	22.8	35.9	4.01081+09	4.45518+08	3.66513+09	1.11569+07	0.00000
110.	220.	1.67532-13	934.3	5.96227-04	21.8	38.8	1.98878+09	2.00706+08	2.42342+09	9.94675+06	0.00000
120.	240.	9.59730-14	950.1	3.62321-04	20.9	41.5	1.01852+09	9.36400+07	1.64152+09	8.96650+06	0.00000
130.	260.	5.70993-14	959.1	2.26722-04	20.1	43.9	5.31848+08	4.46226+07	1.12781+09	8.13405+06	0.00000
140.	280.	3.50297-14	964.3	1.45361-04	19.3	46.1	2.81219+08	2.15563+07	7.81789+08	7.40674+06	0.00000
150.	300.	2.20950-14	967.3	9.51342-05	18.6	48.2	1.49997+08	1.05160+07	5.45169+08	6.76042+06	0.00000
160.	320.	1.41994-14	969.1	6.33661-05	18.1	50.2	8.05308+07	5.16719+06	3.81806+08	6.18023+06	0.00000
170.	340.	9.31948-15	970.1	4.28482-05	17.5	52.0	4.54661+07	2.55416+06	2.68295+08	5.65621+06	0.00000
180.	360.	6.21678-15	970.7	2.93556-05	17.1	53.7	2.35686+07	1.26910+06	1.89062+08	5.18111+06	0.00000
190.	380.	4.20904-15	971.0	2.03444-05	16.7	55.3	1.28330+07	6.33574+05	1.33561+08	4.74935+06	0.00000
200.	400.	2.88361-15	971.2	1.42460-05	16.3	56.9	7.01469+06	3.17710+05	9.45892+07	4.35628+06	0.00000
210.	420.	1.99630-15	971.4	1.00717-05	16.0	58.5	3.84893+06	1.59999+05	6.71068+07	3.99807+06	0.00000
220.	440.	1.39462-15	971.4	7.18838-06	15.7	60.1	2.11953+06	8.09111+04	4.77195+07	3.67130+06	0.00000
230.	460.	9.82139-16	971.5	5.17475-06	15.5	61.8	1.17135+06	4.10833+04	3.40028+07	3.37301+06	0.00000
240.	480.	6.96711-16	971.5	3.76149-06	15.0	63.7	6.49619+05	2.09441+04	2.42777+07	3.10054+06	0.00000
250.	500.	4.97667-16	971.5	2.76591-06	14.5	65.9	3.61520+05	1.07195+04	1.73685+07	2.85150+06	3.24448+04
260.	520.	3.57820-16	971.5	2.05363-06	14.1	68.5	2.01879+05	5.50791+03	1.24499+07	2.62375+06	3.22056+04
270.	540.	2.58969-16	971.5	1.54264-06	13.6	71.5	1.13116+05	2.84105+03	8.94150+06	2.41536+06	3.15463+04
280.	560.	1.88746-16	971.5	1.17408-06	13.0	75.1	6.35931+04	1.47108+03	6.43410+06	2.22460+06	3.09041+04
290.	580.	1.38572-16	971.5	9.05969-07	12.4	79.4	3.58708+04	7.64616+02	4.63865+06	2.04987+06	3.02786+04
300.	600.	1.02592-16	971.5	7.09528-07	11.7	84.5	2.03003+04	3.98919+02	3.35052+06	1.88978+06	2.96692+04
310.	620.	7.65662-17	971.5	5.64367-07	11.0	90.5	1.15261+04	2.08904+02	2.42461+06	1.74297+06	2.90755+04
320.	640.	5.77255-17	971.5	4.56152-07	10.2	97.6	6.56548+03	1.09603+02	1.75783+06	1.60832+06	2.84969+04
330.	660.	4.39932-17	971.5	3.74604-07	9.5	105.8	3.75185+03	5.79264+01	1.27675+06	1.48478+06	2.79331+04
340.	680.	3.39274-17	971.5	3.12463-07	8.8	115.1	2.15082+03	3.06702+01	9.29025+05	1.37131+06	2.73839+04
350.	700.	2.63034-17	971.5	2.64522-07	8.1	125.4	1.23690+03	1.62975+01	6.77220+05	1.26710+06	2.68477+04
360.	720.	2.09902-17	971.5	2.27039-07	7.5	136.7	7.13547+02	8.69119+00	4.94548+05	1.17133+06	2.63254+04
370.	740.	1.69649-17	971.5	1.97317-07	6.9	148.7	4.12911+02	4.65132+00	3.61790+05	1.08328+06	2.58161+04
380.	760.	1.37909-17	971.5	1.73403-07	6.4	161.2	2.39677+02	2.49803+00	2.65136+05	1.00230+06	2.53194+04
390.	780.	1.13778-17	971.5	1.53878-07	6.0	173.8	1.39547+02	1.34628+00	1.94642+05	9.27765+05	2.48350+04
400.	800.	9.55074-18	971.5	1.37695-07	5.6	186.3	8.14942+01	7.28065-01	1.43138+05	8.59147+05	2.43625+04
410.	820.	8.12754-18	971.5	1.24097-07	5.3	198.4	4.77348+01	3.95088-01	1.05443+05	7.95945+05	2.39015+04
420.	840.	7.00515-18	971.5	1.12517-07	5.0	209.9	2.80437+01	2.15127-01	7.78065+04	7.37705+05	2.34518+04
430.	860.	6.10831-18	971.5	1.02535-07	4.8	220.6	1.65240+01	1.17532-01	5.75105+04	6.84015+05	2.30129+04
440.	880.	5.38193-18	971.5	9.38330-08	4.6	230.4	9.76483+00	6.44274-02	4.25799+04	6.34497+05	2.25846+04
450.	900.	4.78546-18	971.5	8.61736-08	4.5	239.3	5.78727+00	3.54343-02	3.15777+04	5.88608+05	2.21665+04
460.	920.	4.28695-18	971.5	7.93734-08	4.4	247.3	3.43979+00	1.95526-02	2.34569+04	5.46634+05	2.17585+04
470.	940.	3.87015-18	971.5	7.32915-08	4.3	254.4	2.05035+00	1.08243-02	1.74530+04	5.07687+05	2.13601+04
480.	960.	3.51245-18	971.5	6.78174-08	4.2	260.8	1.22561+00	6.01174-03	1.30068+04	4.71706+05	2.09712+04
490.	980.	3.20339-18	971.5	6.28642-08	4.1	266.5	7.34677-01	3.34959-03	9.70879+03	4.38450+05	2.05913+04
500.	1000.	2.93351-18	971.5	5.83621-08	4.1	271.7	4.41619-01	1.87226-03	7.25858+03	4.07701+05	2.02204+04

Test #39
Reference [19]

ALT.	N_2	O_2	O
115	3.2×10^{11}	5.8×10^{10}	7.1×10^{10}
120	2.1×10^{11}	3.5×10^{10}	5.5×10^{10}
130	7.3×10^{10}	1.2×10^{10}	2.7×10^{10}
140	3.0×10^{10}	3.3×10^{9}	1.7×10^{10}
150	1.2×10^{10}	(5.5×10^{8})	1.1×10^{10}
155	1.0×10^{10}		9.9×10^{9}

Test No. 39

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE DECEMBER 11, 1965 GM TIME 4 HRS 43 MINS LAT 39.60000 DEGS LONG 9.40000 DEGS

F10 76.00000 F10B 78.00000 AP 16.0000 EXOS TEMP 721.2706 HOUR ANG -97.3880

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (DK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
65.	120.	2.45946-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
74.	140.	4.13965-12	516.2	6.94535-03	25.6	17.9	6.47179+10	9.86842+09	2.28619+10	2.18408+07	0.00000
86.	160.	1.23600-12	606.0	2.56654-03	24.3	22.3	1.80342+10	2.34422+09	1.02836+10	1.68285+07	0.00000
97.	180.	4.68273-13	656.3	1.11423-03	22.9	25.7	6.19132+09	6.98712+08	5.39505+09	1.38951+07	0.00000
108.	200.	2.02464-13	684.5	5.32734-04	21.6	28.5	2.34875+09	2.32182+08	3.04525+09	1.18529+07	0.00000
119.	220.	9.55553-14	700.4	2.72521-04	20.4	31.1	9.39901+08	8.17852+07	1.78675+09	1.02837+07	0.00000
130.	240.	4.61371-14	709.4	1.46726-04	19.4	33.5	3.87918+08	2.98000+07	1.07168+09	9.00628+06	0.00000
140.	260.	2.55301-14	714.9	8.22216-05	18.4	35.8	1.63208+08	1.10904+07	6.51446+08	7.93081+06	0.00000
151.	280.	1.41118-14	717.4	4.75537-05	17.7	37.5	6.95591+07	4.18897+06	3.99462+08	7.00727+06	0.00000
162.	300.	8.08302-15	719.0	2.82069-05	17.1	39.1	2.99277+07	1.59748+06	2.46458+08	6.20490+06	0.00000
173.	320.	4.72992-15	720.0	1.70810-05	16.6	40.6	1.29733+07	6.14658+05	1.52776+08	5.50295+06	0.00000
183.	340.	2.83330-15	720.5	1.05286-05	16.1	42.0	5.65978+06	2.58213+05	9.50730+07	4.88620+06	0.00000
194.	360.	1.72598-15	720.8	6.59569-06	15.7	43.5	2.48336+06	9.29235+04	5.93666+07	4.34261+06	0.00000
205.	380.	1.06619-15	721.0	4.19832-06	15.2	45.1	1.09548+06	3.64693+04	3.71868+07	3.86314+06	0.00000
216.	400.	6.66889-16	721.1	2.71773-06	14.7	47.0	4.85719+05	1.43965+04	2.33626+07	3.43914+06	0.00000
227.	420.	4.21660-16	721.2	1.79250-06	14.1	49.3	2.16430+05	5.71535+03	1.47196+07	3.06393+06	0.00000
237.	440.	2.69789-16	721.2	1.20770-06	13.4	52.2	9.69066+04	2.28155+03	9.29991+06	2.73160+06	0.00000
248.	460.	1.74743-16	721.2	8.33647-07	12.6	55.9	4.35973+04	9.15762+02	5.89161+06	2.45699+06	0.00000
259.	480.	1.14789-16	721.3	5.91241-07	11.6	60.7	1.97065+04	3.69546+02	3.74272+06	2.17563+06	0.00000
270.	500.	7.71116-17	721.3	4.59752-07	10.1	70.7	8.94905+03	1.49921+02	2.38387+06	1.94360+06	2.81136+05
281.	520.	5.26298-17	721.3	3.52885-07	8.9	80.0	4.08267+03	6.11418+01	1.52237+06	1.73747+06	2.80356+05
291.	540.	3.67496-17	721.3	2.79126-07	7.9	91.2	1.67107+03	2.50655+01	9.74737+05	1.55420+06	2.72654+05
302.	560.	2.63372-17	721.3	2.27300-07	6.9	104.2	8.61366+02	1.03290+01	6.25716+05	1.39117+06	2.65204+05
313.	580.	1.94163-17	721.3	1.89882-07	6.1	118.7	3.98335+02	4.27817+00	4.02696+05	1.24603+06	2.57999+05
324.	600.	1.47415-17	721.3	1.62069-07	5.5	134.2	1.85023+02	1.78099+00	2.59824+05	1.11675+06	2.51030+05
335.	620.	1.15233-17	721.3	1.40778-07	4.9	150.0	8.63204+01	7.45154-01	1.68063+05	1.00150+06	2.44287+05
345.	640.	9.25854-18	721.3	1.24007-07	4.5	165.4	4.04477+01	3.13325-01	1.08980+05	8.98714+05	2.37762+05
356.	660.	7.62495-18	721.3	1.10445-07	4.1	179.9	1.90349+01	1.32400-01	7.08423+04	8.06971+05	2.31447+05
367.	680.	6.41484-18	721.3	9.92202-08	3.9	193.2	8.99639+00	5.62224-02	4.61639+04	7.29038+05	2.25334+05
378.	700.	5.49344-18	721.3	8.97466-08	3.7	205.3	4.27003+00	2.39904-02	3.01555+04	6.51819+05	2.19416+05
389.	720.	4.77260-18	721.3	8.16207-08	3.5	216.1	2.03526+00	1.02663-02	1.97489+04	5.86346+05	2.13686+05
399.	740.	4.19414-18	721.3	7.45599-08	3.4	225.9	9.74158-01	4.43150-03	1.29605+04	5.27765+05	2.08136+05
410.	760.	3.71919-18	721.3	6.83614-08	3.3	234.9	4.66203-01	1.91822-03	8.52702+03	4.75316+05	2.02760+05
421.	780.	3.32144-18	721.3	6.28758-08	3.2	243.3	2.25955-01	8.34229-04	5.62529+03	4.28334+05	1.97553+05
432.	800.	2.98278-18	721.3	5.79904-08	3.1	251.2	1.09491-01	3.64496-04	3.71701+03	3.86219+05	1.92507+05
443.	820.	2.69053-18	721.3	5.36178-08	3.0	258.0	5.32707-02	1.59994-04	2.46264+03	3.48446+05	1.87616+05
453.	840.	2.43560-18	721.3	4.96884-08	2.9	266.6	2.60218-02	7.05510-05	1.63531+03	3.14547+05	1.82877+05
464.	860.	2.21132-18	721.3	4.61457-08	2.9	274.2	1.27618-02	3.12517-05	1.08839+03	2.84106+05	1.78282+05
475.	880.	2.01270-18	721.3	4.29430-08	2.8	281.9	6.28342-03	1.39059-05	7.26017+02	2.56757+05	1.73827+05
486.	900.	1.83588-18	721.3	4.00409-08	2.8	289.8	3.10582-03	6.21529-06	4.85376+02	2.32168+05	1.69507+05
496.	920.	1.67781-18	721.3	3.74058-08	2.7	297.9	1.54113-03	2.79027-06	3.25216+02	2.10052+05	1.65316+05
507.	940.	1.53606-18	721.3	3.50087-08	2.6	306.2	7.67661-04	1.25617-06	2.18362+02	1.90147+05	1.61254+05
518.	960.	1.40859-18	721.3	3.28243-08	2.6	314.8	3.83844-04	5.69800-07	1.46963+02	1.72281+05	1.57311+05
529.	980.	1.29372-18	721.3	3.08305-08	2.5	323.7	1.92656-04	2.59168-07	9.91149+01	1.56070+05	1.53485+05
540.	1000.	1.19008-18	721.3	2.90079-08	2.5	332.9	9.70590-05	1.18386-07	6.69882+01	1.41509+05	1.49773+05

Test #40
Reference [20]

ALT (km)	$O_2(cm^{-3})$
110	1.9×10^{11}
120	8.0×10^{10}
130	2.3×10^{10}
140	9.4×10^{9}
150	3.8×10^{9}

Test No. 40

MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

DATE MARCH 15, 1967 GM TIME 1 HRS 0 MINS LAT -31.00000 DEGS LONG -136.00000 DEGS

F10 133.00000 F10B 146.00000 AP 6.0000 EXOS TEMP 1146.4836 HOUR ANG -302.6895

ALT (NM)	ALT (KM)	DENSITY (GM/CM3)	TEMP (OK)	PRESSURE (DYNE/CM2)	MOL. WT (UNITLESS)	SCALE HT (KM)	NUMBER DENSITY (CM-3) N(N2)	N(O2)	N(O)	N(HE)	N(H)
85.	120.	2.45948-11	355.0	2.70030-02	26.9	11.6	4.00000+11	7.50000+10	7.60000+10	3.40000+07	0.00000
78.	140.	3.85884-12	679.4	8.44410-03	25.8	23.3	6.08369+10	9.56309+09	1.96169+10	1.89369+07	0.00000
86.	160.	1.39690-12	870.0	4.05636-03	24.9	31.1	2.11531+10	2.96211+09	9.64823+09	1.44366+07	0.00000
97.	180.	6.62919-13	982.2	2.24959-03	24.1	36.6	9.55013+09	1.21459+09	5.81436+09	1.21463+07	0.00000
108.	200.	3.57609-13	1048.6	1.34153-03	23.2	40.7	4.85204+09	5.65446+08	3.83957+09	1.06806+07	0.00000
119.	220.	2.07512-13	1088.0	8.36858-04	22.4	44.0	2.62223+09	2.81349+08	2.65893+09	9.60773+06	0.00000
130.	240.	1.26239-13	1111.4	5.39003-04	21.6	46.9	1.46785+09	1.45405+08	1.89125+09	8.75219+06	0.00000
140.	260.	7.94530-14	1125.4	3.55917-04	20.9	49.5	8.39332+08	7.69002+07	1.36681+09	8.03145+06	0.00000
151.	280.	5.13549-14	1133.8	2.39908-04	20.2	51.9	4.86531+08	4.12793+07	9.97706+08	7.40278+06	0.00000
162.	300.	3.39366-14	1138.8	1.64584-04	19.5	54.2	2.84660+08	2.23856+07	7.33096+08	6.84234+06	0.00000
173.	320.	2.28590-14	1141.8	1.14652-04	18.9	56.4	1.67683+08	1.22309+07	5.41165+08	6.33591+06	0.00000
183.	340.	1.56587-14	1143.6	8.09499-05	18.4	58.5	9.92992+07	6.72219+06	4.00874+08	5.87441+06	0.00000
194.	360.	1.08877-14	1144.7	5.78366-05	17.9	60.5	5.90625+07	3.71282+06	2.97779+08	5.45163+06	0.00000
205.	380.	7.67109-15	1145.4	4.17594-05	17.5	62.3	3.52656+07	2.05961+06	2.21721+08	5.06300+06	0.00000
216.	400.	5.46838-15	1145.8	3.04354-05	17.1	64.1	2.11309+07	1.14709+06	1.65438+08	4.70496+06	0.00000
227.	420.	3.93859-15	1146.1	2.23706-05	16.8	65.8	1.27034+07	6.41272+05	1.23683+08	4.37460+06	0.00000
237.	440.	2.86267-15	1146.2	1.65707-05	16.5	67.5	7.66119+06	3.59793+05	9.26374+07	4.06944+06	0.00000
248.	460.	2.09745-15	1146.3	1.23636-05	16.2	69.1	4.63454+06	2.02574+05	6.95079+07	3.78733+06	0.00000
259.	480.	1.54779-15	1146.4	9.28857-06	15.9	70.8	2.81205+06	1.14447+05	5.22437+07	3.52634+06	0.00000
270.	500.	1.14953-15	1146.4	7.02748-06	15.6	72.5	1.71126+06	6.48769+04	3.93341+07	3.28476+06	1.17336+04
281.	520.	8.58726-16	1146.4	5.35190-06	15.3	74.4	1.04444+06	3.68995+04	2.96641+07	3.06102+06	1.17019+04
291.	540.	6.44983-16	1146.5	4.10421-06	15.0	76.4	6.39289+05	2.10562+04	2.24082+07	2.85370+06	1.14986+04
302.	560.	4.86890-16	1146.5	3.17024-06	14.6	78.6	3.92417+05	1.20546+04	1.69548+07	2.66151+06	1.13000+04
313.	580.	3.69378-16	1146.5	2.46759-06	14.3	81.1	2.41559+05	6.92347+03	1.28492+07	2.48327+06	1.11059+04
324.	600.	2.81801-16	1146.5	1.93635-06	13.9	84.0	1.49112+05	3.98917+03	9.75339+06	2.31789+06	1.09162+04
335.	620.	2.15749-16	1146.5	1.53273-06	13.4	87.2	9.23000+04	2.30576+03	7.41517+06	2.16436+06	1.07308+04
345.	640.	1.66143-16	1146.5	1.22452-06	12.9	91.0	5.72906+04	1.33693+03	5.64635+06	2.02183+06	1.05496+04
356.	660.	1.28633-16	1146.5	9.87919-07	12.4	95.4	3.56571+04	7.77591+02	4.30615+06	1.88940+06	1.03724+04
367.	680.	1.00163-16	1146.5	8.05286-07	11.9	100.4	2.22526+04	4.53662+02	3.28912+06	1.76633+06	1.01992+04
378.	700.	7.84752-17	1146.5	6.63470-07	11.3	106.2	1.39243+04	2.65486+02	2.51613+06	1.65191+06	1.00299+04
389.	720.	6.18931-17	1146.5	5.52640-07	10.7	112.8	8.73616+03	1.55835+02	1.92773+06	1.54548+06	9.86427+03
399.	740.	4.91668-17	1146.5	4.69426-07	10.1	120.3	5.49550+03	9.17471+01	1.47914+06	1.44645+06	9.70231+03
410.	760.	3.93612-17	1146.5	3.98280-07	9.5	128.7	3.46598+03	5.41760+01	1.13663+06	1.35428+06	9.54390+03
421.	780.	3.17743-17	1146.5	3.41017-07	8.9	137.9	2.19162+03	3.20861+01	8.74725+05	1.26844+06	9.38894+03
432.	800.	2.58780-17	1146.5	2.96466-07	8.3	148.1	1.38937+03	1.90586+01	6.74153+05	1.18848+06	9.25734+03
443.	820.	2.12734-17	1146.5	2.60224-07	7.8	159.0	8.83029+02	1.13534+01	5.20327+05	1.11397+06	9.08902+03
453.	840.	1.76587-17	1146.5	2.30457-07	7.3	170.5	5.62633+02	6.78286+00	4.02179+05	1.04450+06	8.94368+03
464.	860.	1.48050-17	1146.5	2.05767-07	6.9	182.6	3.59385+02	4.06586+00	3.11302+05	9.79711+05	8.80184+03
475.	880.	1.25381-17	1146.5	1.85080-07	6.5	195.1	2.30129+02	2.44171+00	2.41302+05	9.19269+05	8.66283+03
486.	900.	1.07253-17	1146.5	1.67572-07	6.1	207.6	1.47724+02	1.47119+00	1.87304+05	8.62858+05	8.52676+03
496.	920.	9.26502-18	1146.5	1.52607-07	5.8	220.1	9.50575+01	8.88902-01	1.45593+05	8.10191+05	8.39355+03
507.	940.	8.07960-18	1146.5	1.39689-07	5.5	232.3	6.13158+01	5.38565-01	1.13327+05	7.61002+05	8.26314+03
518.	960.	7.10936-18	1146.5	1.28437-07	5.3	244.0	3.96460+01	3.27199-01	8.83522+04	7.15043+05	8.13546+03
529.	980.	6.30832-18	1146.5	1.18548-07	5.1	255.2	2.56956+01	1.99327-01	6.89439+04	6.72049+05	8.01043+03
540.	1000.	5.64103-18	1146.5	1.09788-07	4.9	265.8	1.66933+01	1.21756-01	5.38838+04	6.31927+05	7.88798+03

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A COLLECTION OF LOWER THERMOSPHERIC (100 TO 300 KM ALTITUDE) CHEMICAL COMPOSITION, TEMPERATURE, AND MASS DENSITY DATA

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This document has also been reviewed and approved for technical accuracy.

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