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SELECTED NEUTRAL SPECIES PROFILES, 0-100 KM.(U)
JUL 77 F E NILES, J M HEIMERL
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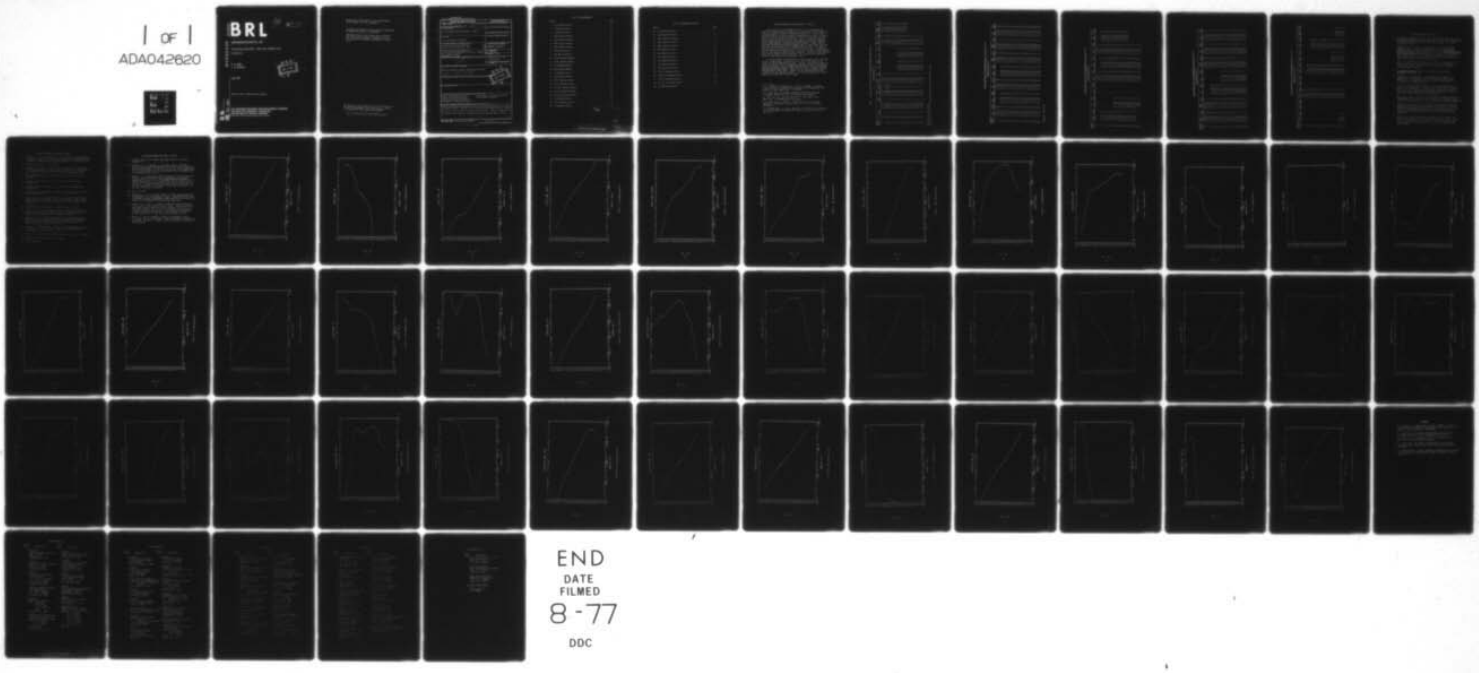

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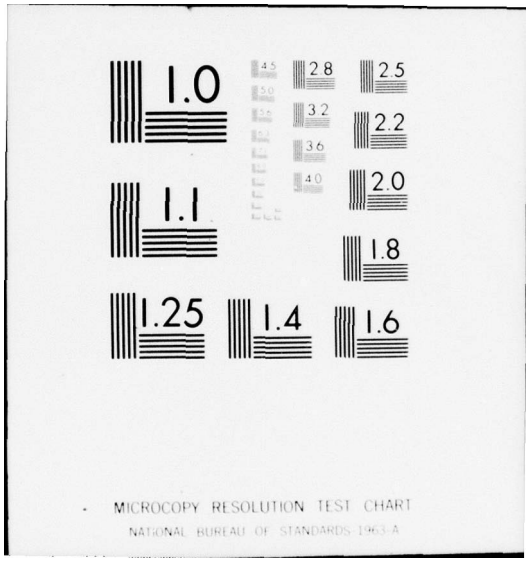
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MEMORANDUM REPORT NO. 2767

SELECTED NEUTRAL SPECIES PROFILES, 0-100 km

F. E. Niles
J. M. Heimerl

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Neutral density profiles

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Daytime and nighttime concentration profiles have been assembled for the following neutral species: CO, CO_2, H, H_2, H_2O, H_2O_2, HNO_2, HNO_3, HO, HO_2, N, $N(^2D)$, NO, NO_2, N_2, N_2O, O, $O(^1D)$, O_2, $O_2(^1\Delta)$, $O_2(^1\Sigma)$ and O_3. Values for each species concentration are given in 5 km intervals for the altitude range 0-100 km.

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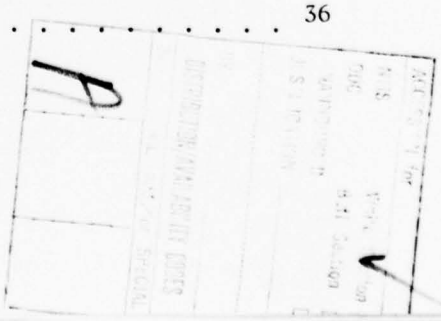
LIST OF ILLUSTRATIONS



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SELECTED NEUTRAL SPECIES PROFILES, 0-100 km

The multispecies code AIRCHEM[1] has been used to understand and predict the charged particle composition of the earth's stratosphere and mesosphere under a variety of excitation conditions.[2-4] Such a code requires profiles of neutral species concentrations as input. The major species N_2 and O_2 present few problems. However, self-consistent profiles for most of the minor species were not and are not yet available. Recourse has been made to specific measurements, other model computations, interpolations, extrapolations and estimates. Table I and its attendant references describe the neutral species input values that have been used in the versions of the AIRCHEM code since 1974. No claim is made that these are necessarily self-consistent profiles. Fortunately, we have found that the minor species concentrations tend to be determined more by the chemistry than the initial profiles. (However, should reliable minor species profiles become available, they would provide additional checks or constraints on an atmospheric model.)

It is the purpose of this document to record those values that were and are actually used. Explanations as to why a particular set of values was chosen are beyond its scope. The basic data of this report is listed in Table I. The 39 accompanying profiles of each of the species used in the AIRCHEM code were generated from Table I using the standard CALCOMP interpolation scheme. (Note that CO listed in Table I has not been employed in this code.) Figures 1-21 are daytime profiles and Figures 22-39 are nighttime profiles. The initial profiles of N, $N(^2D)$ and $O(^1D)$ are taken to be zero at night.

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[1] E. L. Lortie, M. D. Kregel and F. E. Niles, "AIRCHEM: A Computational Technique for Modeling the Chemistry of the Atmosphere," BRL Report No. 1913, August 1976. (AD #A030157)

[2] F. E. Niles and J. M. Heimerl, "Computed Results for Disturbed Atmospheric Conditions in the Stratosphere and Mesosphere: N_o - 10^{11} cm^{-3}, Q_o = 10^8 ion-pairs $cm^{-3}s^{-1}$," BRL IMR No. 484, March 1976. To be published as BRL Report.

[3] F. E. Niles and J. M. Heimerl, "Computed Results for Disturbed Atmospheric Conditions at 60 km," July 1976. To be published as BRL Report.

[4] J. M. Heimerl and F. E. Niles, "Modeling of Charged Particle Chemistry in the Stratosphere and Mesosphere," Trans. Am. Geophys. Union 57, 303, 1976.

TABLE I. NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM

Number Densities (m^{-3})

Geometric Altitude (km)	T (K)	Ref/ Remarks	M‡	Ref/ Remarks	CO (Day & Night)	Ref/ Remarks	CO_2 (Day & Night)	Ref/ Remarks	H (Day)	Ref/ Remarks	H (Night)	Ref/ Remarks	HNO_2 (Day & Night)	Ref/ Remarks	HNO_3 (Day & Night)	Ref/ Remarks
0	288	1	2.55 [25]*	1	4.8 [18]	3,4	8.2 [21]	4	-				3.1 [14]	10	5.0 [16]	10
5	256	1	1.53 [25]	1	2.0 [18]	3,4	4.9 [21]	4	-		-		1.1 [14]	10	1.9 [16]	10
10	223	1	8.60 [24]	1	1.1 [18]	3,4,5,6	2.8 [21]	4	-		-		1.5 [13]	10	1.8 [16]	10
15	217	1	4.05 [24]	1	1.6 [17]	3,4,5,6	1.3 [21]	4	-		-		5.0 [12]	10	6.0 [16]	10
20	217	1	1.85 [24]	1	9.3 [15]	3	5.9 [20]	7	-		-		1.6 [12]	10	1.9 [16]	10
25	222	1,2	8.11 [23]	2	4.1 [15]	3	2.6 [20]	7	-		-		6.8 [11]	10	6.0 [15]	10
30	231	2	3.69 [23]	2	1.8 [15]	3	1.2 [20]	7	-		-		5.6 [11]	10	1.0 [15]	10
35	242	2	1.72 [23]	2	8.6 [14]	3	5.5 [19]	7	-		-		5.4 [11]	10	2.0 [14]	10
40	255	2	8.27 [22]	2	4.1 [14]	3	2.7 [19]	7	1.0 [10]	8	1.0 [10]	8	4.4 [11]	10	2.0 [13]	10
45	268	2	4.15 [22]	2	2.1 [14]	3	1.3 [19]	7	2.5 [11]	8	2.5 [11]	8	1.8 [11]	10	8.0 [11]	10
50	272	2	2.20 [22]	2	1.1 [14]	3	7.1 [18]	7	5.6 [11]	8	5.4 [11]	8	4.0 [10]	10	3.0 [10]	10
55	264	2	1.21 [22]	2	6.1 [13]	3	3.9 [18]	7	1.2 [12]	8	1.1 [12]	8	7.0 [9]	10	1.0 [9]	est
60	249	2	6.67 [21]	2	3.3 [13]	3	2.1 [18]	7	2.0 [12]	9	1.8 [12]	8	3.3 [9]	11	3.5 [7]	est
65	233	2	3.57 [21]	2	1.8 [13]	3	1.1 [18]	7	3.5 [12]	9	3.0 [12]	8	1.8 [9]	11	-	
70	216	2	1.82 [21]	2	9.1 [13]	7	5.8 [17]	7	3.1 [13]	9	5.6 [12]	8	9.1 [8]	11	-	
75	205	2	8.70 [20]	2	5.2 [14]	7	2.6 [17]	7	1.0 [14]	9	1.4 [13]	8	4.4 [8]	11	-	
80	195	2	3.96 [20]	2	9.1 [14]	7	1.2 [17]	7	2.5 [14]	9	1.5 [14]	9	2.0 [8]	11	-	
85	185	2	1.74 [20]	2	1.0 [15]	7	4.7 [16]	7	3.1 [14]	9	3.1 [14]	9	8.7 [7]	11	-	
90	184	2	7.09 [19]	2	7.1 [14]	7	1.7 [16]	7	2.5 [14]	9	2.5 [14]	9	3.5 [7]	11	-	
95	190	2	2.81 [19]	2	4.8 [14]	7	6.2 [15]	7	1.6 [14]	9	1.6 [14]	9	1.4 [7]	11	-	
100	204	2	1.13 [19]	2	2.5 [14]	7	2.3 [15]	7	1.1 [14]	9	1.1 [14]	9	5.7 [6]	11	-	

‡M denotes total number density.

*Read 2.55 [25] at 2.55×10^{25}. Values have been rounded off to three significant figures.

NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM (contd)

Number Densities (m^{-3})

Geometric Altitude (km)	HO (Day)	Ref/ Remarks	HO (Night)	Ref/ Remarks	HO_2 (Day)	Ref/ Remarks	HO_2 (Night)	Ref/ Remarks	H_2 (Day & Night)	Ref/ Remarks	H_2O (Day & Night)	Ref/ Remarks	H_2O_2 (Day)	Ref/ Remarks
0	5.4 [12]	10	-		9.0 [14]	10	-		1.27[19]	4	1.9 [23]	4	6.8 [16]	10
5	1.5 [12]	10*	-		1.4 [14]	10*	-		6.6 [18]	est	2.0 [22]	4	3.0 [15]	10*
10	3.9 [11]	10	1.6 [8]	12	2.7 [13]	10	5.0 [9]	12	3.3 [18]	est	5.9 [20]	4	2.7 [14]	10
15	8.4 [10]	10	4.2 [8]	12	1.0 [13]	10	3.5 [9]	12	1.8 [18]	est	2.1 [19]	4	8.5 [14]	10
20	3.0 [11]	10	2.5 [9]	12	1.5 [13]	10	6.0 [9]	12	9.3 [17]	14	7.8 [18]	15	1.3 [15]	10
25	6.3 [11]	10	2.5 [9]	12	2.1 [13]	10	6.0 [9]	12	4.6 [17]	14	3.4 [18]	15	1.8 [15]	10
30	1.3 [12]	10	8.0 [9]	12	2.2 [13]	10	1.7 [10]	12	1.8 [17]	14	1.5 [18]	15	1.2 [15]	10
35	3.0 [12]	10	8.5 [10]	12	1.5 [13]	10	1.2 [11]	12	8.6 [16]	14	7.2 [17]	15	2.8 [14]	10
40	6.5 [12]	10	2.0 [11]	12	8.9 [12]	10	2.4 [11]	12	4.1 [16]	14	3.5 [17]	15	4.0 [13]	10
45	6.7 [12]	10*	2.0 [11]	12	6.1 [12]	10*	2.3 [11]	12	2.1 [16]	14	1.7 [17]	15	1.3 [13]	10*
50	7.1 [12]	10	2.0 [11]	12	4.5 [12]	10	1.6 [11]	13	1.1 [16]	14	9.2 [16]	15	4.4 [12]	10
55	5.1 [12]	10*	1.1 [11]	8	3.2 [12]	10*	1.0 [11]	13	6.1 [15]	14	5.1 [16]	15	1.9 [12]	10*
60	3.8 [12]	10	7.0 [10]	8	2.1 [12]	10	7.5 [10]	13	3.3 [15]	14	2.8 [16]	15	8.1 [11]	10
65	3.0 [12]	10*	5.6 [10]	8	1.5 [12]	10*	1.2 [11]	13	2.8 [15]	est	1.0 [16]	9	4.0 [11]	10*
70	2.3 [12]	10	5.6 [10]	8	1.1 [12]	10	1.5 [11]	13	2.4 [15]	est	5.0 [15]	9	1.9 [11]	10
75	1.1 [12]	10*	3.0 [12]	8	9.0 [11]	10*	1.1 [11]	13	2.0 [15]	9	1.6 [15]	9	3.6 [10]	10*
80	5.4 [11]	10	1.0 [12]	8	2.0 [11]	10	5.0 [8]	13	1.0 [15]	9	5.0 [14]	9	6.5 [9]	10
85	6.0 [10]	est	1.0 [11]	8	1.0 [10]	est	2.0 [7]	13	5.0 [14]	9	1.6 [14]	9	7.0 [7]	est
90	3.0 [9]	est	1.3 [10]	8	7.0 [8]	est	1.4 [6]	13	1.8 [14]	9	4.0 [13]	9	2.0 [6]	est
95	1.0 [9]	est	2.5 [9]	8	5.0 [7]	est	1.2 [5]	13	7.0 [13]	9	1.4 [13]	9	3.0 [4]	est
100	1.0 [8]	est	5.6 [8]	8	3.0 [6]	est	1.0 [4]	13	3.2 [13]	9	4.0 [12]	9	5.0 [2]	est

*Logarithmic interpolation

NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM (contd)

Number Densities (m^{-3})

Geometric Altitude (km)	H_2O_2 (Night)	Ref/ Remarks	N (Day)	Ref/ Remarks	N (Night)	Ref/ Remarks	NO (Day)	Ref/ Remarks	NO (Night)	Ref/ Remarks	NO_2 (Day)	Ref/ Remarks	NO_2 (Night)	Ref/ Remarks
0	-		-		-		1.27[16]	4	-		2.55[16]	4	-	
5	-		-		-		7.0 [15]	10	-		1.0 [16]	10	-	
10	3.1 [13]	12	-		-		2.3 [15]	10	4.5 [9]	12	1.6 [15]	10	3.9 [15]	23
15	1.0 [13]	12	-		-		4.0 [15]	10	1.4 [9]	12	1.6 [15]	10	5.6 [15]	23
20	1.0 [13]	12	-		-		2.0 [15]	16	3.0 [8]	12	1.0 [15]	22	3.0 [15]	23
25	1.3 [13]	12	-		-		2.0 [15]	16	1.8 [7]	12	2.2 [15]	22	4.2 [15]	23
30	2.0 [13]	12	-		-		2.0 [15]	16	5.6 [5]	est	1.8 [15]	22	3.8 [15]	23
35	1.3 [13]	12	-		-		1.0 [15]	16	4.0 [3]	est	1.3 [15]	22	2.3 [15]	23
40	1.1 [13]	12	1.0 [9]	8	-		8.0 [14]	16	1.0 [4]	est	4.0 [14]	22	1.2 [15]	23
45	1.3 [13]	12	1.1 [9]	8	-		5.5 [14]	10	6.0 [5]	est	7.0 [13]	10	6.2 [14]	23
50	5.5 [13]	12	1.2 [9]	8	-		2.8 [14]	10	4.0 [6]	8	7.0 [12]	10	2.9 [14]	23
55	8.0 [12]	est	1.8 [9]	8	-		1.4 [14]	10	1.0 [10]	8	7.0 [11]	10	1.4 [14]	23
60	2.0 [12]	9	3.3 [9]	8	-		5.6 [13]	10	2.0 [12]	8	7.0 [10]	10	5.4 [13]	23
65	4.5 [11]	9	6.2 [9]	8	-		3.3 [13]	18	9.0 [12]	8	7.0 [9]	8	2.4 [13]	23
70	6.5 [12]	9	2.0 [10]	8	-		3.8 [13]	18	2.0 [13]	8	7.0 [8]	8	1.8 [13]	23
75	3.1 [13]	9	5.0 [10]	8	-		5.2 [13]	18	5.2 [13]	18	1.4 [8]	8	-	
80	2.0 [13]	9	6.2 [10]	8	-		6.3 [13]	18	6.3 [13]	18	2.4 [7]	8	-	
85	1.8 [10]	9	9.0 [10]	8	-		6.3 [13]	18	6.3 [13]	18	6.0 [6]	8	-	
90	2.5 [6]	9	1.0 [11]	8	-		6.2 [13]	18	6.2 [13]	18	1.3 [6]	8	-	
95	-		1.0 [11]	8	-		6.0 [13]	18	6.0 [13]	18	3.0 [5]	8	-	
100	-		1.0 [11]	8	-		5.5 [13]	18	5.5 [13]	18	5.0 [4]	8	-	

NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM (contd)

Number Densities (m^{-3})

Geometric Altitude (km)	N_2 (Day & Night)	Ref/ Remarks	N_2O (Day & Night)	Ref/ Remarks	O (Day)	Ref/ Remarks	O (Night)	Ref/ Remarks	O_2 (Day & Night)	Ref/ Remarks	O_3 (Day)	Ref/ Remarks	O_3 (Night)	Ref/ Remarks
0	1.99 [25]	24	6.88 [18]	4	-		-		5.36 [24]	28	1.02 [18]	4	1.02 [18]	4
5	1.19 [25]	24	4.13 [18]	4	-		-		3.21 [24]	28	5.6 [17]	4	5.6 [17]	4
10	6.71 [24]	24	2.32 [18]	4	-		-		1.81 [24]	28	1.13 [18]	4	1.13 [18]	4
15	3.16 [24]	24	1.01 [18]	4	1.5 [9]	est	-		8.51 [23]	28	2.6 [18]	4	2.6 [18]	4
20	1.44 [24]	24	1.9 [16]	25	1.8 [10]	27	-		3.89 [23]	28	4.77 [18]	4	4.77 [18]	4
25	6.33 [23]	24	8.1 [15]	25	7.0 [11]	27	-		1.70 [23]	28	4.3 [18]	4	4.3 [18]	4
30	2.88 [23]	24	3.7 [15]	25	4.0 [12]	27	-		7.75 [22]	28	2.52 [18]	4	2.52 [18]	4
35	1.34 [23]	24	1.7 [15]	25	7.0 [13]	est	-		3.61 [22]	28	1.34 [18]	4	1.34 [18]	4
40	6.45 [22]	24	8.3 [14]	25	1.0 [15]	8	1.4 [6]	8	1.74 [22]	28	6.08 [17]	4	6.08 [17]	4
45	3.24 [22]	24	4.2 [14]	25	3.2 [15]	8	1.7 [6]	8	8.72 [21]	28	2.2 [17]	4	3.1 [17]	8
50	1.72 [22]	24	2.2 [14]	25	5.6 [15]	8	2.2 [6]	8	4.62 [21]	28	6.65 [16]	4	1.2 [17]	8
55	9.44 [21]	24	1.2 [14]	25	1.0 [16]	8	2.5 [6]	8	2.54 [21]	28	2.1 [16]	4	6.0 [16]	8
60	5.20 [21]	24	6.7 [13]	25	1.4 [16]	8	5.6 [6]	8	1.40 [21]	28	7.35 [15]	4	3.2 [16]	8
65	2.78 [21]	24	3.6 [13]	25	1.8 [16]	8	3.1 [7]	8	7.50 [20]	28	2.4 [15]	4	1.6 [16]	8
70	1.42 [21]	24	1.8 [13]	25	1.4 [16]	8	4.0 [8]	8	3.82 [20]	28	5.46 [14]	4	9.0 [15]	8
75	6.79 [20]	2	8.7 [12]	25	1.0 [16]	8	1.0 [11]	8	1.82 [20]	2	4.0 [14]	est	6.0 [13]	8
80	3.10 [20]	2	4.0 [12]	25	6.22 [16]	2	2.0 [16]	8	8.20 [19]	2	3.13 [14]	2	5.0 [13]	8
85	1.36 [20]	2	1.7 [12]	25	1.39 [17]	2	1.39 [17]	2	3.55 [19]	2	1.25 [14]	2	8.0 [14]	8
90	5.58 [19]	2	7.1 [11]	25	1.66 [17]	2	1.66 [17]	2	1.42 [19]	2	2.66 [13]	2	4.5 [14]	8
95	2.22 [19]	2	2.8 [11]	25	1.91 [17]	2	1.91 [17]	2	5.48 [18]	2	4.62 [12]	2	1.2 [14]	8
100	8.71 [18]	2	1.1 [11]	25	4.15 [17]	2	4.15 [17]	2	1.99 [18]	2	1.26 [12]	2	2.2 [13]	8

NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM (contd)

Number Densities (m^{-3})

Geometric Altitude (km)	$N(^2D)$ (Day)	Ref/ Remarks	$N(^2D)$ (Night)	Ref/ Remarks	$O(^1D)$ (Day)	Ref/ Remarks	$O(^1D)$ (Night)	Ref/ Remarks	$O_2(^1\Delta)$ (Day)	Ref/ Remarks	$O_2(^1\Delta)$ (Night)	Ref/ Remarks	$O_2(^1\Sigma)$ (Day)	Ref/ Remarks	$O_2(^1\Sigma)$ (Night)	Ref/ Remarks
0	-		-		2.0 [3]	29	-		-		-		-		-	
5	-		-		3.0 [3]	29	-		-		-		-		-	
10	-		-		1.0 [4]	29	-		6.3 [11]	est	-		-		-	
15	-		-		6.0 [4]	29	-		1.2 [12]	27	-		-		-	
20	-		-		4.6 [5]	29	-		5.0 [12]	27	-		4.0 [9]	est	-	
25	-		-		2.5 [6]	est	-		3.5 [13]	27	-		2.5 [10]	est	-	
30	-		-		1.6 [7]	est	-		1.0 [15]	30	-		1.5 [11]	31	-	
35	-		-		1.0 [8]	est	-		2.3 [15]	30	-		8.0 [11]	31	-	
40	-		-		5.0 [8]	8	-		5.8 [15]	30	-		4.0 [12]	31	-	
45	-		-		7.0 [8]	8	-		1.9 [16]	30	-		4.0 [12]	31	-	
50	-		-		7.0 [8]	8	-		2.8 [16]	30	-		4.0 [12]	est	-	
55	-		-		7.0 [8]	8	-		2.2 [16]	30	-		4.0 [12]	est	-	
60	-		-		7.0 [8]	8	-		1.5 [16]	30	-		4.0 [12]	9	-	
65	-		-		4.5 [8]	8	-		9.6 [15]	30	-		3.0 [12]	9	-	
70	-		-		1.8 [8]	8	-		6.3 [15]	30	5.5 [6]	9	1.2 [12]	9	-	
75	-		-		6.5 [7]	8	-		3.2 [15]	30	6.3 [8]	9	1.0 [12]	9	-	
80	-		-		1.5 [8]	8	-		2.2 [15]	30	1.7 [11]	9	9.0 [11]	9	1.0 [7]	9
85	-		-		4.3 [8]	8	-		3.2 [15]	30	3.5 [14]	9	9.5 [11]	9	5.6 [10]	9
90	1.0 [6]	9	-		5.5 [8]	8	-		1.0 [15]	30	4.0 [14]	9	6.6 [11]	9	1.0 [11]	9
95	1.0 [7]	9	-		1.3 [9]	8	-		1.6 [14]	9	1.0 [14]	9	6.0 [11]	9	3.2 [10]	9
100	7.0 [7]	9	-		3.2 [9]	8	-		1.8 [13]	9	1.7 [13]	9	9.0 [11]	9	7.0 [9]	9

REFERENCES/REMARKS FOR TABLE I

1. United States Committee on Extension to the Standard Atmosphere (COESA) US Standard Atmosphere, 1962, US Government Printing Office, Washington, DC, Dec 62; 45° latitude, annual mean values rounded off to three significant figures.

2. Champion, K. S. W., and R. A. Schweinfurth, "A New Mean Reference Atmosphere for 25 to 500 Km," AFCRL-72-0579, 2 Oct 72; "The Mean COSPAR International Reference Atmosphere 1972" in COSPAR International Reference Atmospheres 1972, Akademic Verlag, Berlin, 1972; DNA Reaction Rate Handbook, 2nd Ed., M. H. Bortner and T. Baurer, Ed.-in-Chief, Chap. 2 (Rev. No. 1, Nov 1972). Between 25 and 75 km, values are for annual mean conditions for latitudes near 30°.

3. [CO] = 1.9 $x_8 10^{-7}$ [M] at surface, 1.3 x 10^{-7} [M] in troposphere (0-11 km), 4 x 10^{-8} [M] in lower stratosphere (11-20 km) according to Reference 4, Table 17, 036 (45° N. Lat.); and 5 x 10^{-9} [M] above 17 km according to Reference 5.

4. US Standard Atmosphere, 1976, US Government Printing Office, Washington, DC, Oct 76.

5. Goldman, A., D. G. Murcray, F. H. Murcray, W. I. Williams, J. N. Brooks, and C. M. Bradford, "Vertical Distribution of CO in the Atmosphere," J. Geophys. Res., 78, 5273 (1973); measurements 4 to 17 km, 18 Jan 72, Alamogordo, NM.

6. Seiler, W., and P. Warneck, "Decrease of the Carbon Monoxide Mixing Ratio at the Tropopause," J. Geophys. Res. 77, 3204 (1972); measurements 7.5 to 12.5 km show almost identical concentrations during the day and at night; measurements made over West France 21, 22 Jan 71 and 19 Mar 71 and made over North Sea 20 Mar 71.

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8. Shimazaki, T., and A. R. Laird, "A Model Calculation of the Diurnal Variation in Minor Neutral Constituents in the Mesosphere and Lower Thermosphere Including Transport Effects," J. Geophys. Res. 75, 3221 (1970). Calculations for equinoctial, equatorial conditions, low solar activity, temperature profile for 40-80 km taken from CIRA-1965 model.

9. Hunt, B. G., "A Generalized Aeronomic Model of the Mesosphere and Lower Thermosphere Including Ionospheric Processes," J. Atmos. Terrest. Phys. 35, 1755 (1973). Calculations for tropical atmosphere, only N_2 distribution and temperature profile taken from CIRA-1965 equinoctial model.

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10. McConnell, J. C., and M. B. McElroy, "Odd Nitrogen in the Armosphere," J. Atmos. Sci. 30, 1465 (1973); calculations use US Standard Atmosphere Supplements (1966) models for average conditions at a latitude of 30°.

11. Estimated as $[HNO_2] = 5 \times 10^{-13}$ [M].

12. Whitten, R. C., and R. P. Turco, "Diurnal Variations of HO_X and NO_X in the Stratosphere," J. Geophys. Res. 79, 1302 (1974). Calculations for equinoctial conditions at 45° latitude, assuming equilibrium.

13. HO_2 nighttime profile of Reference 8 reduced by 10^{-2} to fit with Reference 12.

14. Between 20 and 60 km, $[H_2] = 5 \times 10^{-7}$ [M] in accordance with Reference 10.

15. Between 20 and 60 km, $[H_2O] = 4.2 \times 10^{-6}$ [M] in accordance with Reference 10.

16. Profile for NO of Reference 10 raised to fit measurement of 2×10^{15} M^{-3} of Reference 17.

17. Patel, C. K. N., E. G. Burkhardt, and C. A. Lambert, "Spectroscopic Measurements of Stratospheric Nitric Oxide and Water Vapor," Science 184, 1173 (1974). Balloon measurements made from Palestine, Texas, 19 OCt 73.

18. Estimated based on measurements of References 19, 20, and 21.

19. Barth, C. A., "Rocket Measurement of Nitric Oxide in the Upper Atmosphere," Planet. Space Sci. 14, 623 (1966). Measurements made from Wallops Island, Virginia (38° N. latitude), 17 Nov 63.

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22. NO_2 profile of Reference 10 reduced according to increase in NO profile.

23. $[NO_2]_{night} = [NO]_{day} + [NO_2]_{day} - [NO]_{night}$.

24. $[N_2] = 0.78$ [M].

REFERENCES/REMARKS FOR TABLE I (CONTD)

25. Constant mixing ratio assumed using upper limit of 0.01 ppm of Reference 26.

26. Goldman, A., D. G. Murcray, F. H. Murcray, and W. J. Williams, "Balloon-Borne Infrared Measurements of the Vertical Distribution of N_2O in the Atmosphere," J. Opt. Soc. Am. 63, 843 (1973); measurements to 19 km with mixing ratio < 0.01 ppm above 20 km; measurements made from Alamogordo, NM, 18 Jan 72.

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28. $[O_2] = 0.21\ [M]$.

29. McConnell, J. C., M. B. McElroy, and S. C. Wofsy, "National Sources of Atmospheric CO," Nature 233, 187 (1971). Computations employ the US Standard Atmosphere Supplements (1966) model with an ozone profile thought to be appropriate for mid-latitude conditions.

30. Evans, W. F. J., and E. J. Llewellyn, "Molecular Oxygen Emissions in the Airglow," Ann. Geophys. 26, 167 (1970). Dayglow measurements were taken at White Sands, NM (33° N. Latitude), 11 Oct 66. The integrated intensity for this O_2 ($^1\Delta g$) profile has been normalized to agree with balloon observations. A.M. atmosphere temperature profile appropriate to a fall low latitude location is used.

31. Wallace, L., and D. M. Hunter, "Dayglow of the Oxygen A. Band," J. Geophys. Res. 73, 4813 (1968). Rocket measurements were made from White Sands, NM (33° N. latitude), 11 Oct 66; overhead sun determination used here.

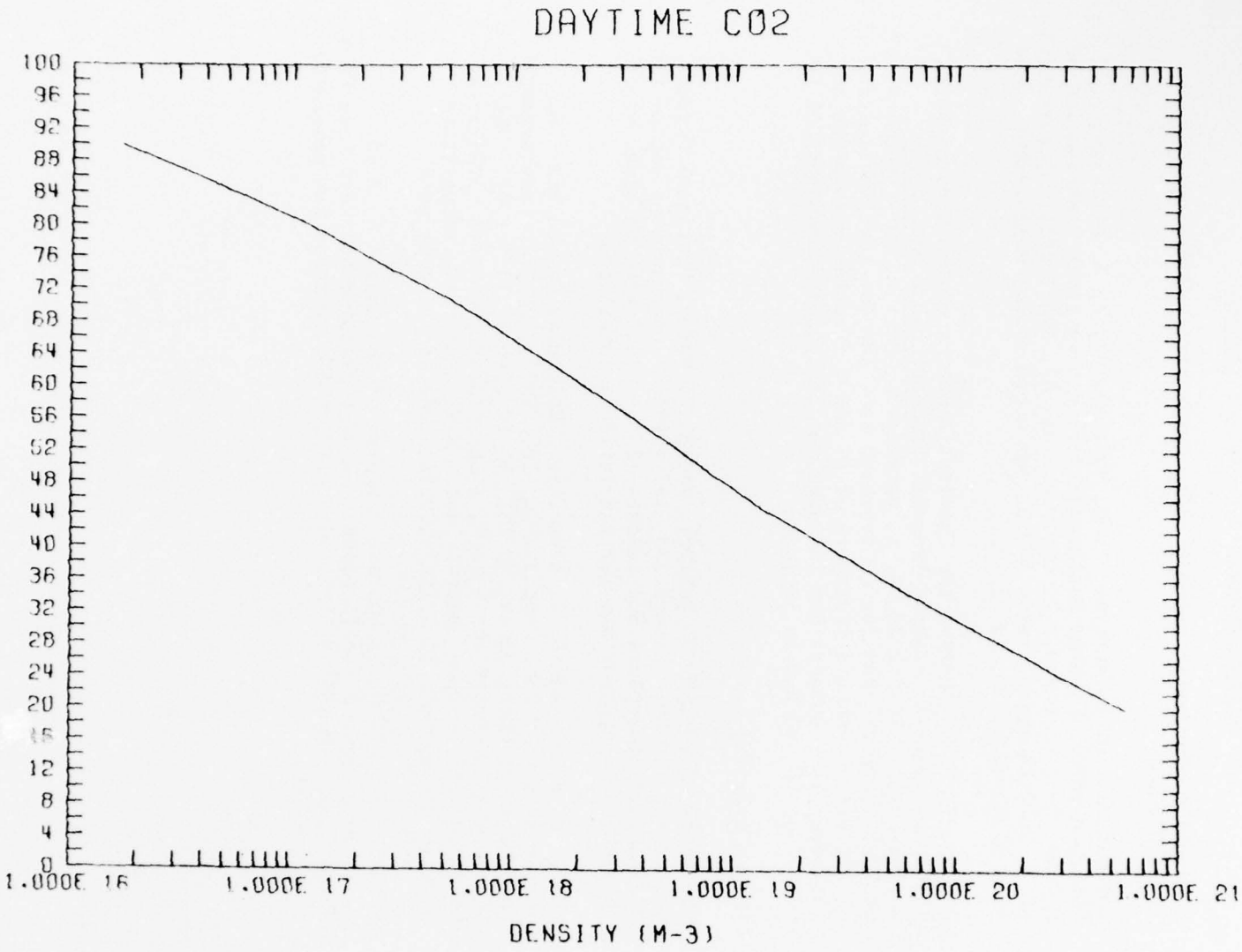

Figure 1. CO_2 daytime profile.

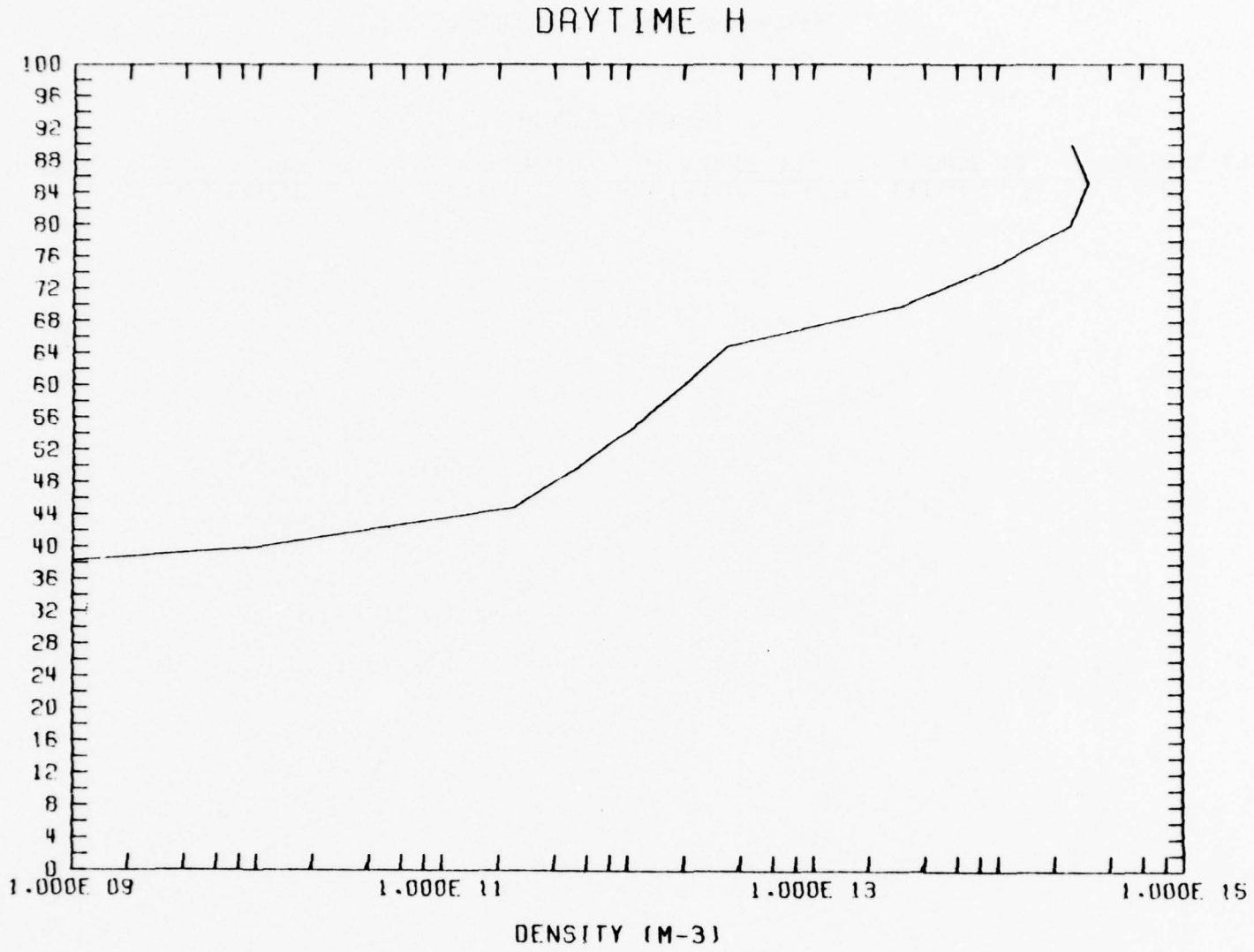

Figure 2. H daytime profile.

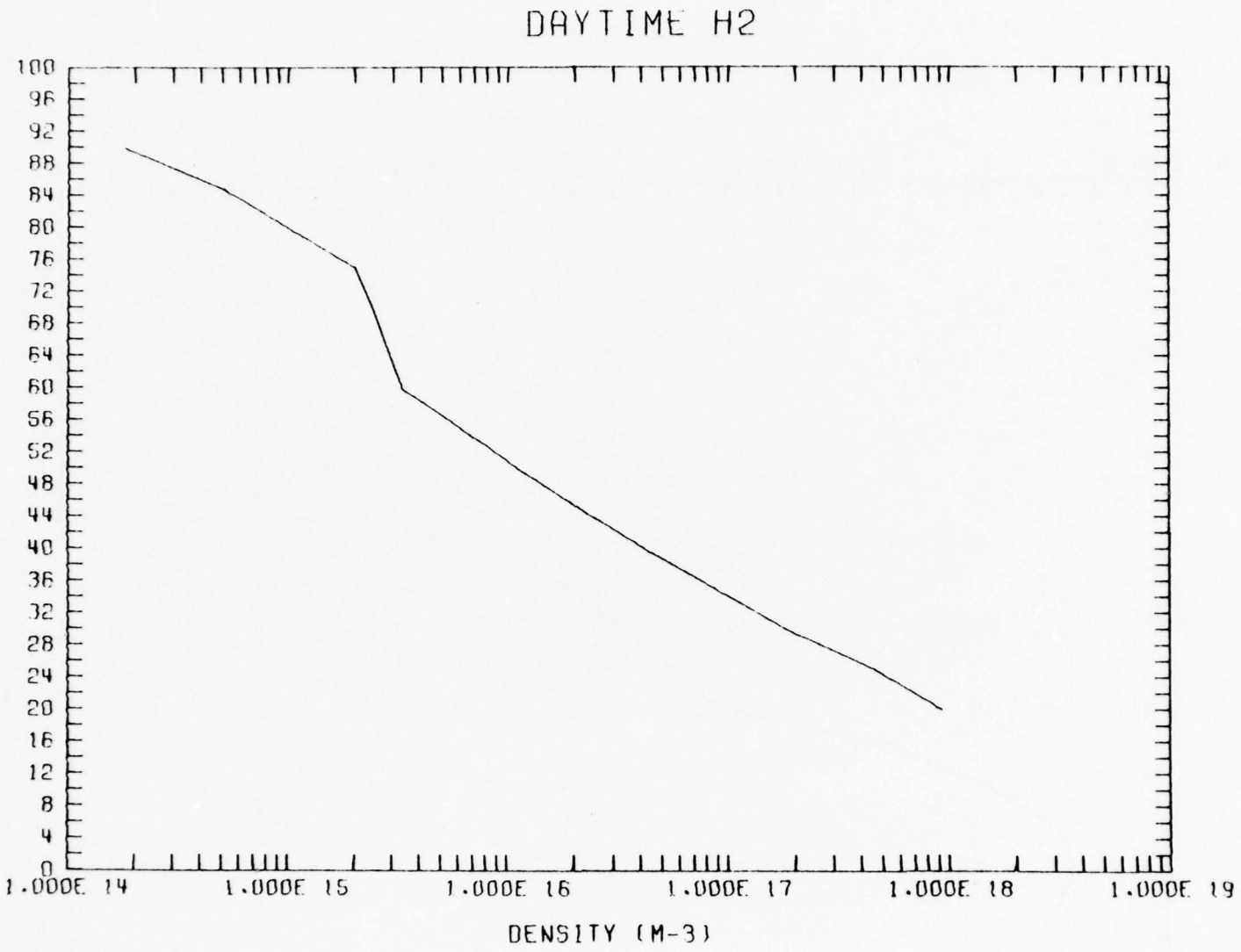

Figure 3. H_2 daytime profile.

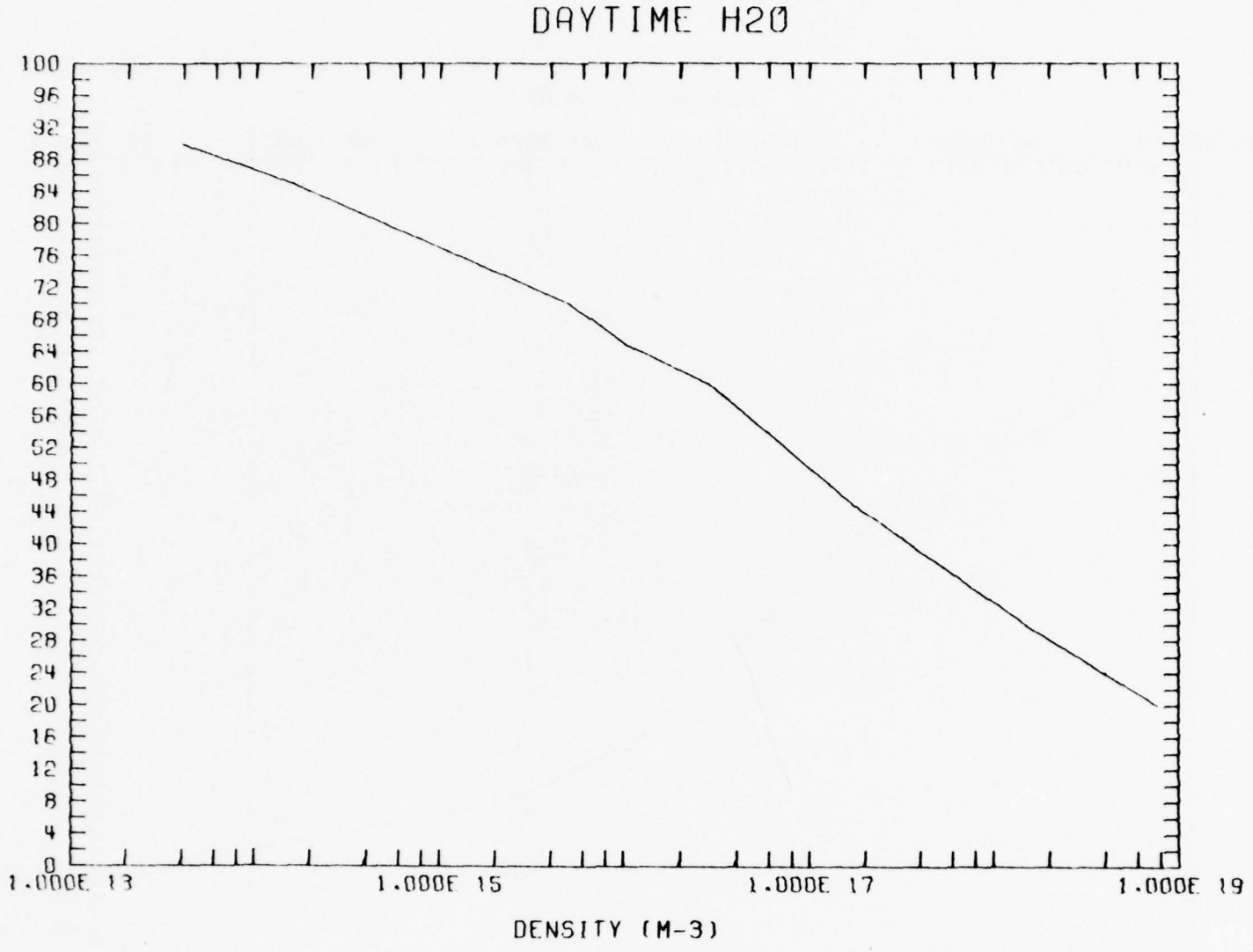

Figure 4. H_2O daytime profile.

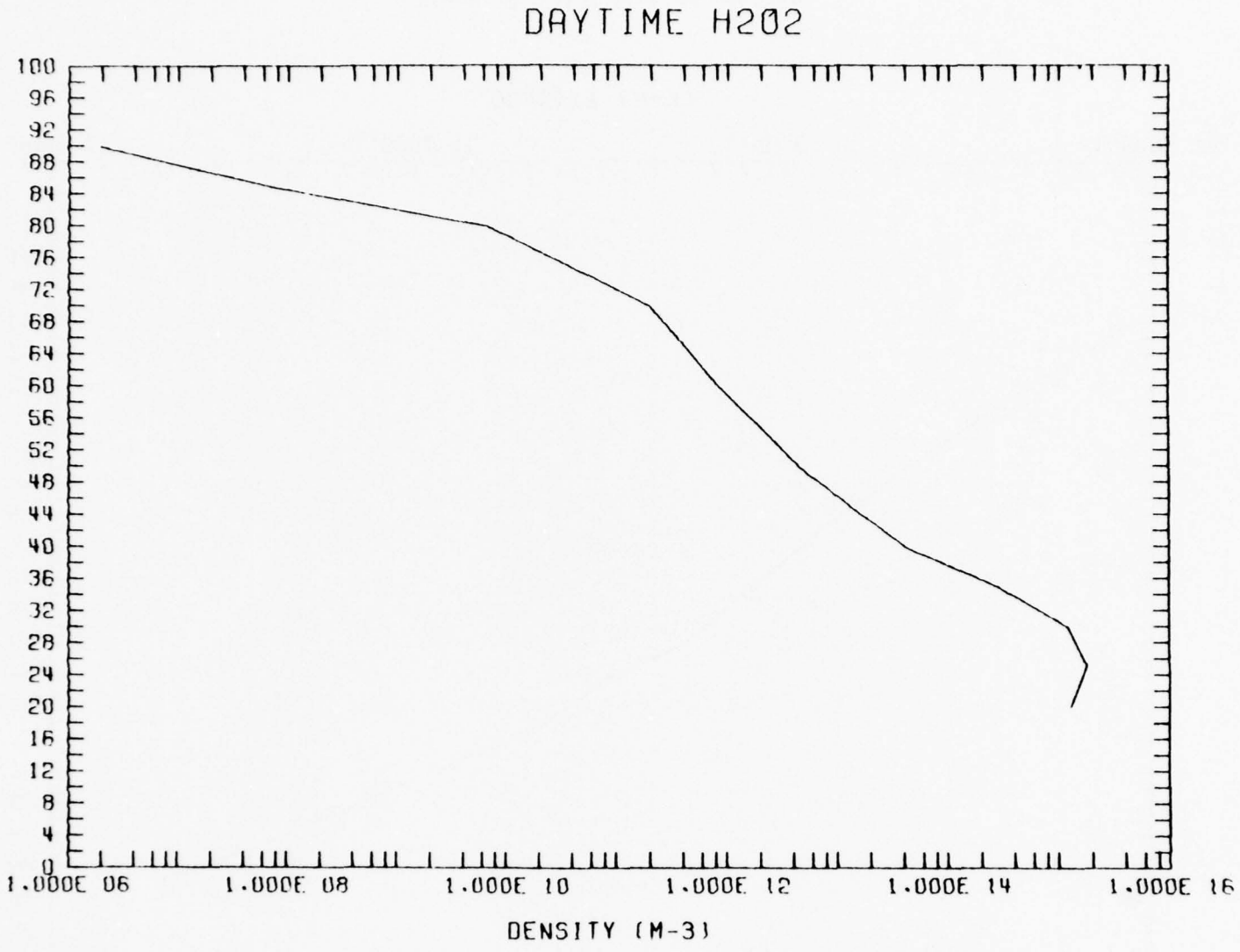

Figure 5. H_2O_2 daytime profile.

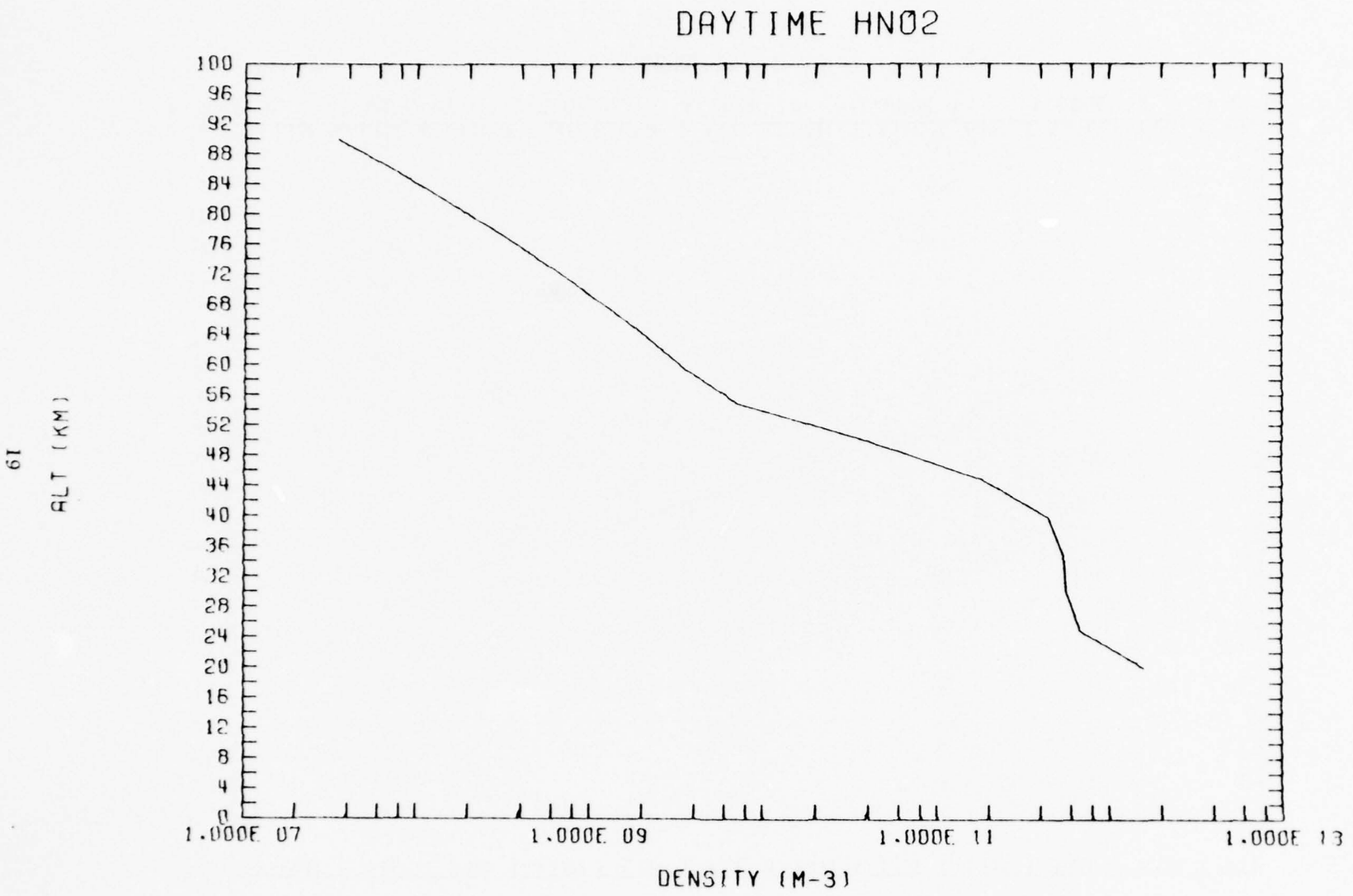

Figure 6. HNO_2 daytime profile.

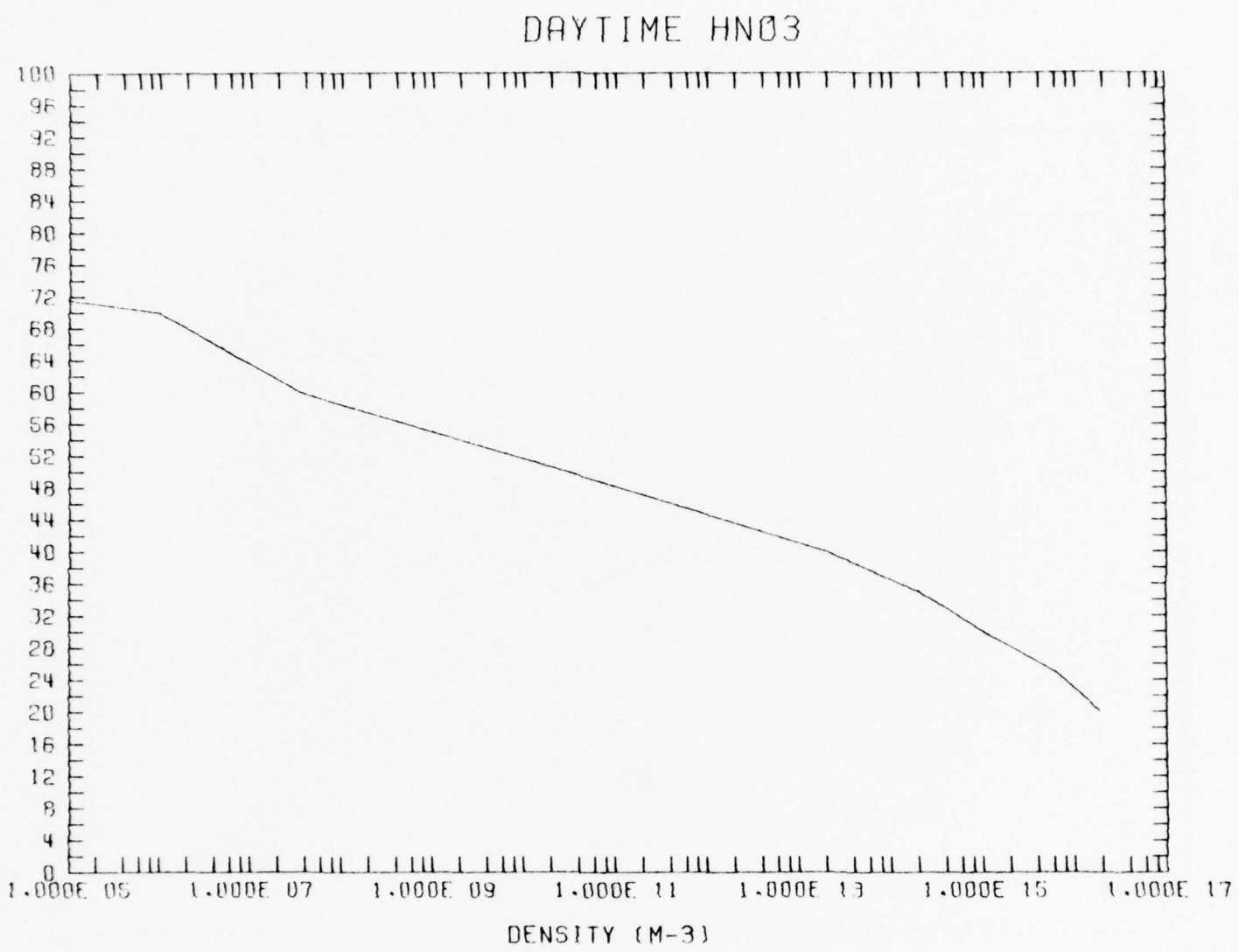

Figure 7. HNO_3 daytime profile.

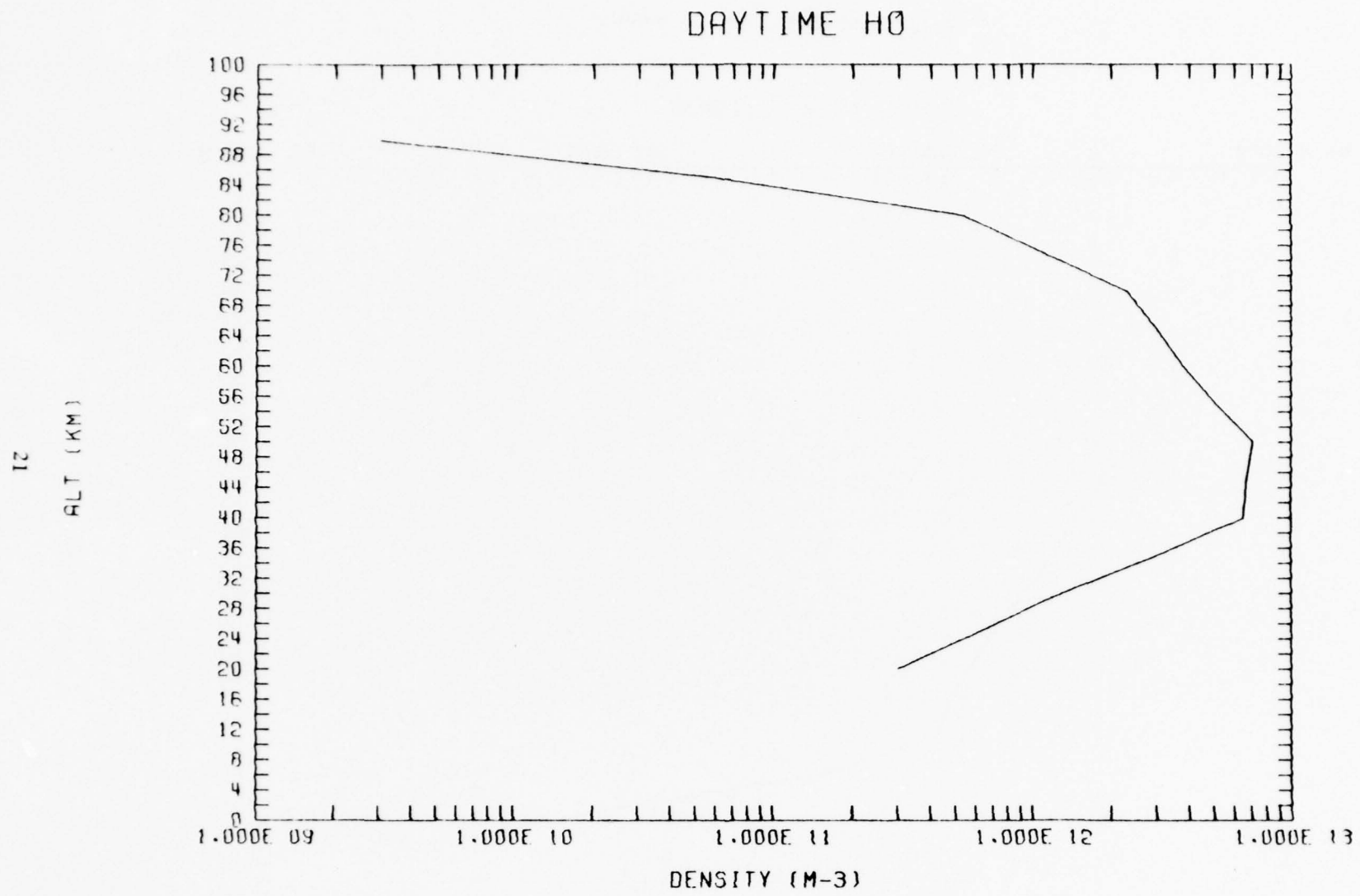

Figure 8. HO daytime profile.

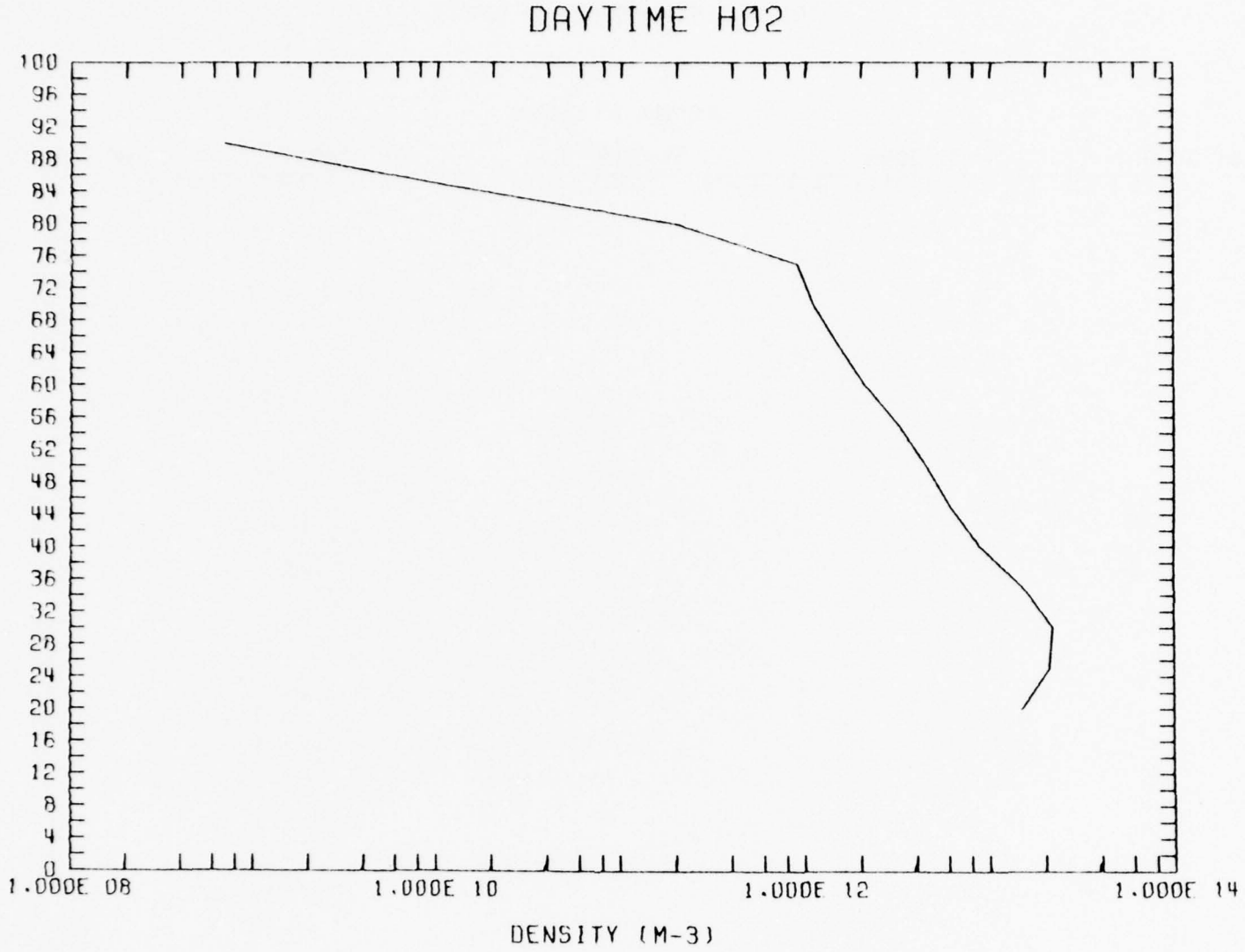

Figure 9. HO_2 daytime profile.

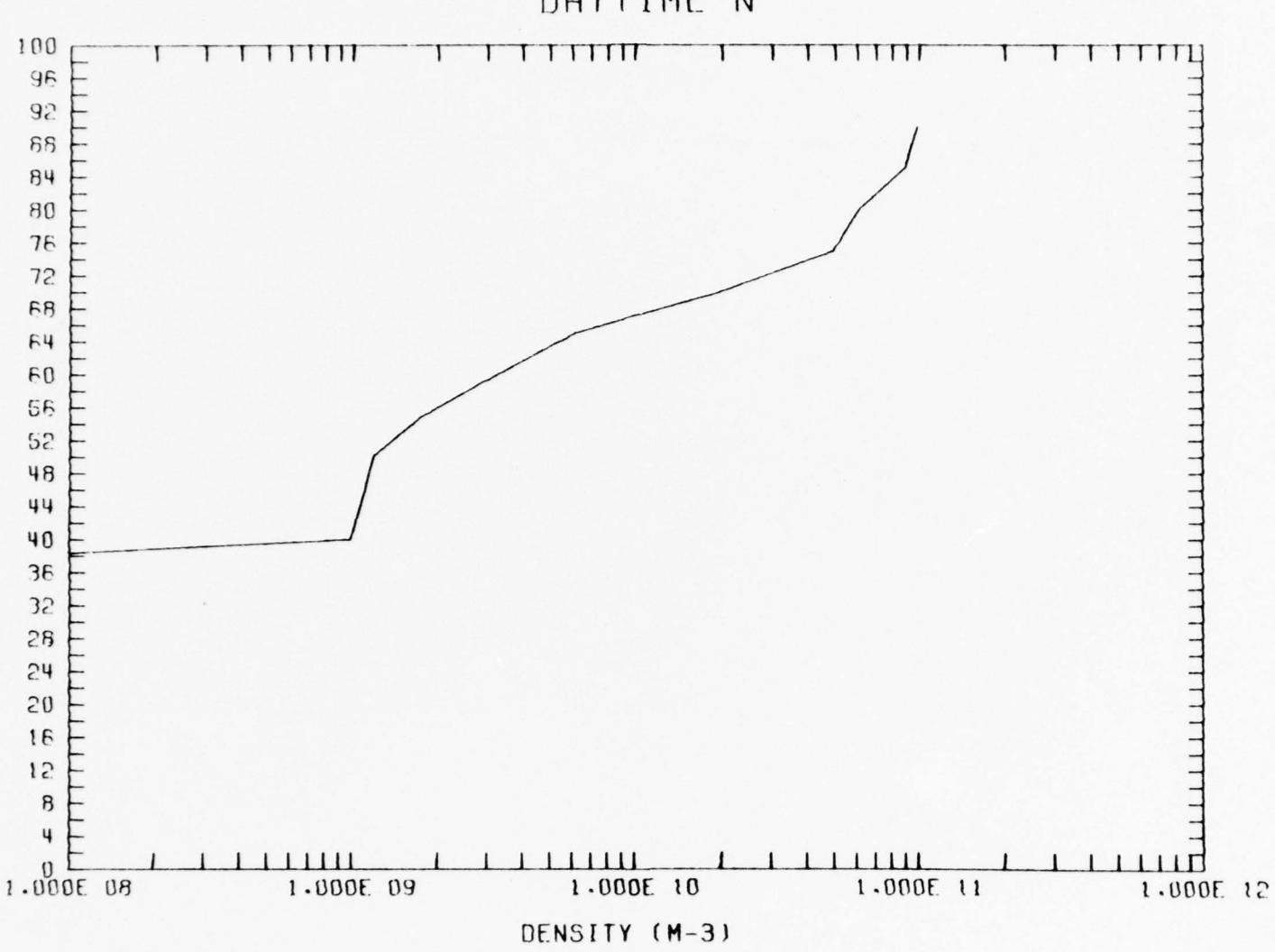

Figure 10. $N(^4S^0)$ daytime profile.

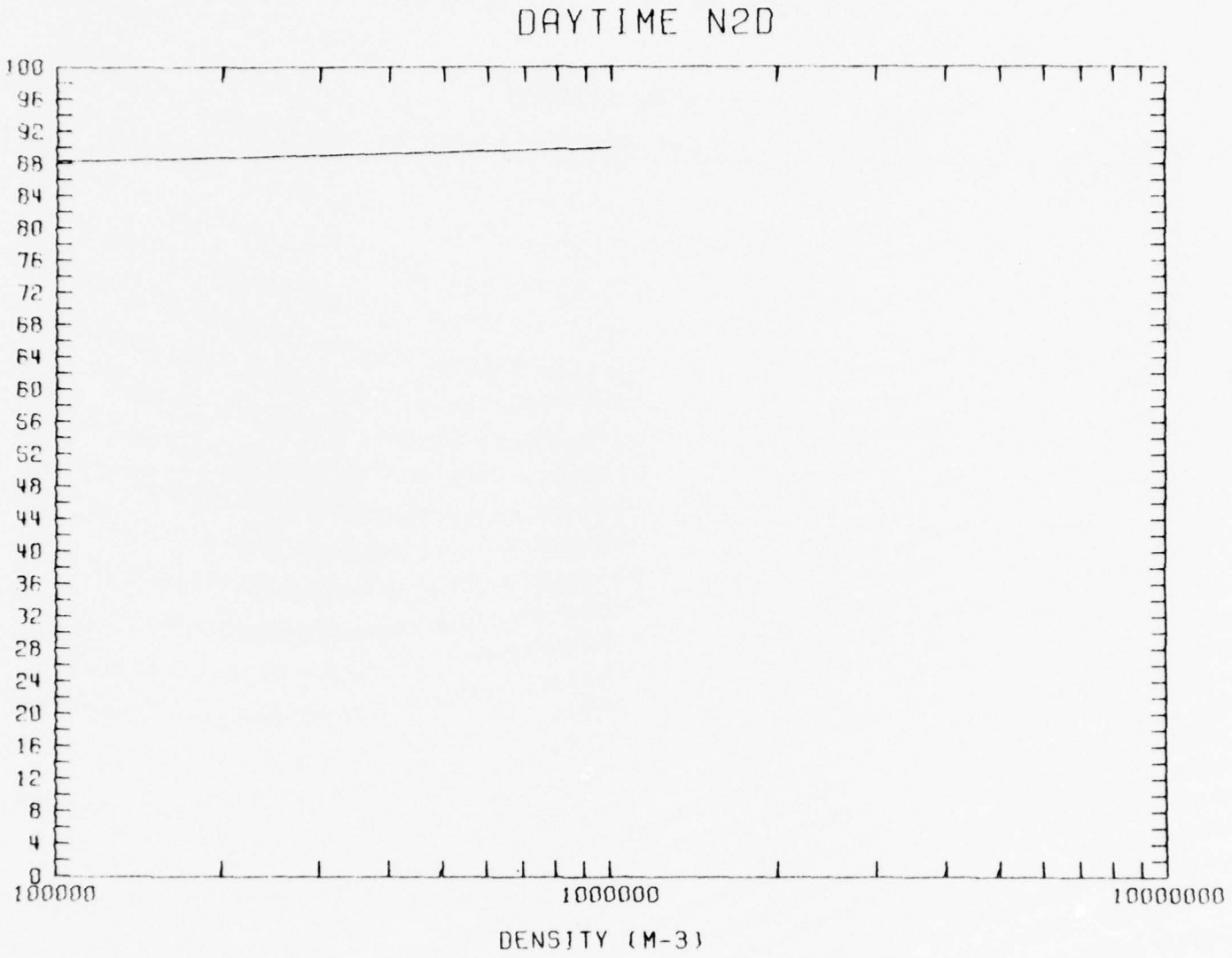

Figure 11. N(^{2}D) daytime profile.

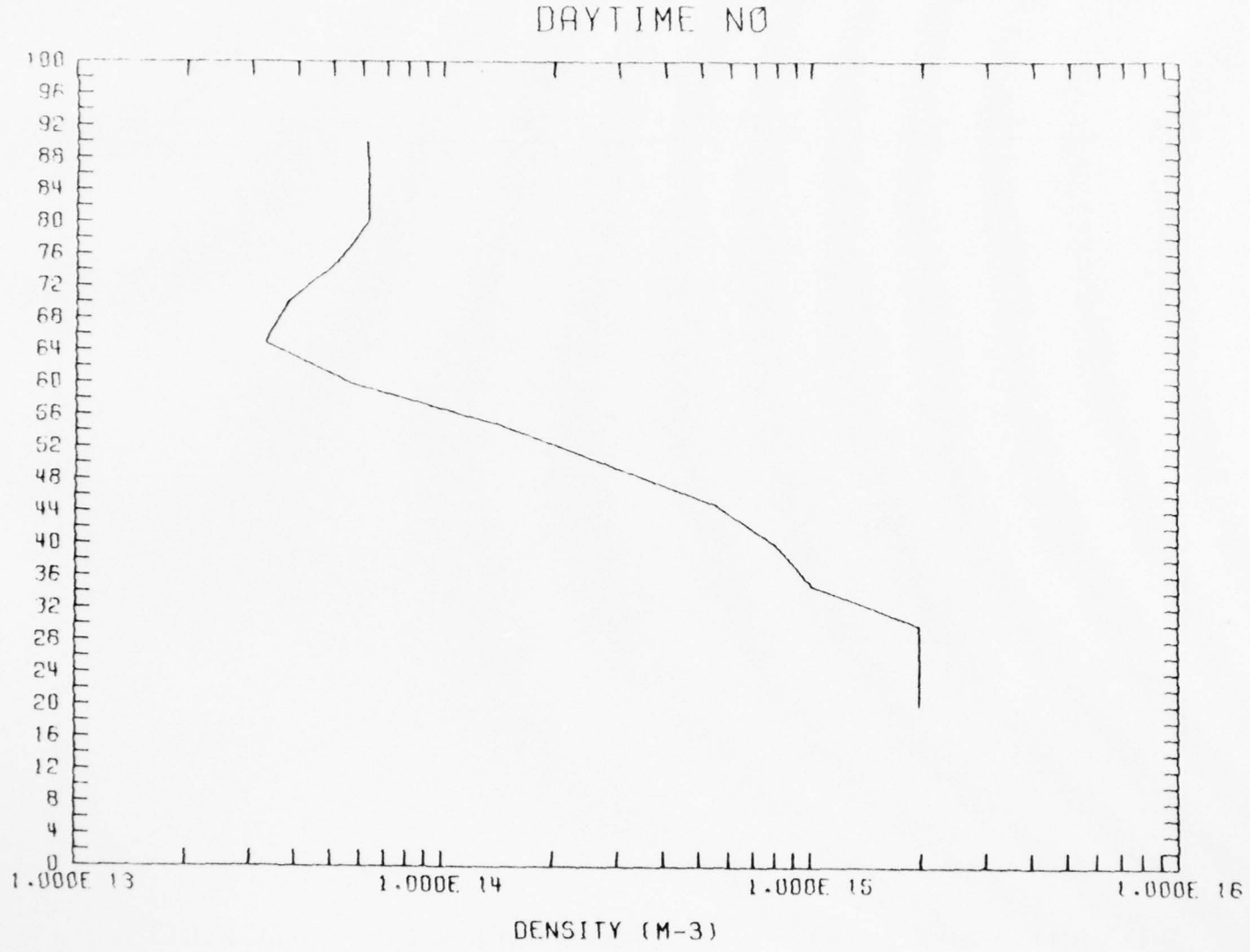

Figure 12. NO daytime profile.

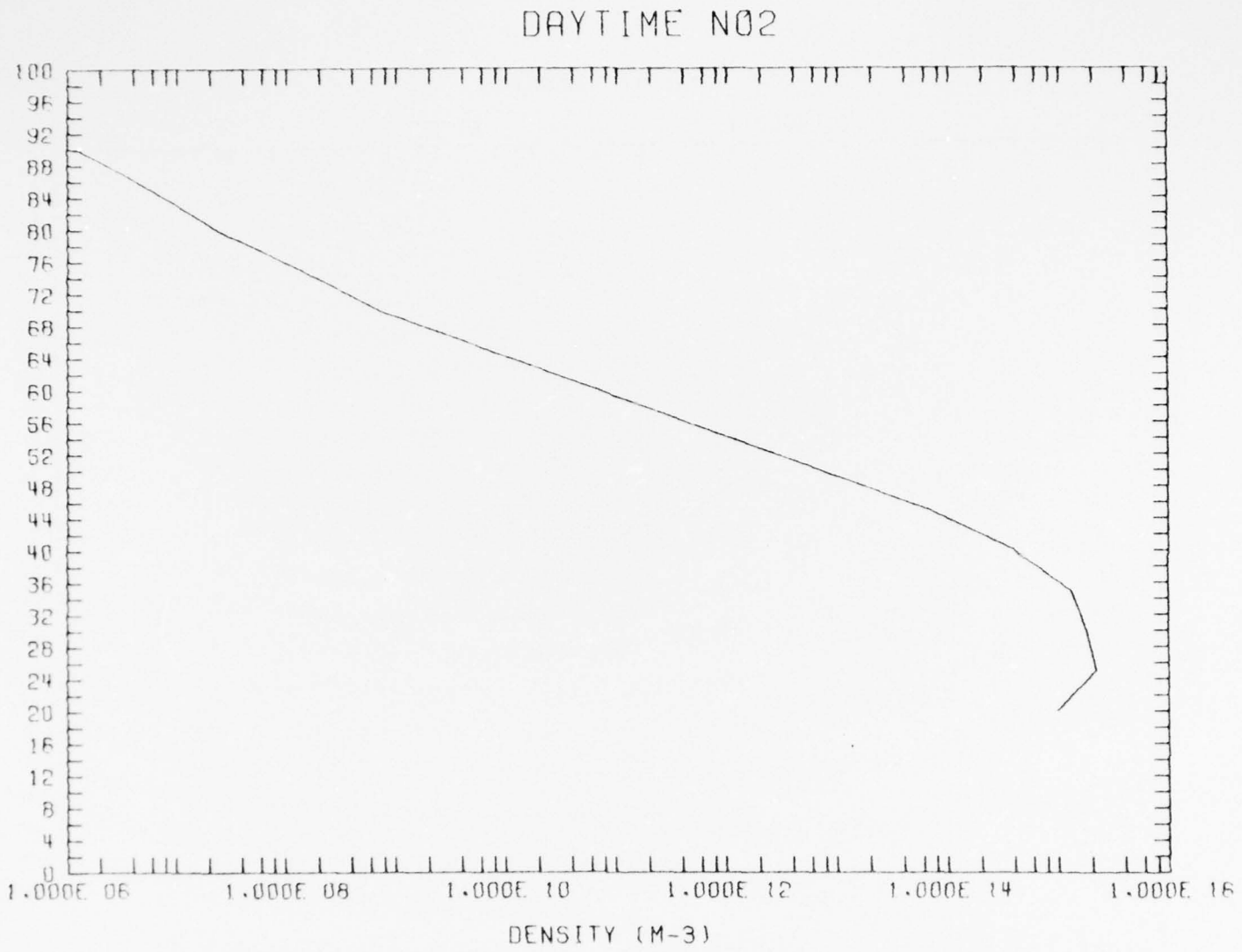

Figure 13. NO_2 daytime profile.

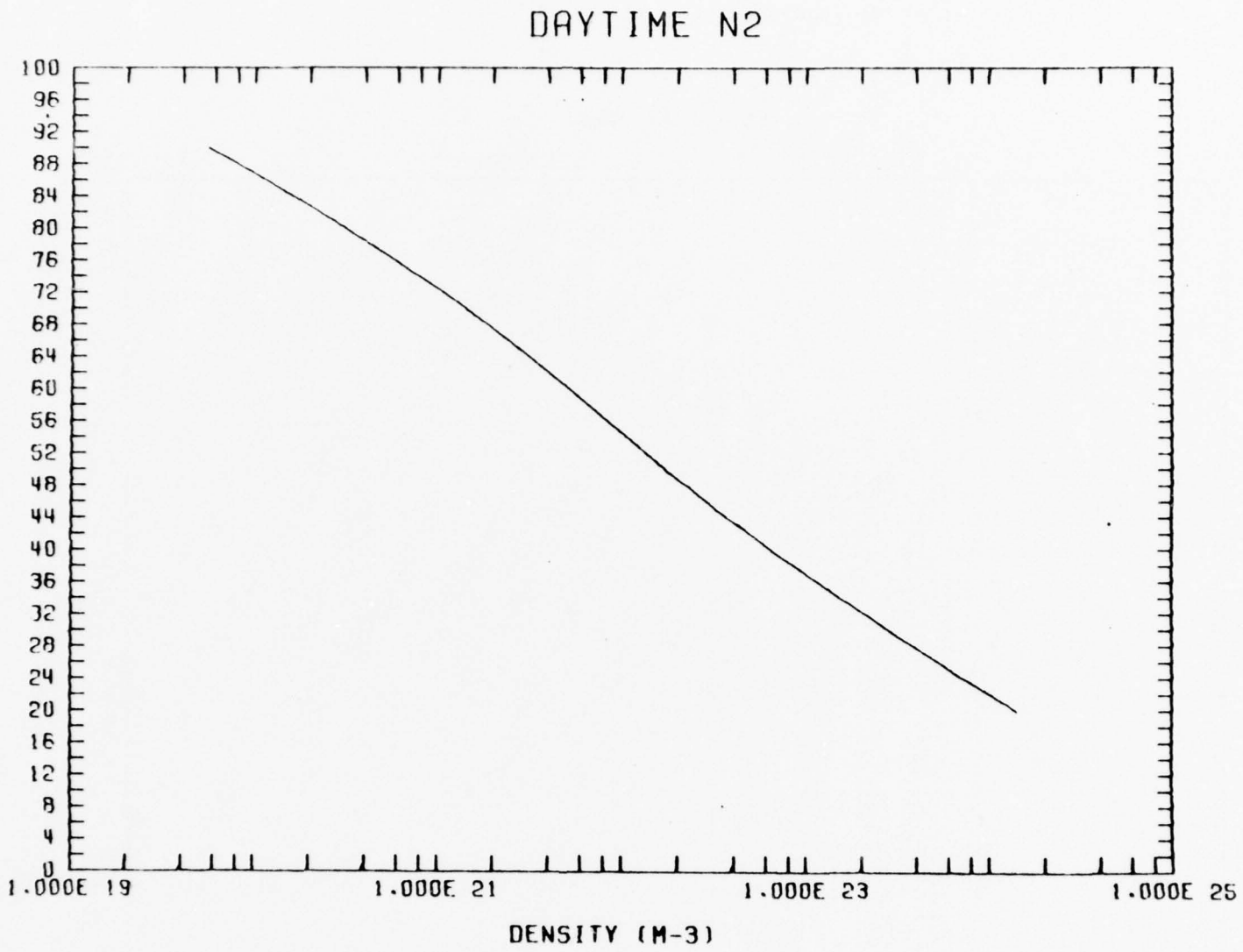

Figure 14. N_2 daytime profile.

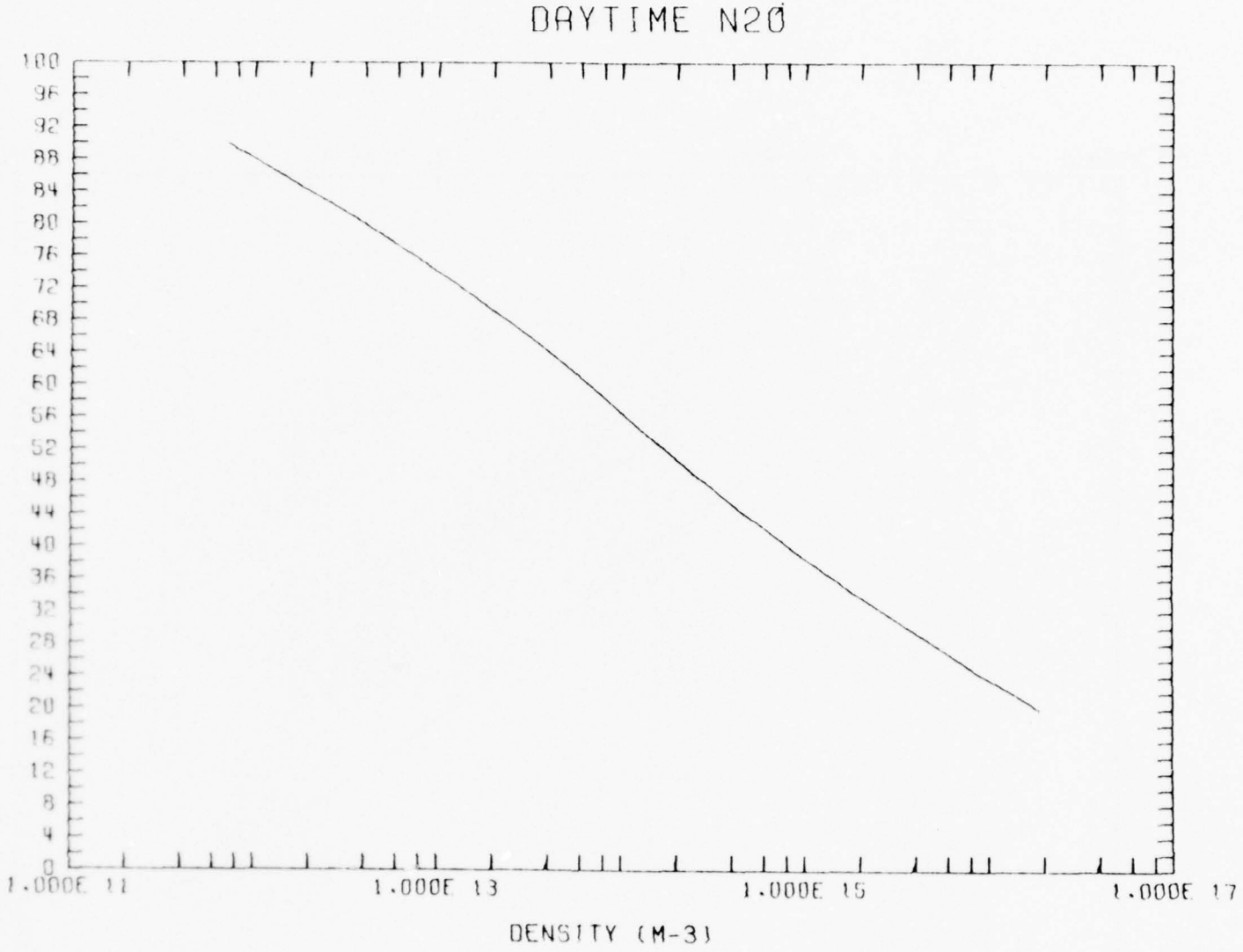

Figure 15. N_2O daytime profile.

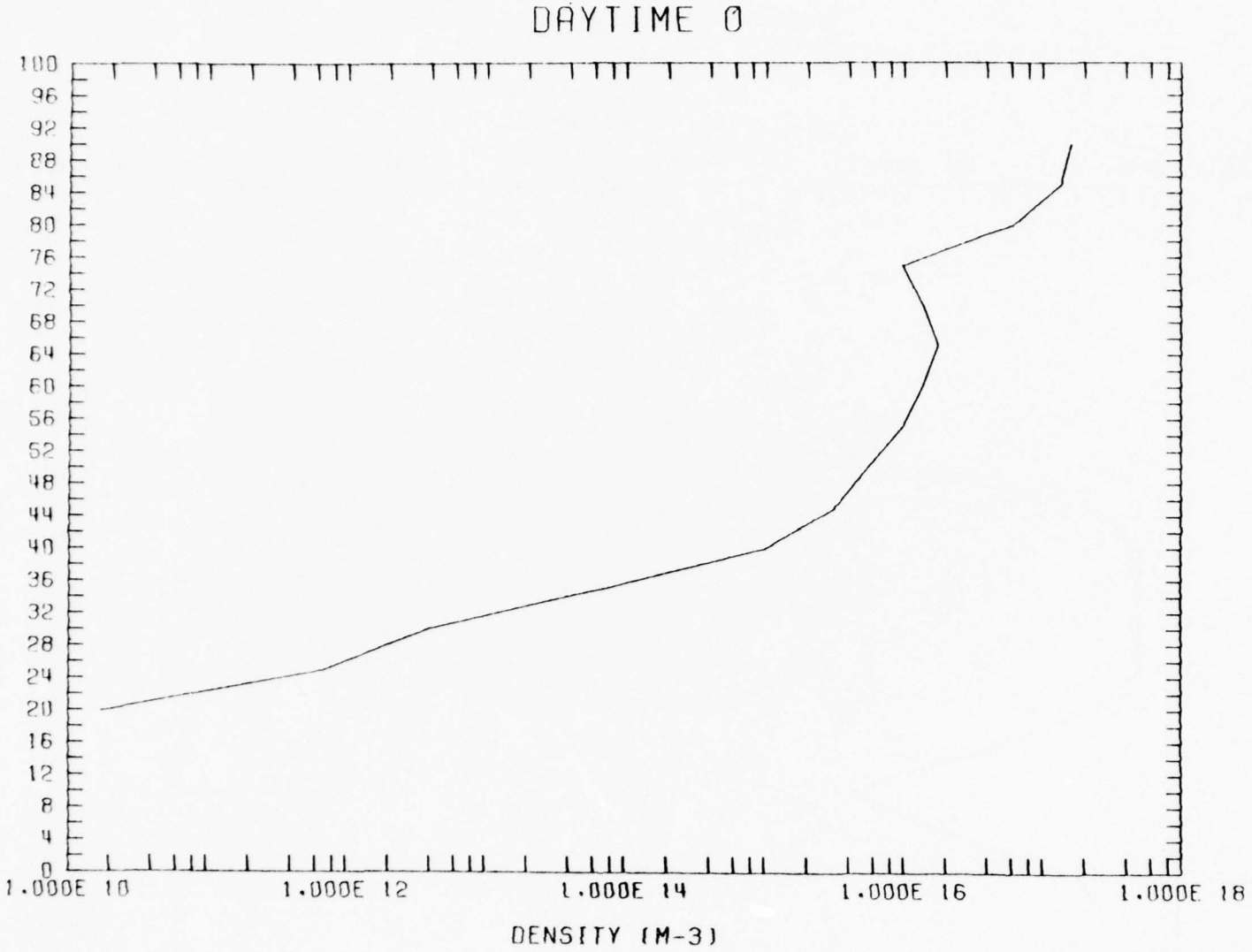

Figure 16. $O(^3P)$ daytime profile.

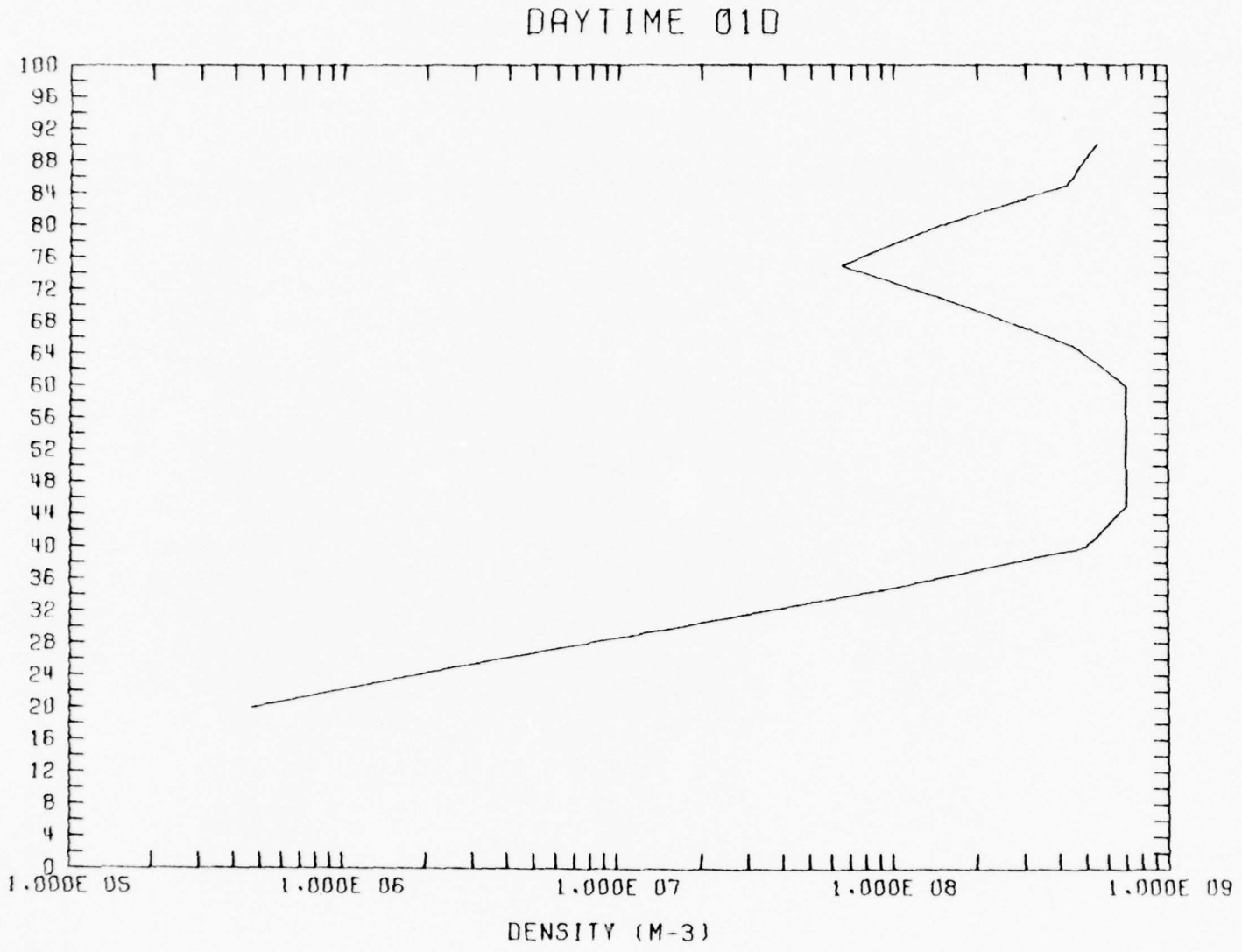

Figure 17. O(^{1}D) daytime profile.

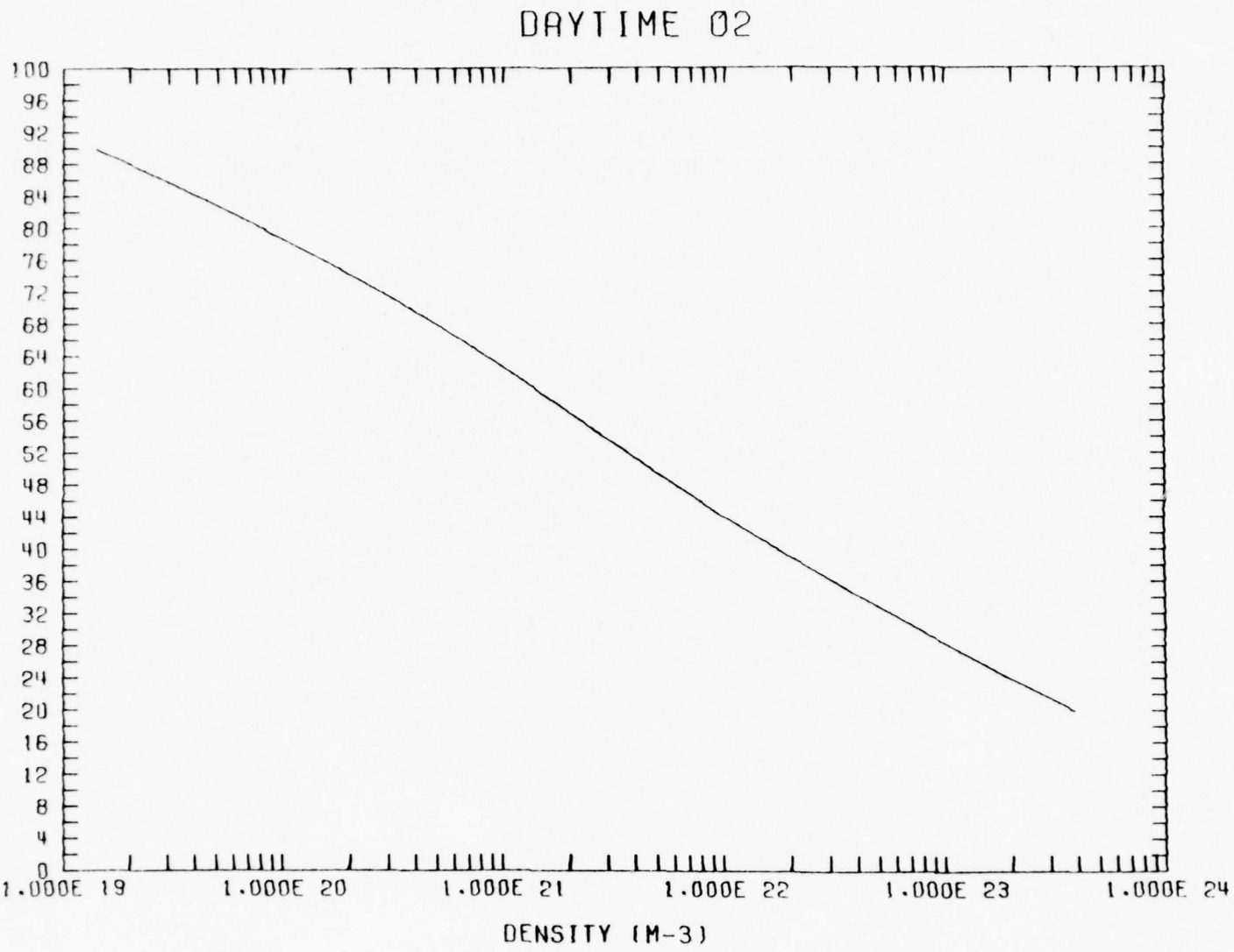

Figure 18. $O_2(^3\Sigma_g^-)$ daytime profile.

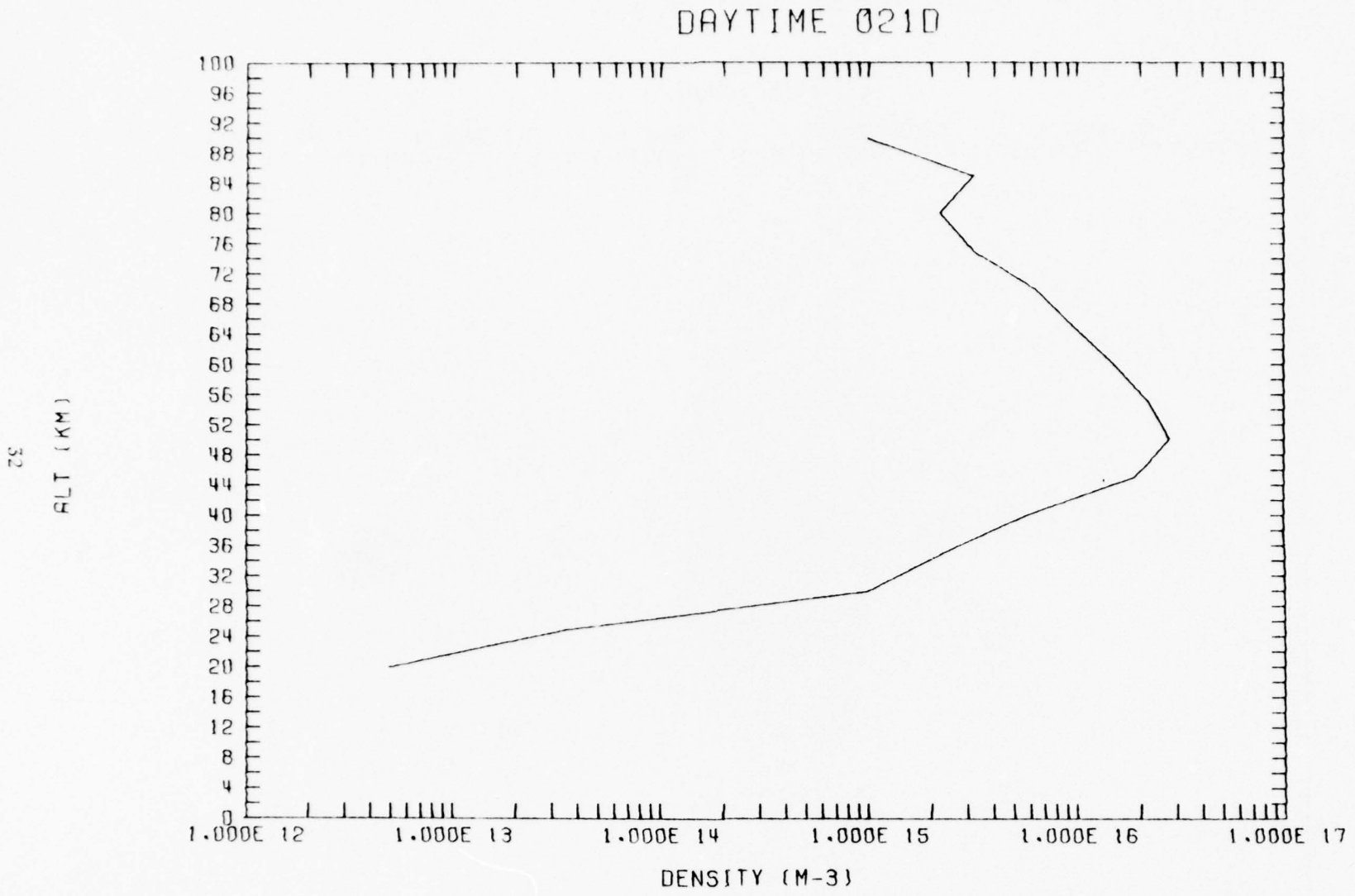

Figure 19. $O_2(^1\Delta_g)$ daytime profile.

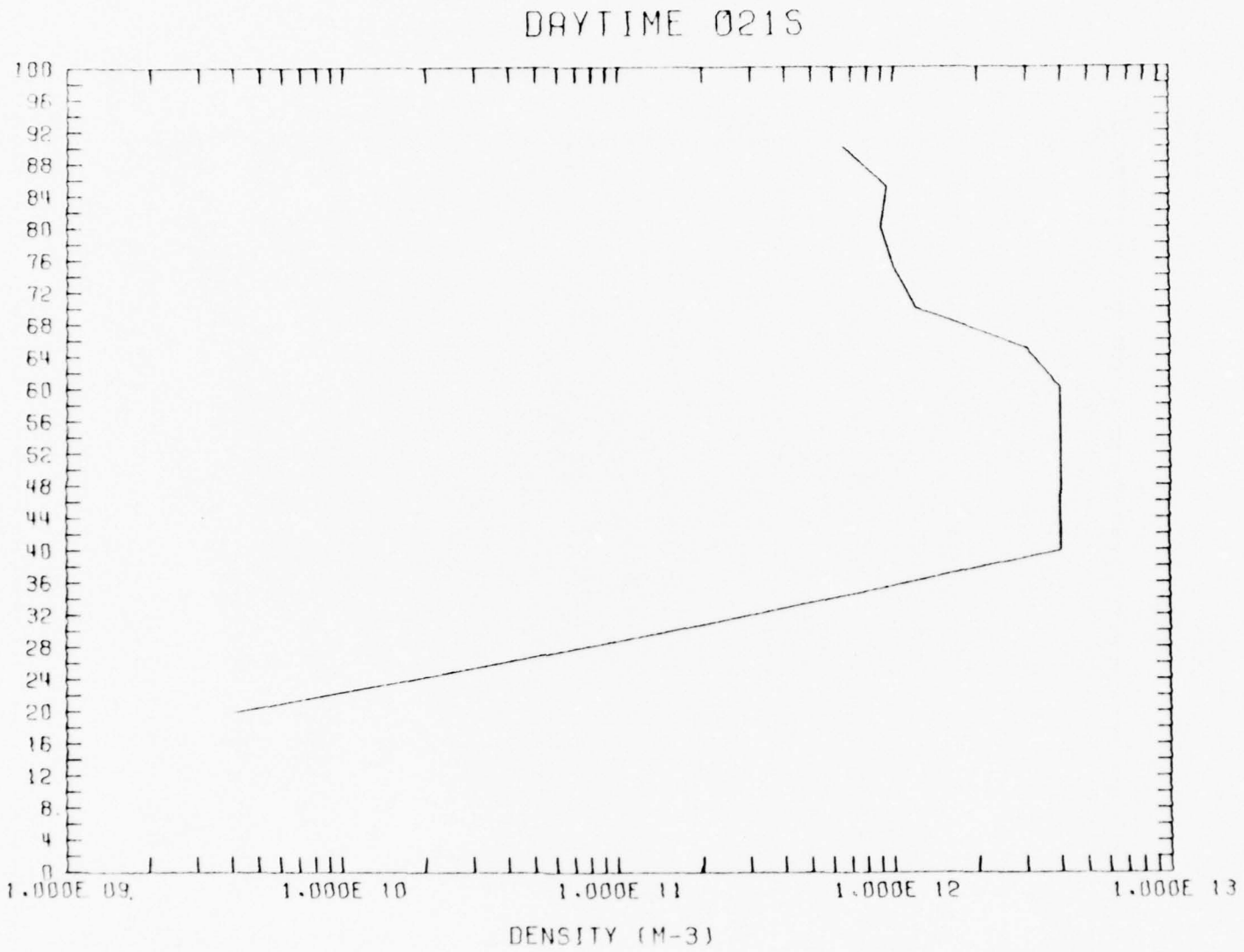

Figure 20. $O_2(^1\Sigma_g^+)$ [illegible] time profile.

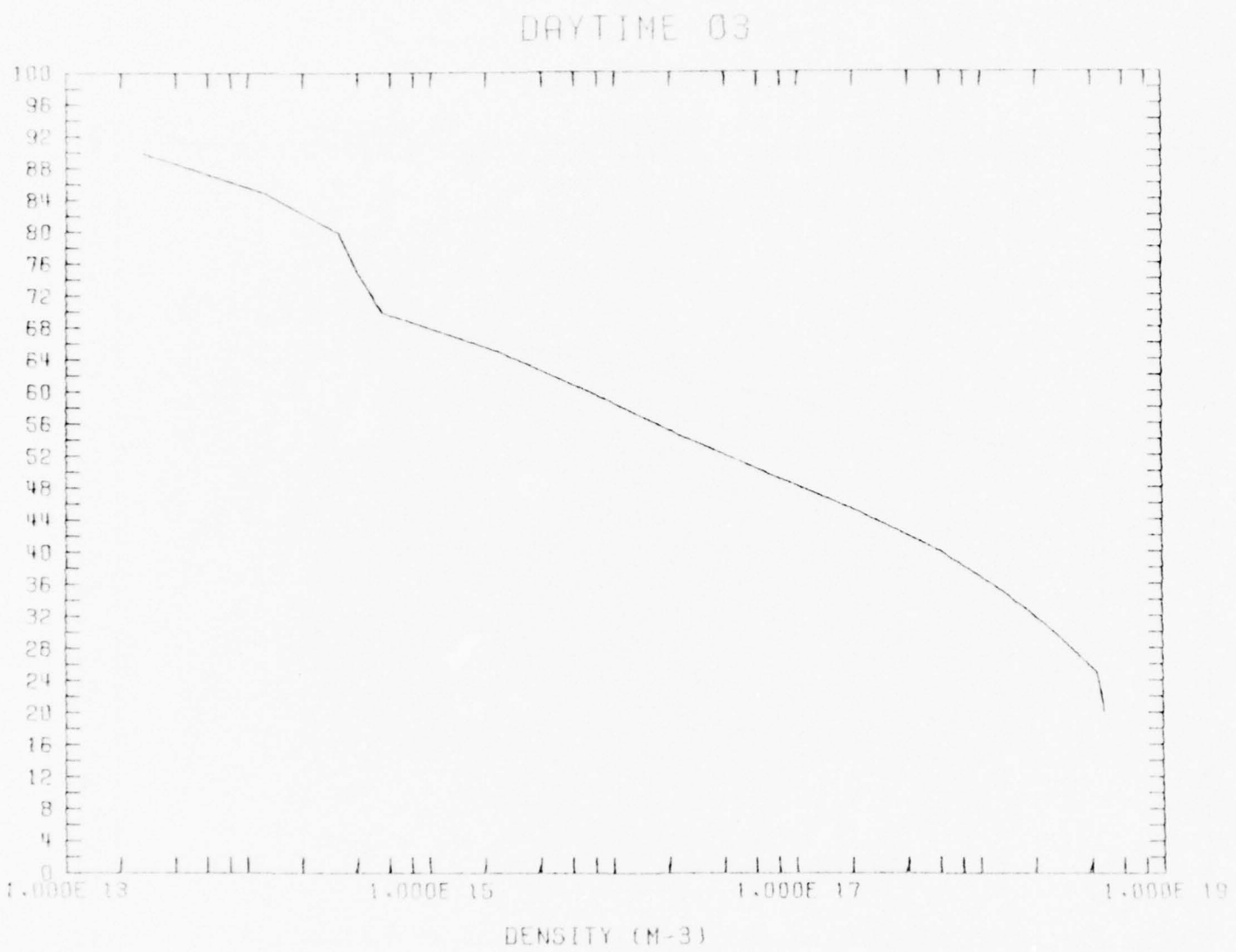

Figure 21. O_3 daytime profile.

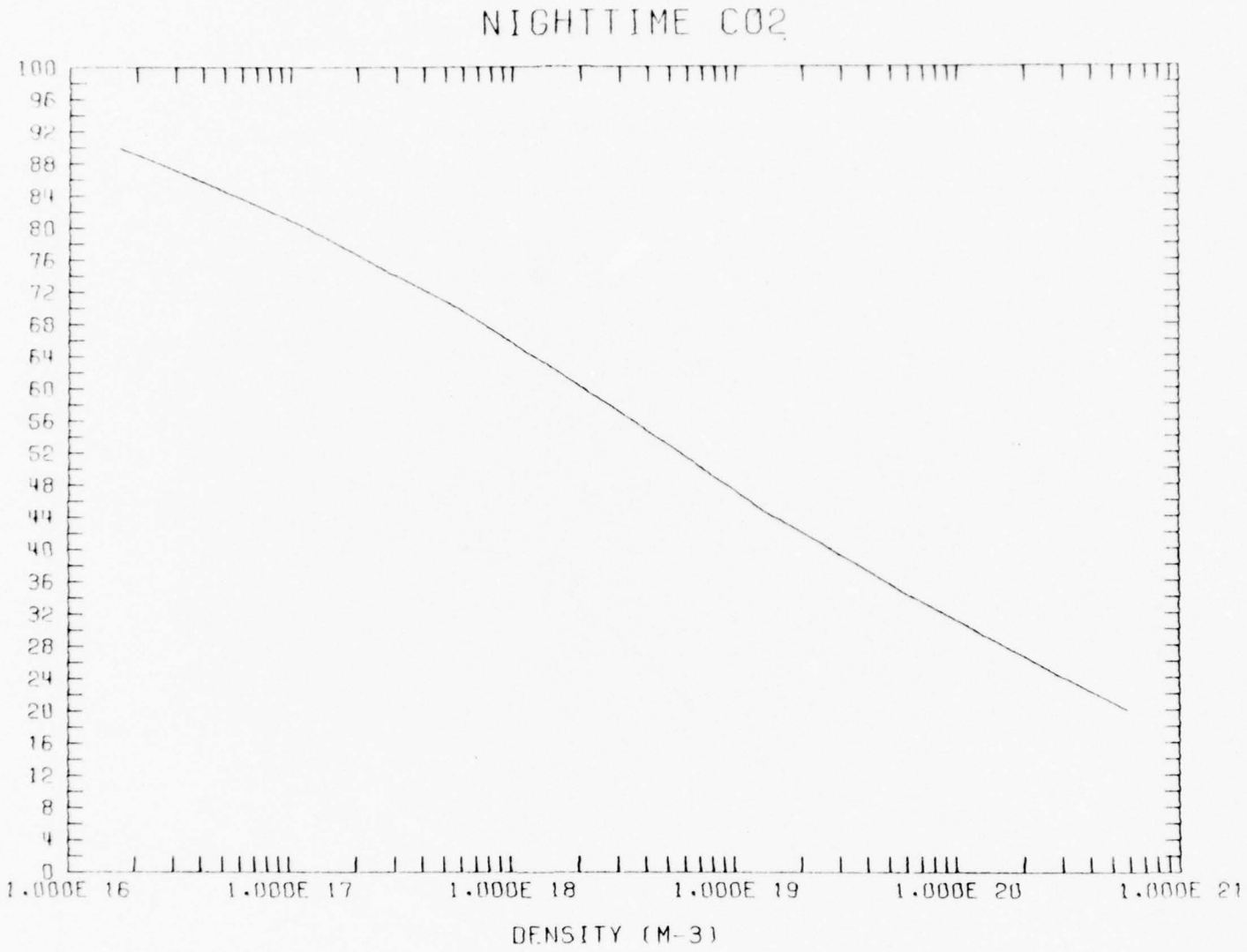

Figure 22. CO_2 nighttime profile.

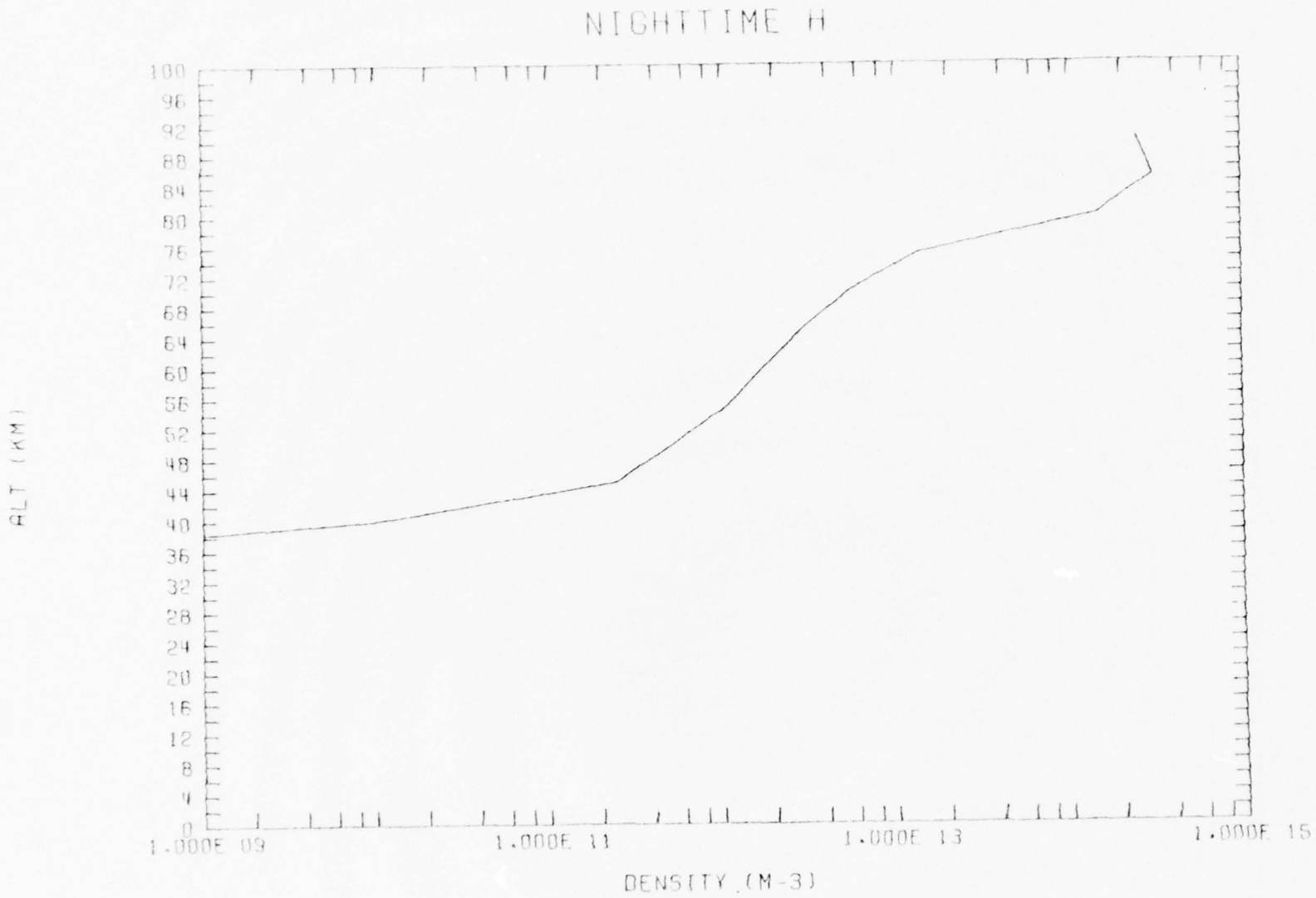

Figure 23. H nighttime profile.

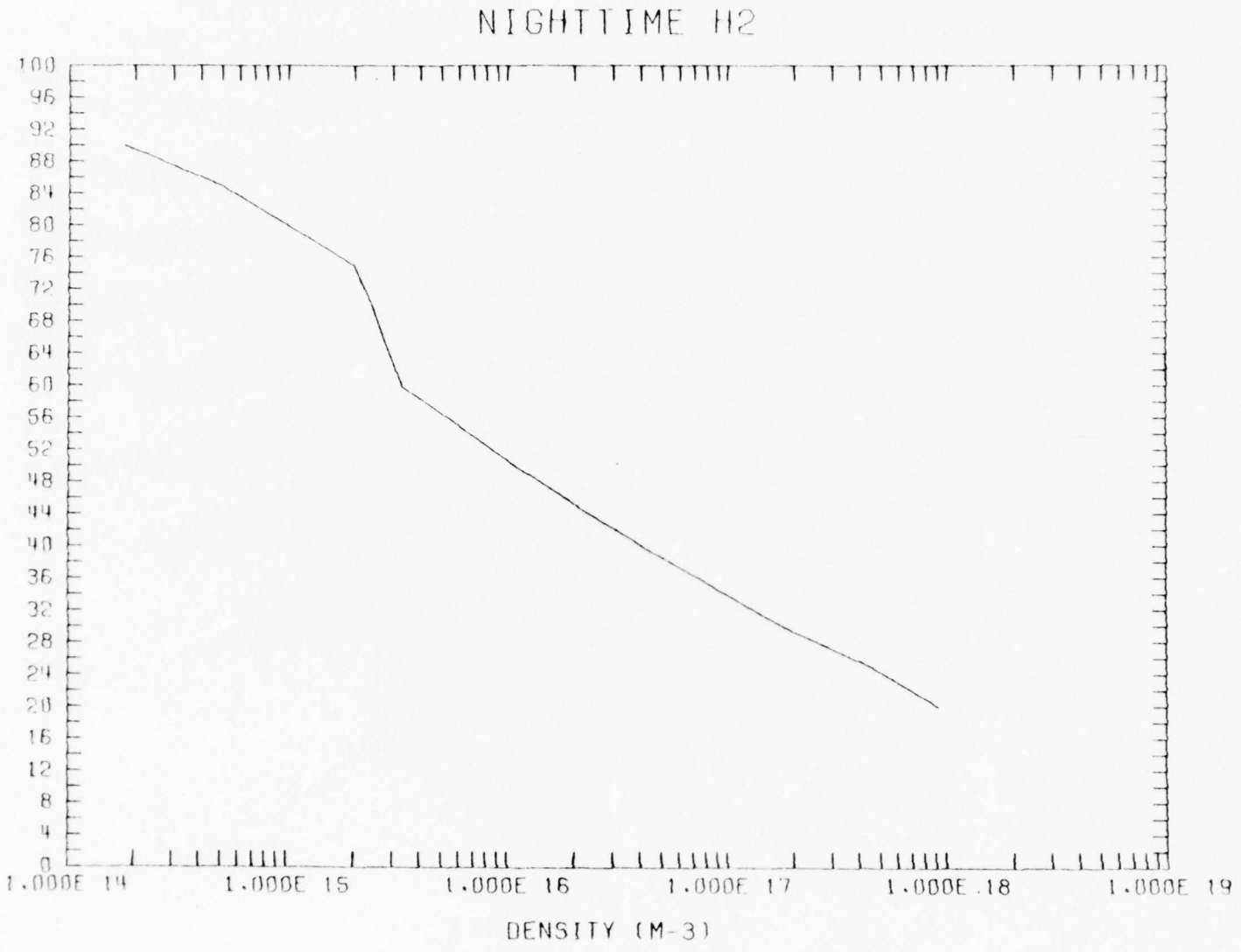

Figure 24. H_2 nighttime profile.

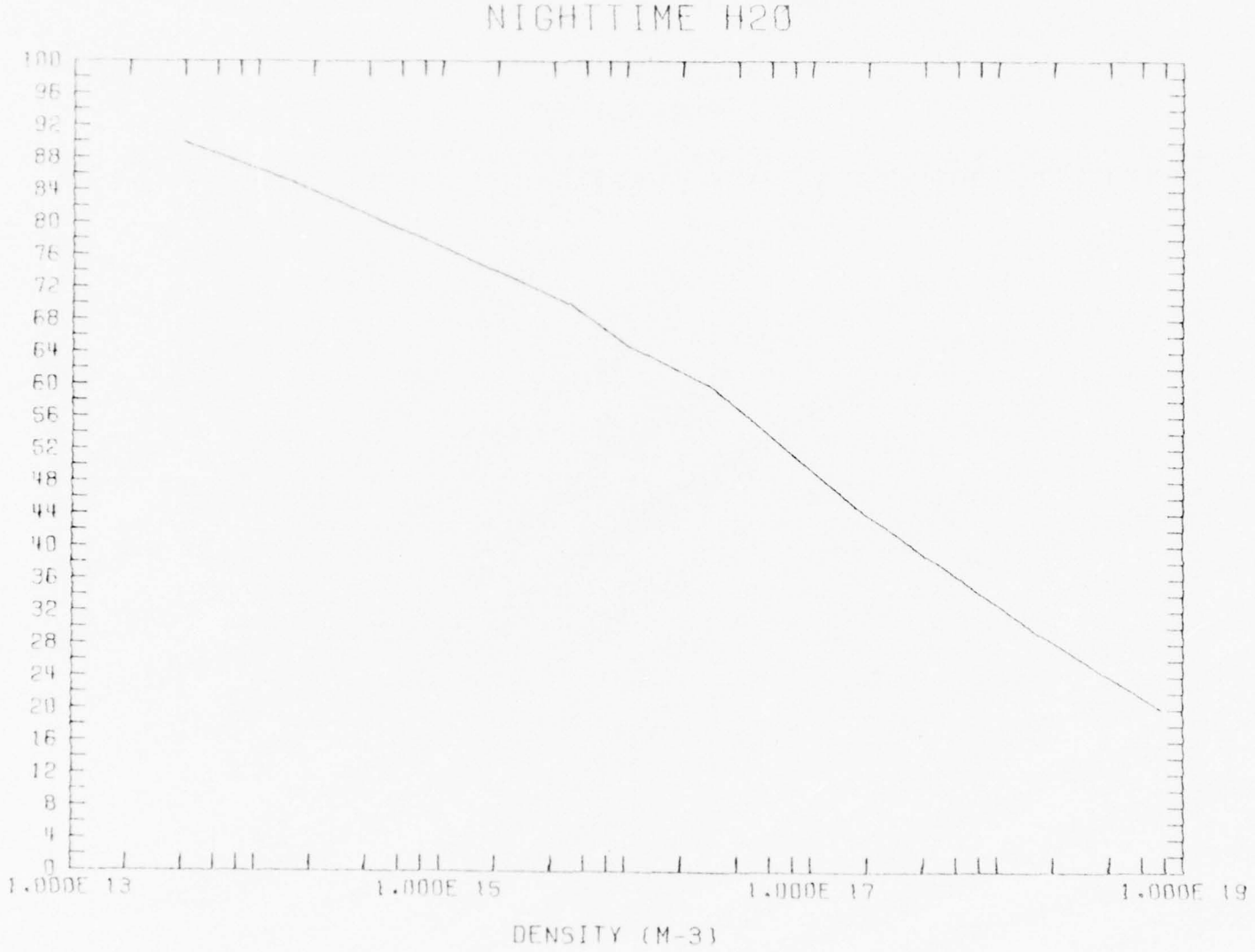

Figure 25. H_2O nighttime profile.

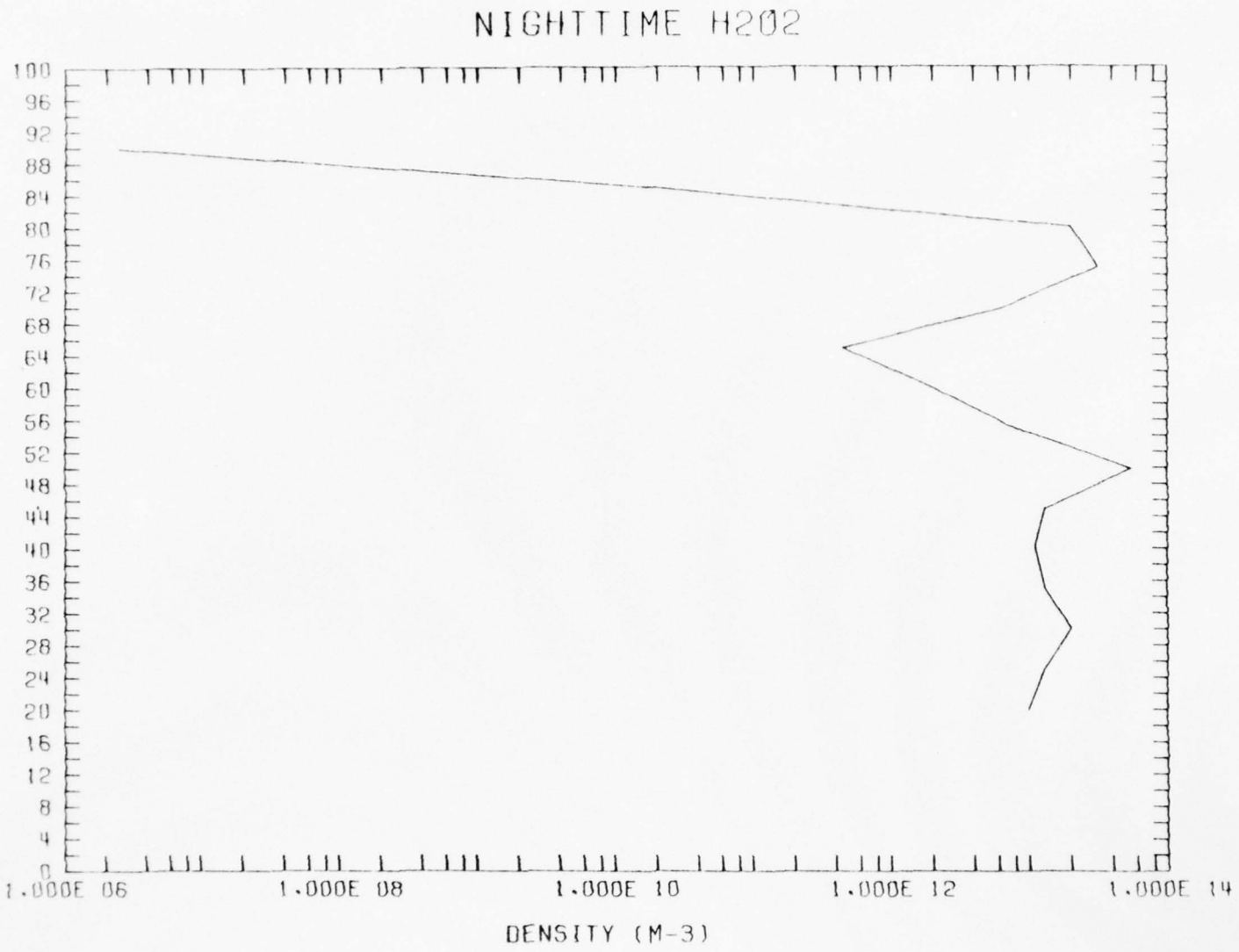

Figure 26. H_2O_2 nighttime profile.

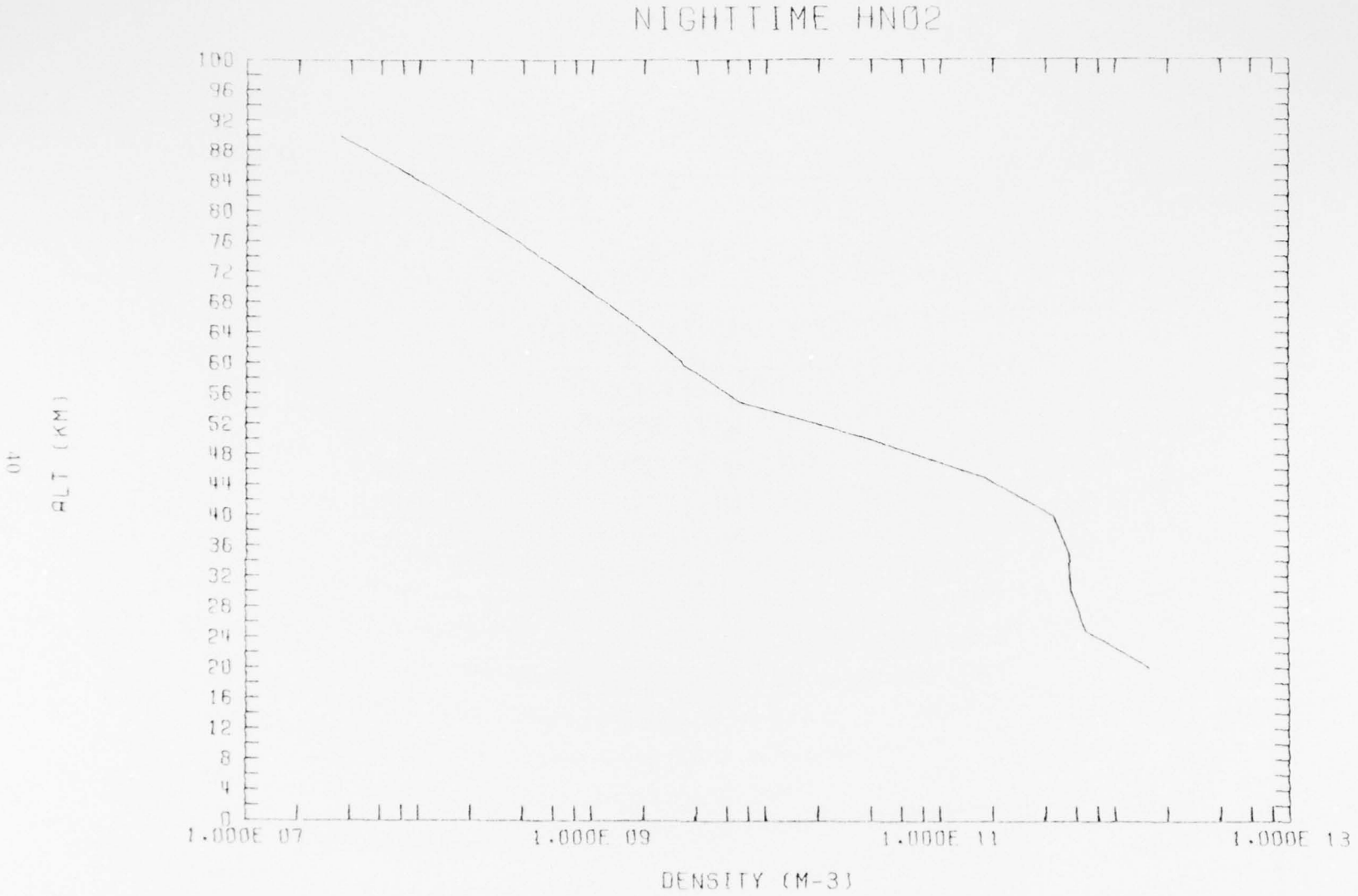

Figure 27. HNO_2 nighttime profile.

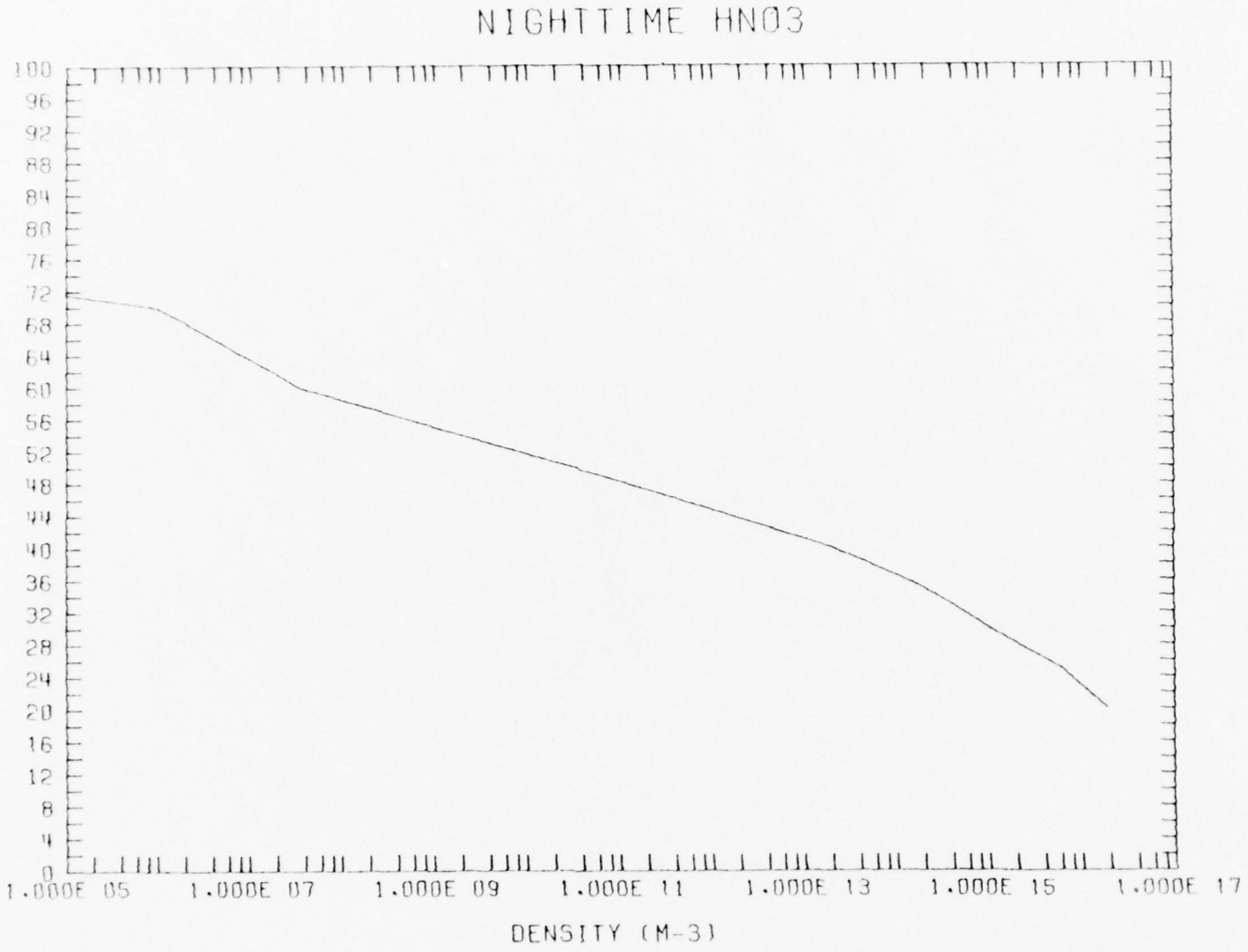

Figure 28. HNO_3 nighttime profile.

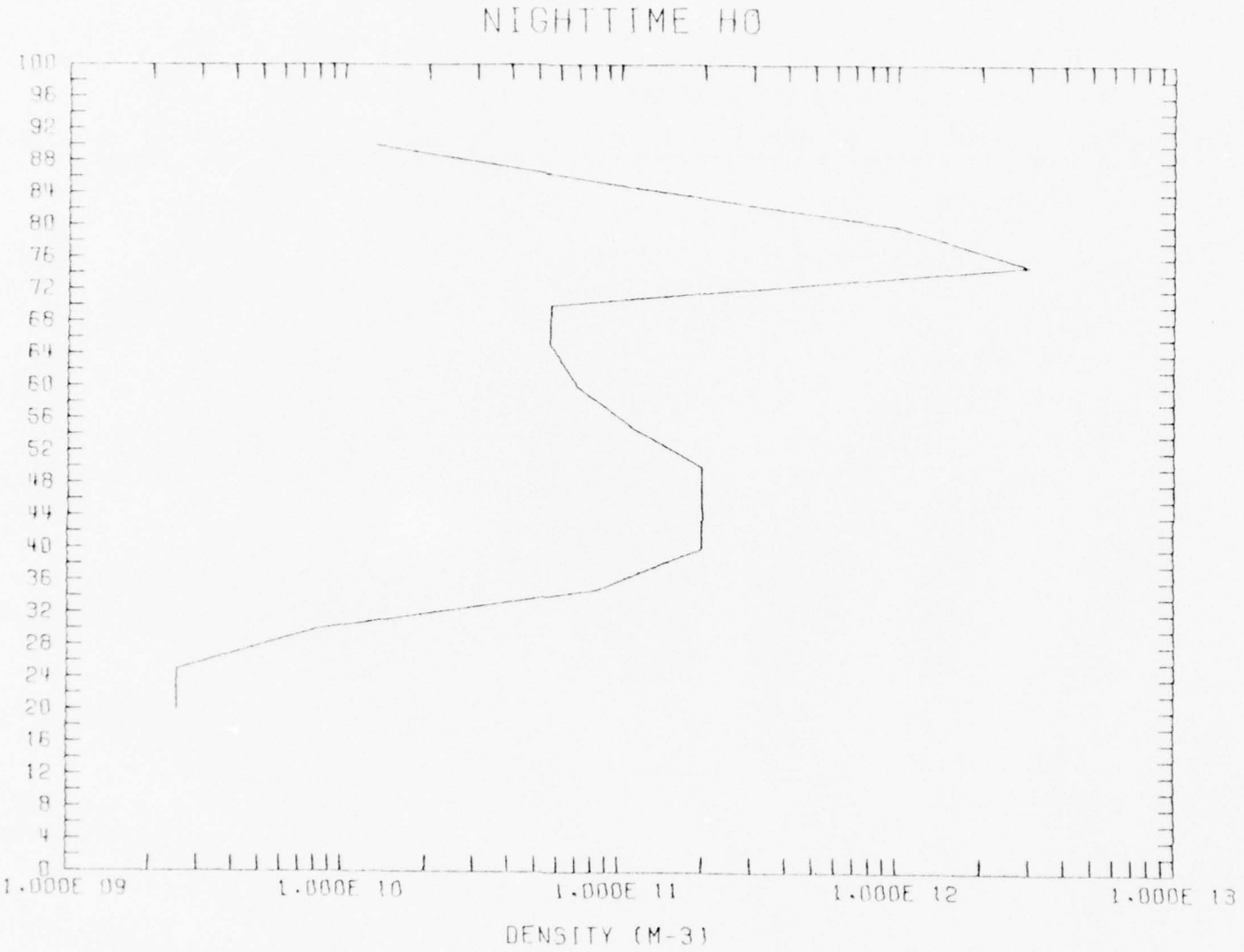

Figure 29. H0 nighttime profile.

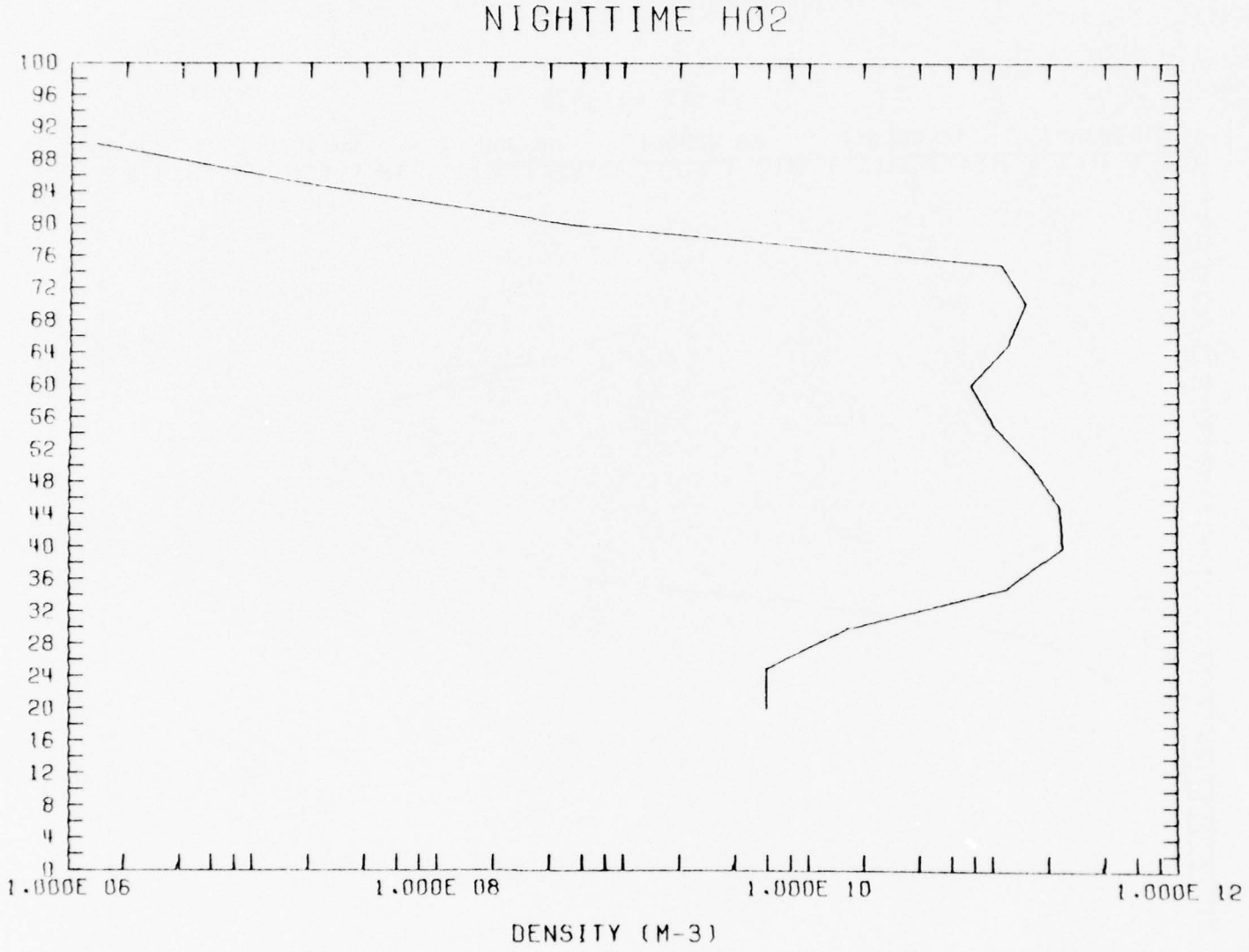

Figure 30. HO_2 nighttime profile.

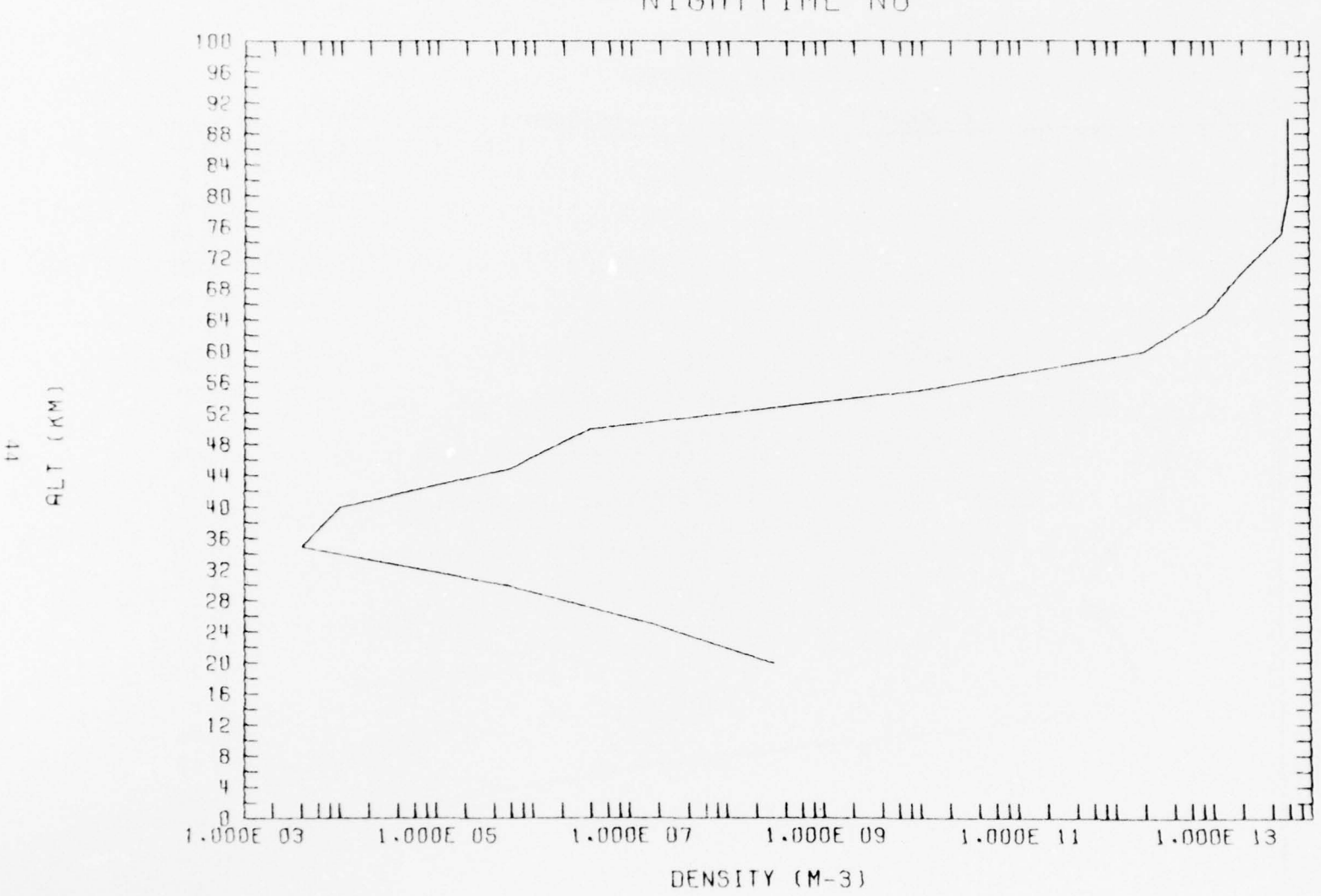

Figure 31. NO nighttime profile.

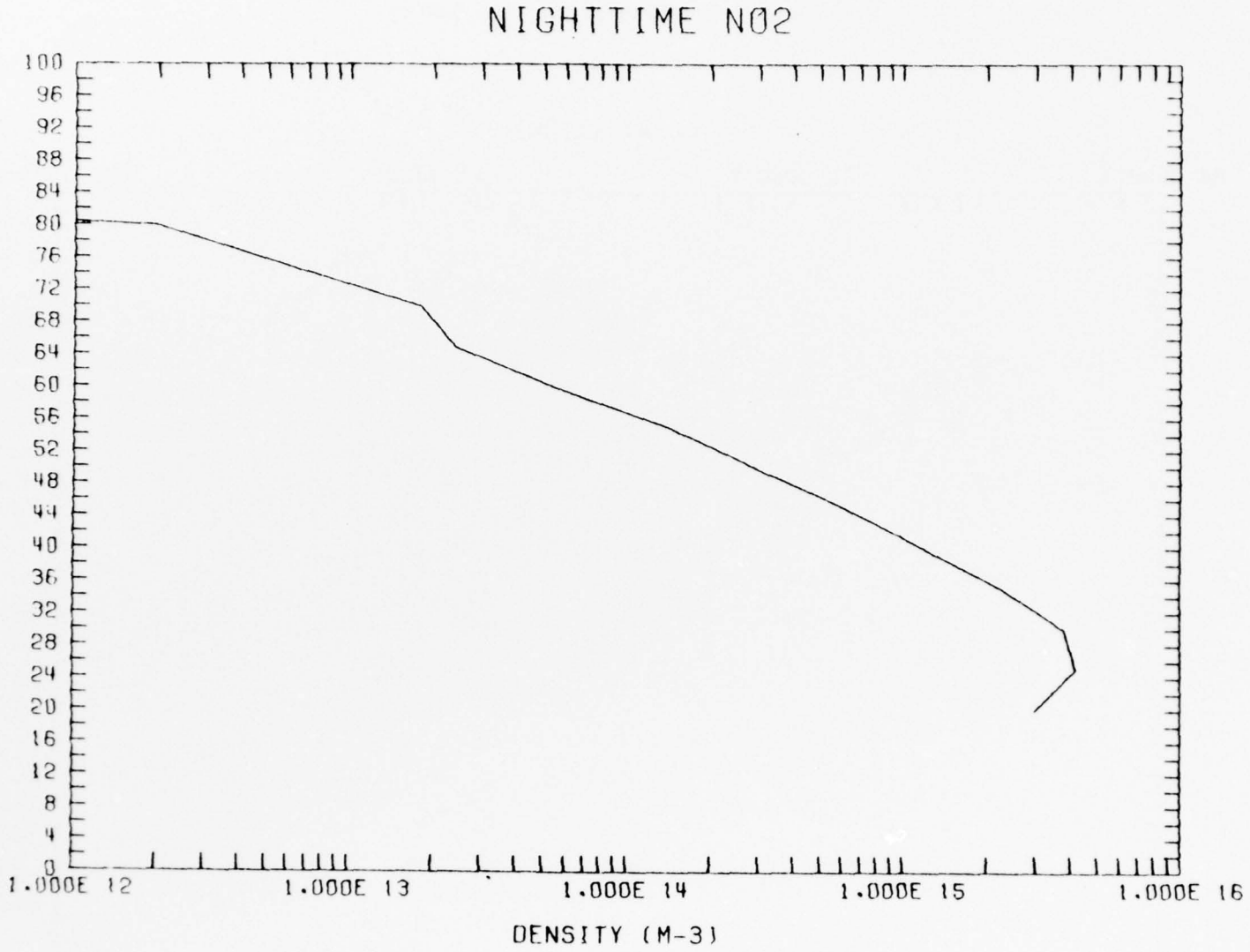

Figure 32. NO_2 nighttime profile.

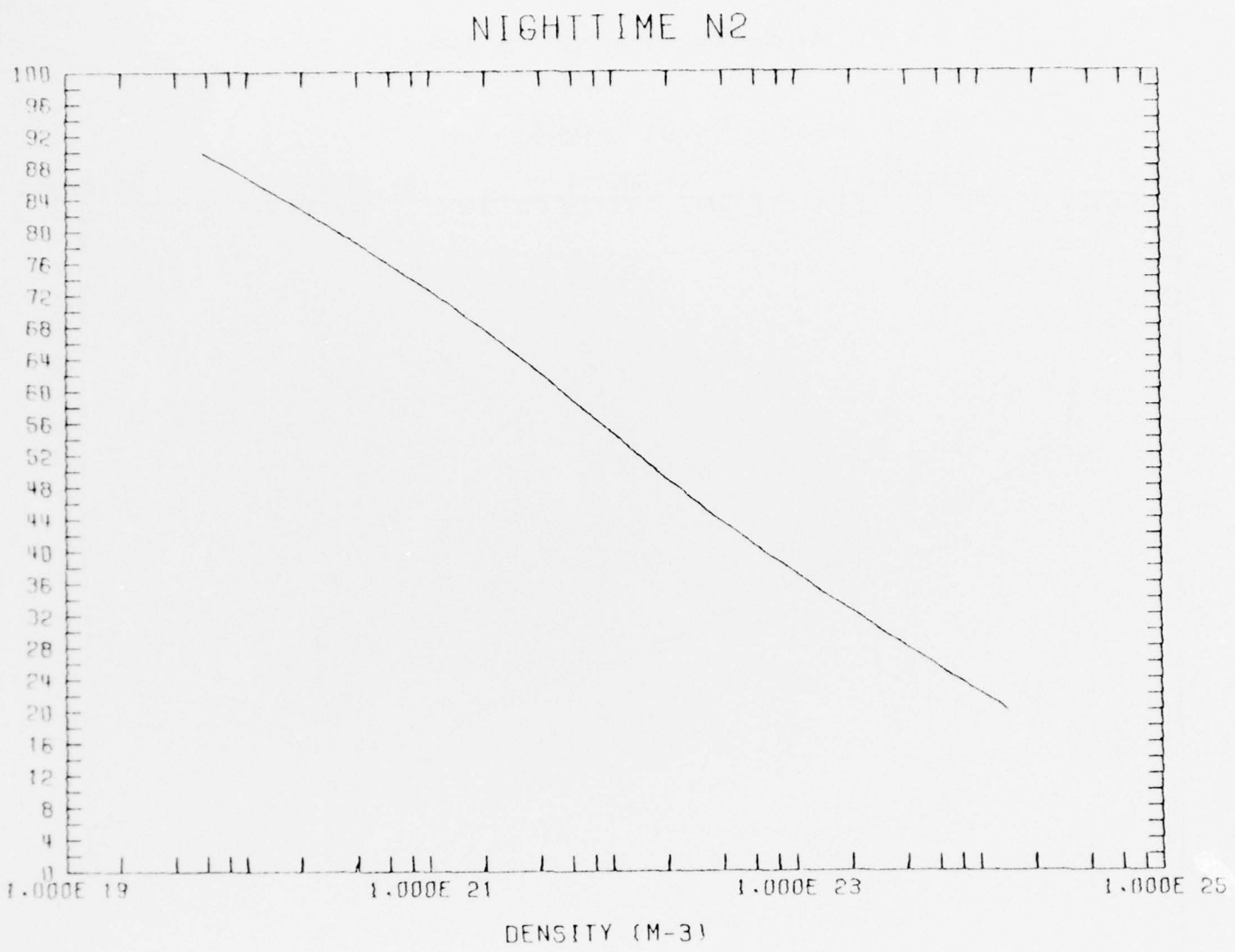

Figure 33. N_2 nighttime profile.

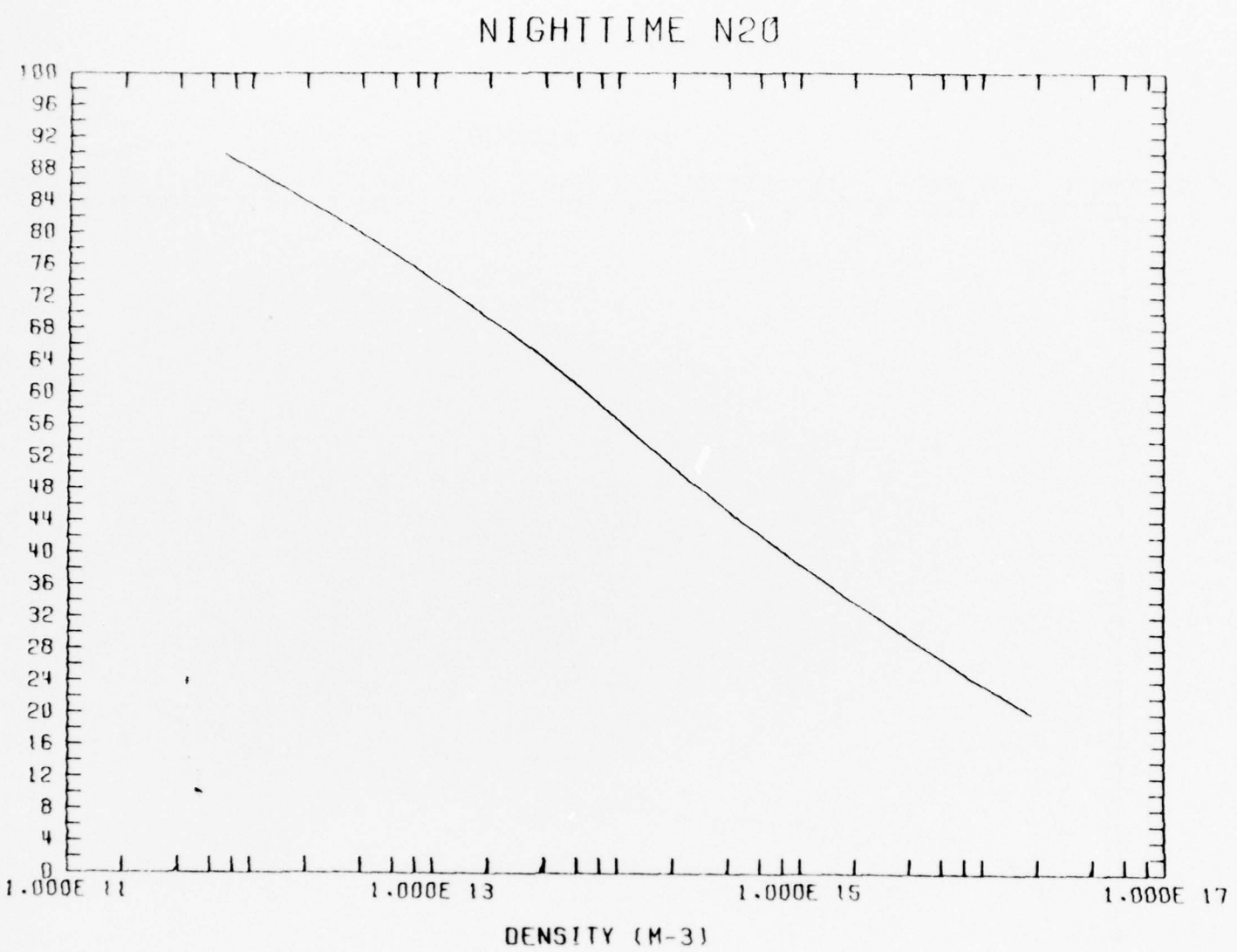

Figure 34. N_2O nighttime profile.

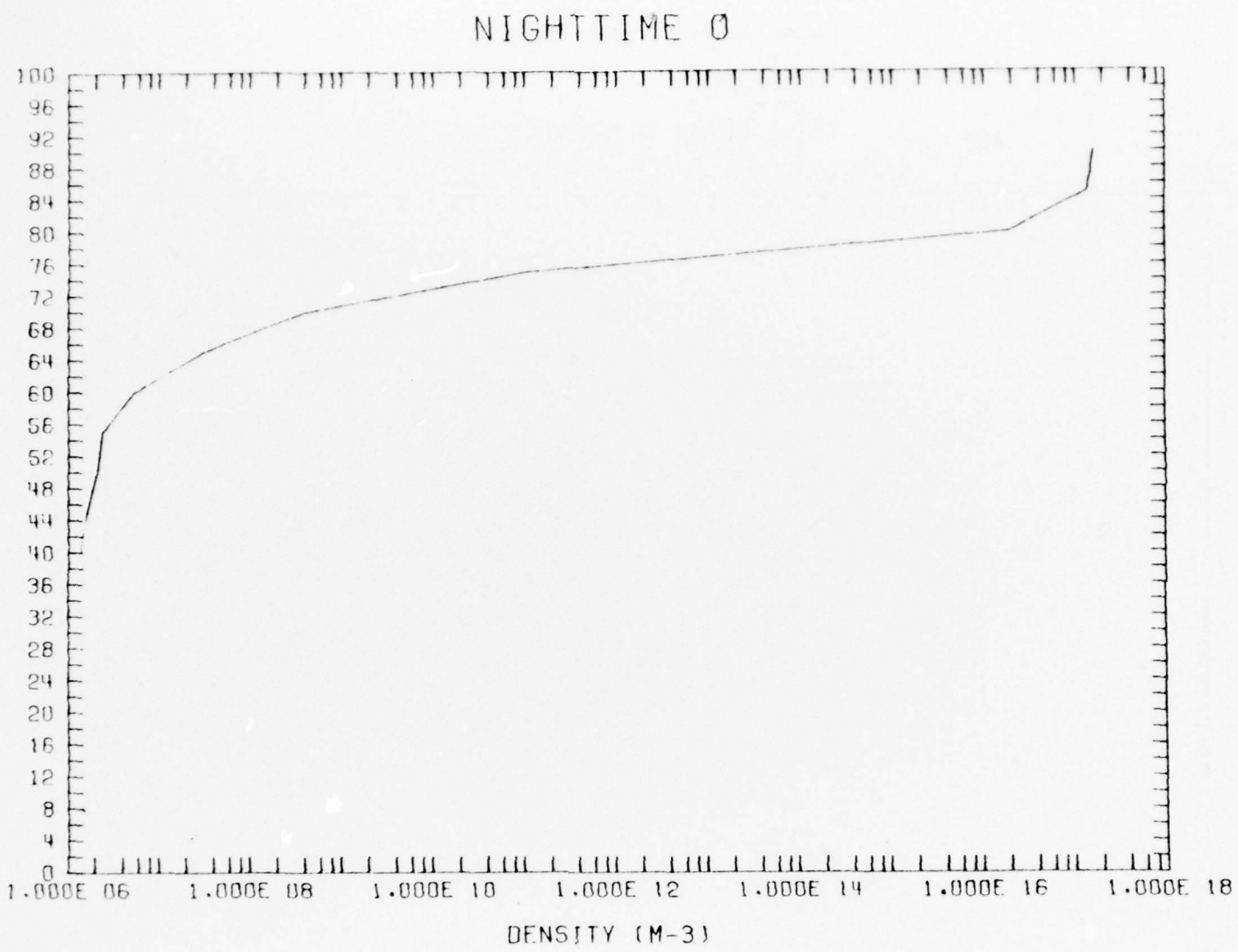

Figure 35. $O(^3P)$ nighttime profile.

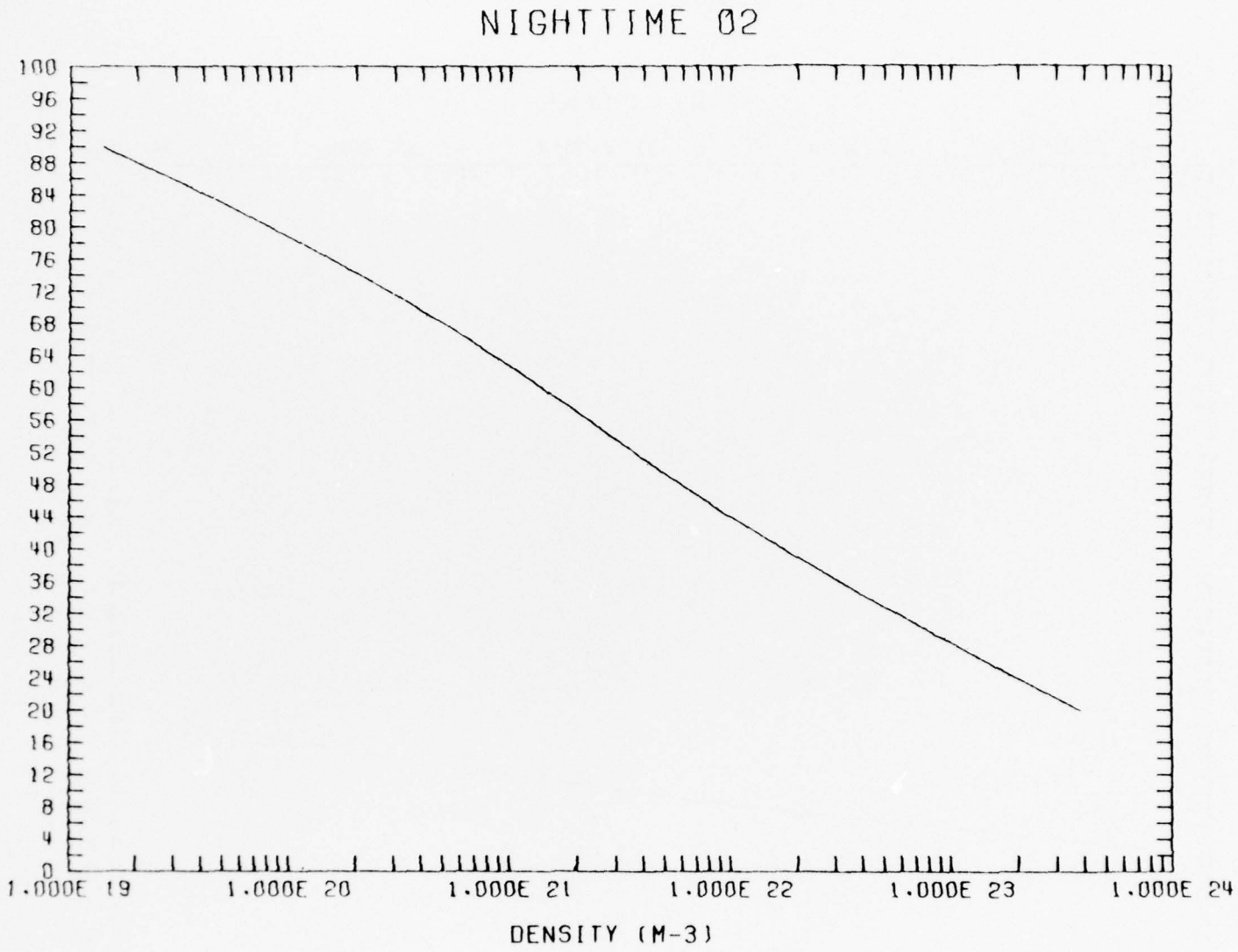

Figure 36. $O_2(^3\Sigma_g^-)$ nighttime profile.

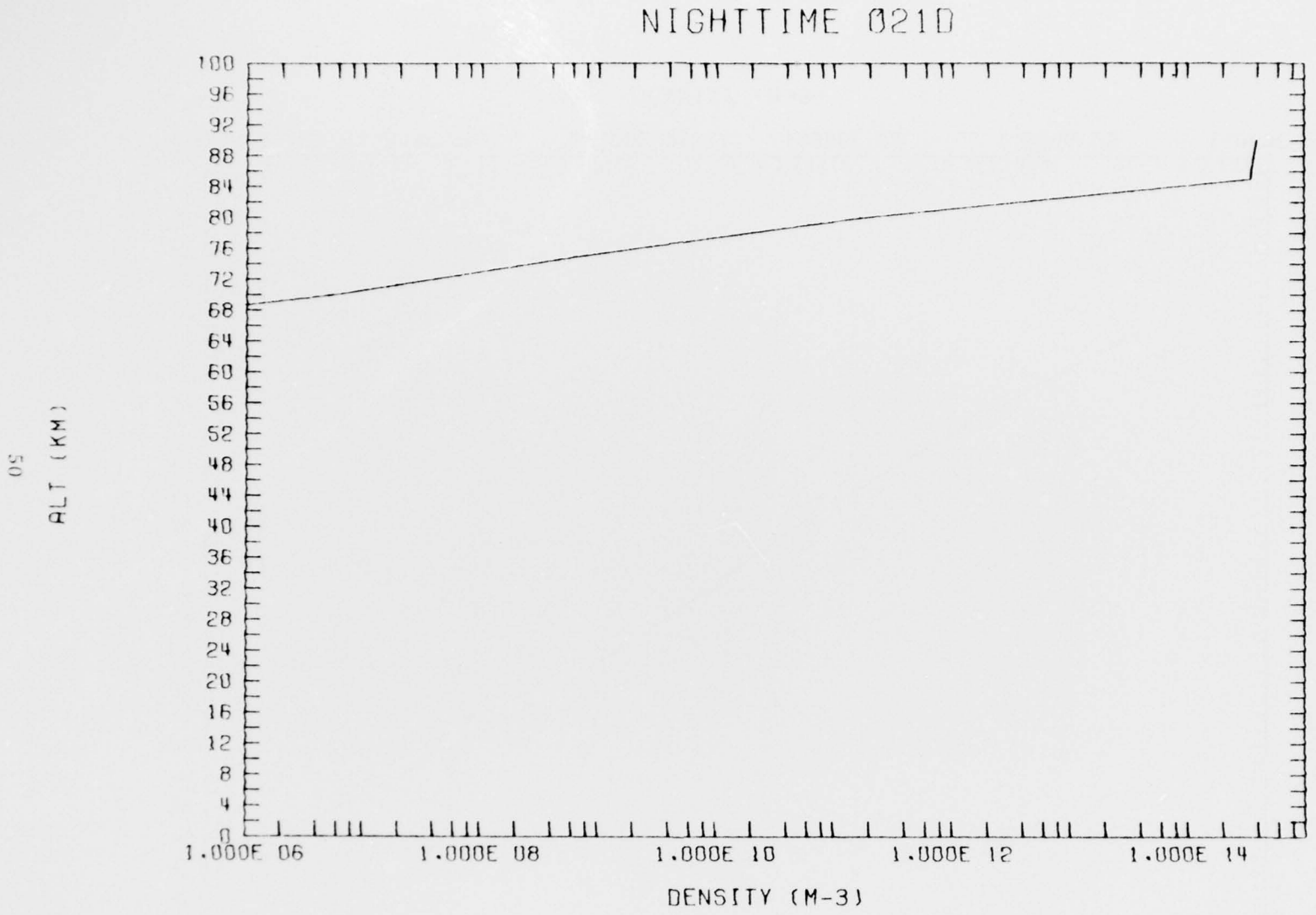

Figure 37. $O_2(^1\Delta_g)$ nighttime profile.

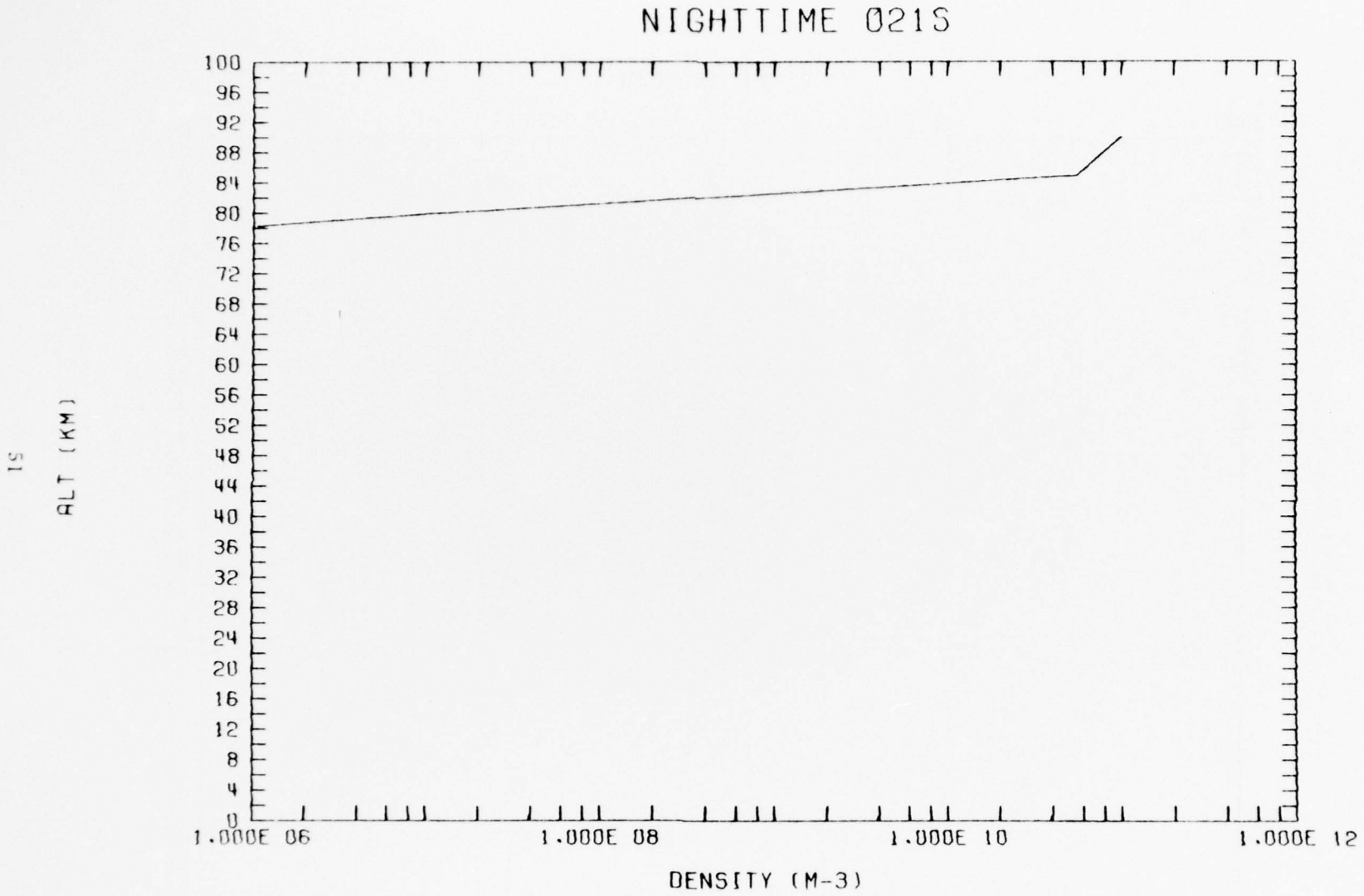

Figure 38. $O_2(^1\Sigma_g^+)$ nighttime profile.

Figure 39. O_3 nighttime profile.

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