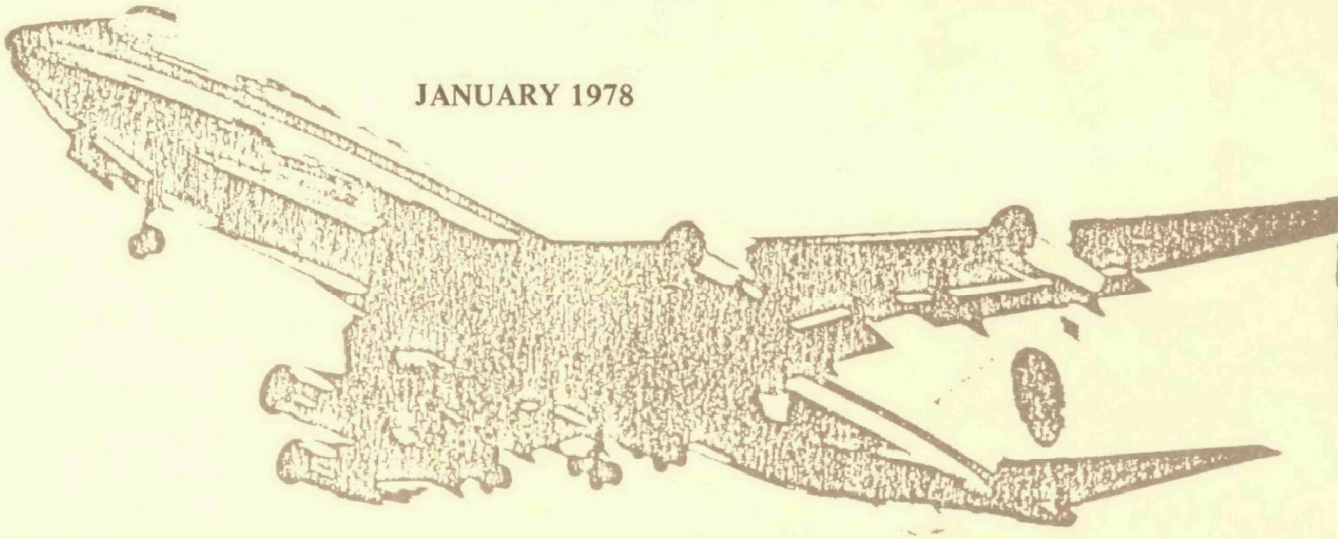
U.S. Environmental Protection Agency
Office of Noise Abatement and Control
Washington, D.C. 20460

EPA 550/9-77-450
ADDENDUM 1



JANUARY 1978

SOUND EXPOSURE LEVELS (SEL) CHART FOR CIVIL JET TRANSPORT AIRCRAFT TAKEOFFS USING ATA PROCEDURES

(Adopted December 1976)

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

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16. ABSTRACT

EPA 550/9-77-450, presented a method for the manual calculation of day-night average sound levels (L_{dn}) due to aircraft operations. Information was presented for different aircraft and different operational procedures. Addendum I presents the additional information needed to predict the Noise levels produced by aircraft which utilize the Air Transport Association (ATA) procedures which were adopted December 1976.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Noise levels, aircraft noise levels, day-night average noise levels, noise level prediction, airport noise levels		

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EPA 550/9-77-450
ADDENDUM 1

SOUND EXPOSURE LEVELS (SEL) CHARTS FOR CIVIL JET TRANSPORT AIRCRAFT TAKEOFFS USING ATA PROCEDURES (Adopted December 1976)

January 1978

Prepared for:

U.S. Environmental Protection Agency
Office of Noise Abatement and Control

Under Contract No. 68-01-4388

This report has been approved for general availability. The contents of this report reflect the views of the contractor, who is responsible for the facts and the accuracy of the data presented herein, and do not necessarily reflect the official views of policy of EPA. This report does not constitute a standard, specification, or regulation.

ADDENDUM I

SOUND EXPOSURE LEVEL (SEL) CHARTS FOR CIVIL JET TRANSPORT AIRCRAFT TAKEOFFS USING ATA PROCEDURES ADOPTED DECEMBER 1976

This addendum presents sound exposure level (SEL) charts for civil jet transport takeoffs based on the revised air transport association (ATA) procedures adopted in December 1976. For studies of current and forecast operations involving air transport aircraft using ATA procedures, these charts (as shown in the table below) should replace the takeoff charts given in Attachment 1, Calculations of Day-Night Levels (L_{dn}) Resulting From Civil Aircraft Operations, EPA Report 550/9-77-450.

Aircraft Types	Aircraft Code	Replace Rept. 550/9-77-450 Attachment 1 Pages	With Addendum Pages
4-Engine LBPR turbofan	4-T-TFL	80-88	10-18
4-Engine LBPR turbofan (quiet nacelle)	4-T-TFL(Q)	111-119	19-27
3-Engine LBPR turbofan	3-T-TFL	142-147	28-33
3-Engine LBPR turbofan (quiet nacelle)	3-T-TFL(Q)	164-169	34-39
2-Engine LBPR	2-T-TFL	186-191	40-45
2-Engine LBPR turbofan (quiet nacelle)	2-T-TFL(Q)	208-213	46-51
4-Engine HBPR turbofan	4-T-TFH	229-237	52-60
4-Engine HBPR turbofan (quiet nacelle)	4-T-TFH(Q)	260-268	61-69
3-Engine HBPR turbofan	3-T-TFH	291-299	70-78

The ATA procedures adopted in December 1976 differ in some details from those used previously. A comparison of procedures is given in Table 1. A comparison of takeoff profiles for a

Boeing 727 aircraft is given in Figure 1.* Note that as in the examples shown in Figure 1, the cutback to climb thrust is usually initiated at a lower altitude in the current ATA procedures than in the previous ATA procedures. Hence, aircraft taking off under the current procedures generally require a longer distance from the start of takeoff roll to reach a height of 3,000 feet.

Figures 2 through 6 show the takeoff profiles for the revised ATA procedures which were utilized to develop the SEL charts given in this addendum. These takeoff profiles may be compared with those given in Figures 2-3 through 2-7 of EPA Report 550/9-77-450.**

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*Detailed differences in the procedures will occur with aircraft type.

**EPA Report 550/9-77-450 "Calculation of Day-Night Levels (L_{dn}) Resulting from Civil Aircraft Operations," January 1977.

TABLE I - COMPARISON OF ATA TAKEOFF PROCEDURES FOR CIVIL TURBOFAN TRANSPORT AIRCRAFT

	Procedures Adopted August 1972	Procedures Adopted December 1976
First Phase	Takeoff to 1500 ft. Takeoff (TO) thrust V_2 + 10 airspeed TO flaps	Takeoff to 1000 ft. Takeoff (TO) thrust V_2 + 10 airspeed TO flaps
Second Phase	1500 to 3000 ft. Reduce thrust to maximum climb thrust Maintain V_2 + 10 airspeed and TO flaps	1000 to 3000 ft. Reduce aircraft pitch to maintain 500 to 1000 rpm climb rate. Accelerate and initiate flap retraction at appropriate minimum speeds. Reduce engine power to climb thrust during/following* cleanup of flaps and slats. Climb to 3000 ft. at zero flap speed.
Third Phase	3000 ft. and Above Accelerate to 250 kt, retract flaps on schedule while maintaining 500 FPM climb, then climb at 250 Kt.	3000 ft. and Above Accelerate to 250 Kt. Maintain rate of climb of 500 to 1000 rpm during acceleration, then continue climb at 250 Kt.

* Procedure varies with aircraft model.

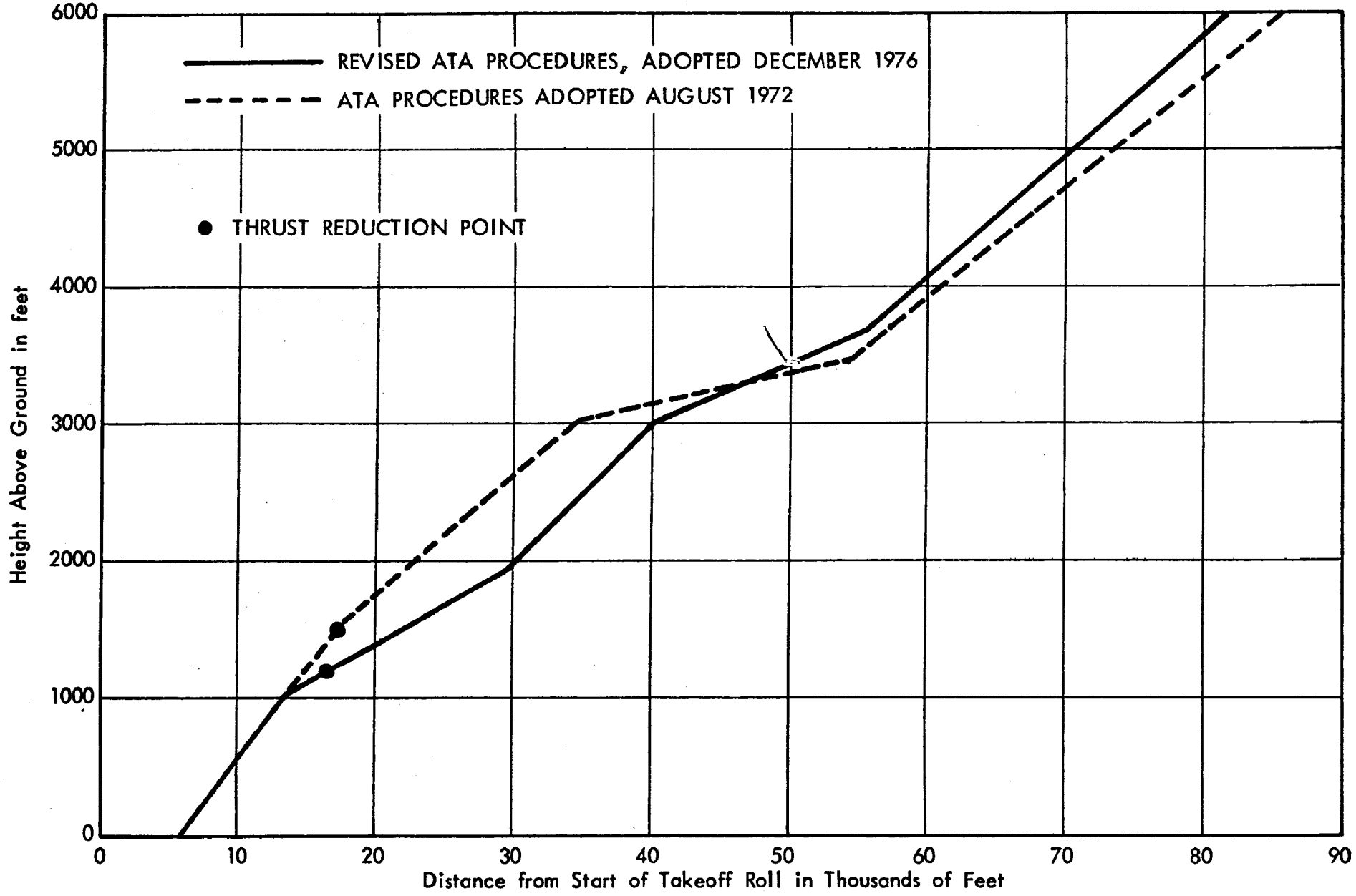


FIGURE 1. COMPARISON OF ATA PROCEDURES FOR 3-ENGINE LBPR TURBOFAN TRANSPORT AIRCRAFT - 727 SERIES (3-T-TFL) - PROFILE 1

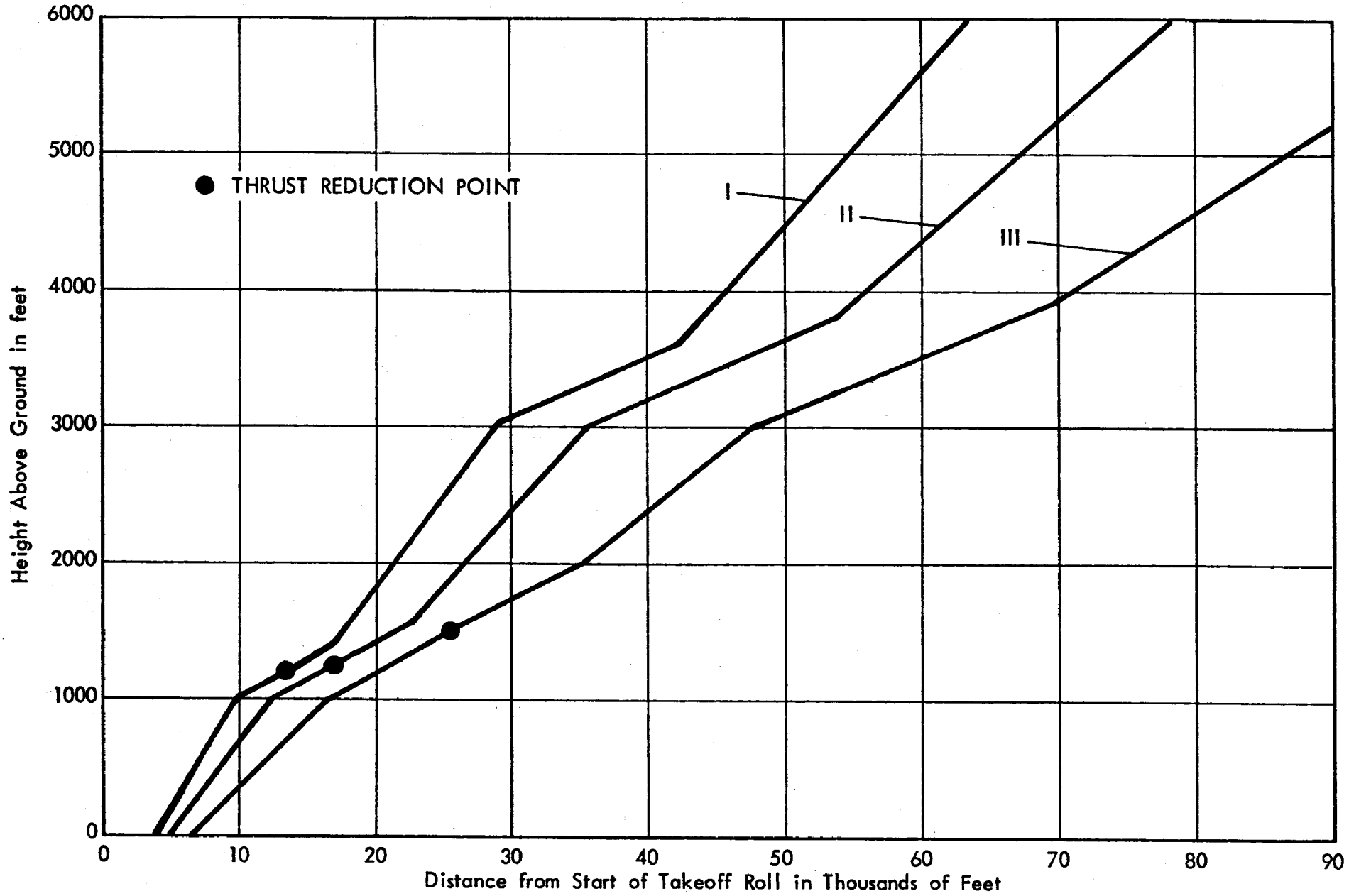


FIGURE 2. ATA TAKEOFF PROFILES FOR 4-ENGINE LBPR TURBOFAN TRANSPORT AIRCRAFT - DC-8, 707 SERIES (4-T-TFL) - REVISED PROCEDURES ADOPTED DECEMBER 1976

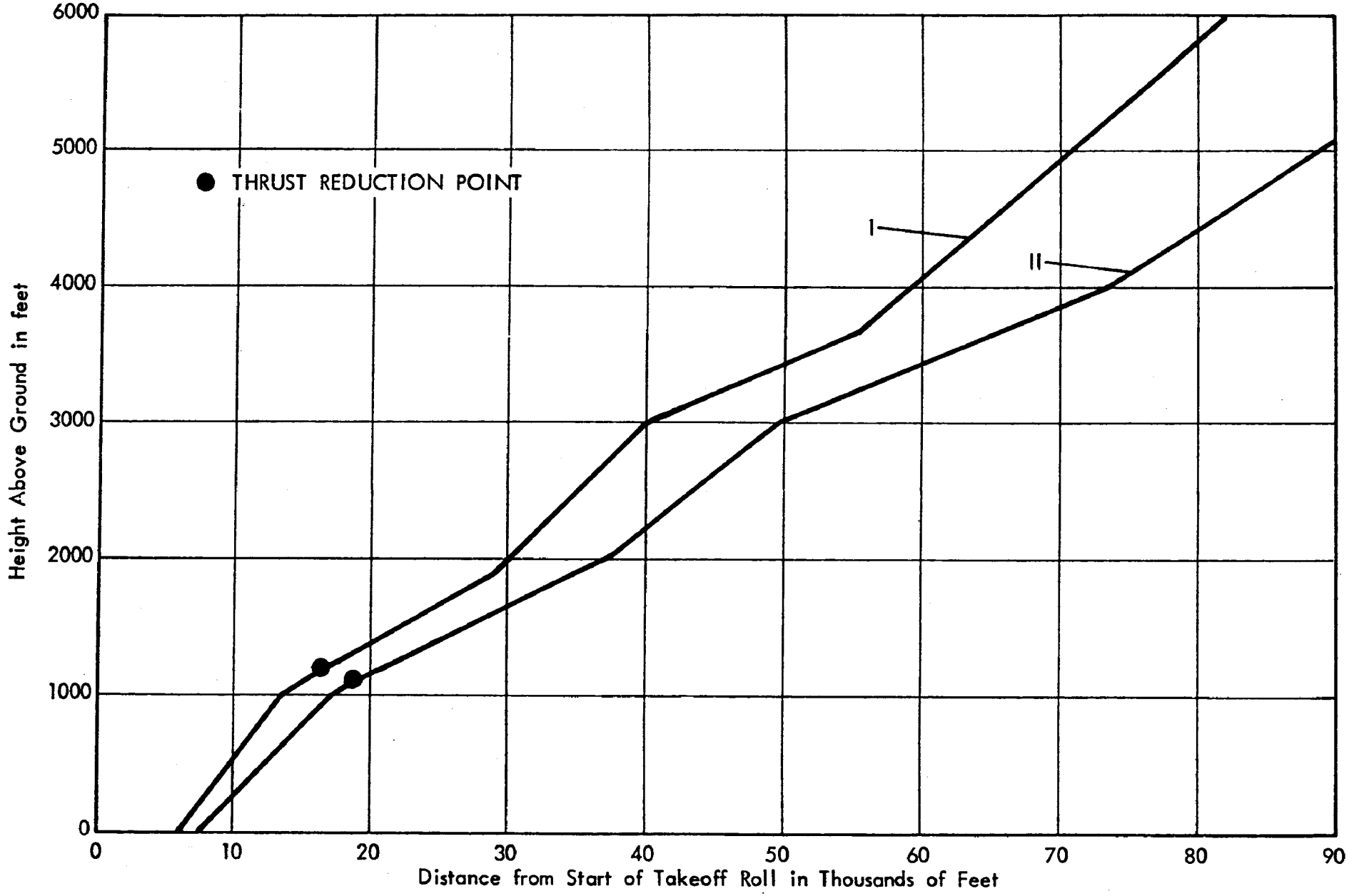


FIGURE 3. ATA TAKEOFF PROFILES FOR 3-ENGINE LBPR TURBOFAN TRANSPORT AIRCRAFT - 727 SERIES (3-T-TFL) - REVISED PROCEDURES ADOPTED DECEMBER 1976

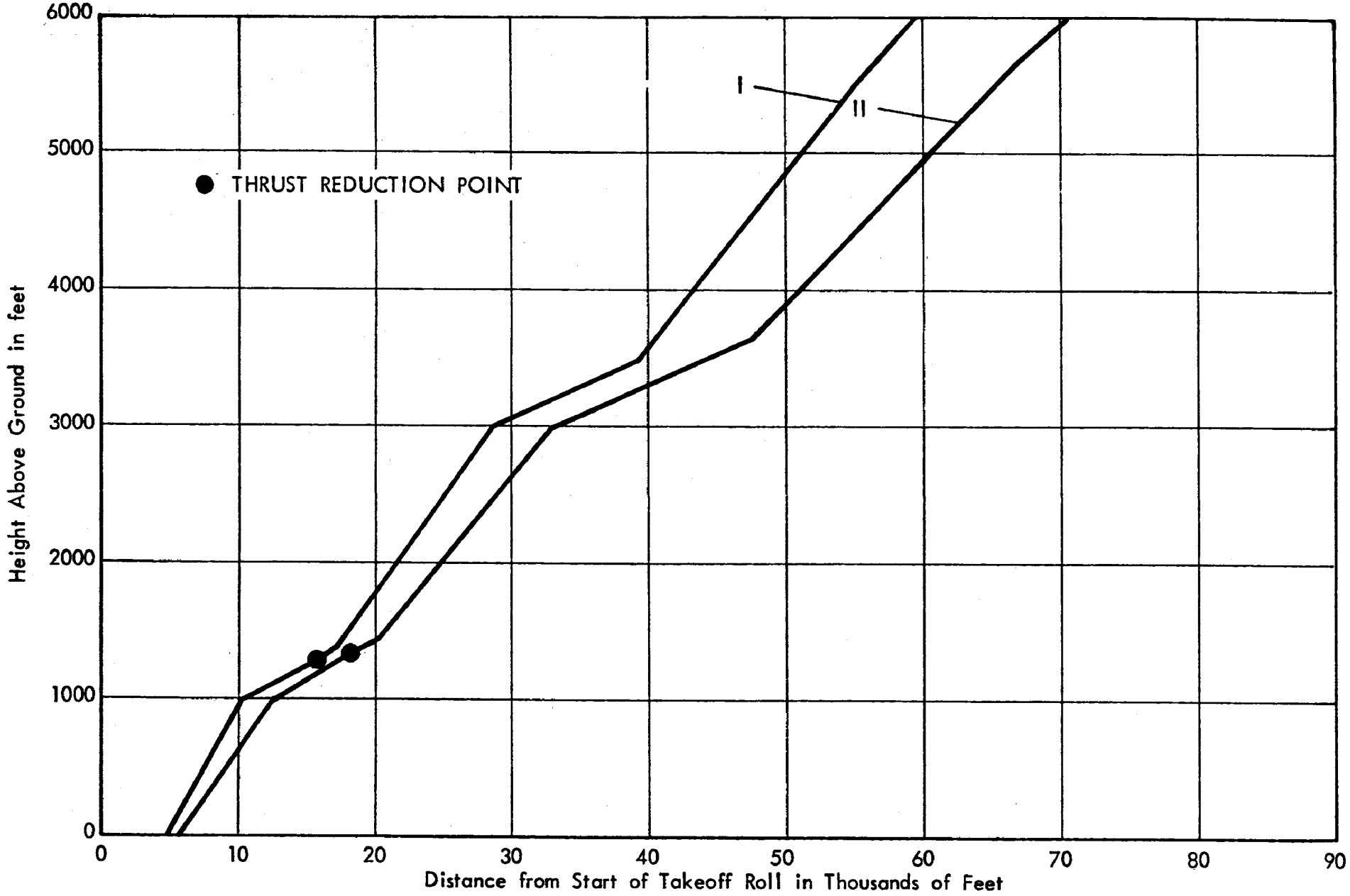


FIGURE 4. ATA TAKEOFF PROFILES FOR 2-ENGINE LBPR TURBOFAN TRANSPORT AIRCRAFT - DC-9, 737 SERIES (2-T-TFL) - REVISED PROCEDURES ADOPTED DECEMBER 1976

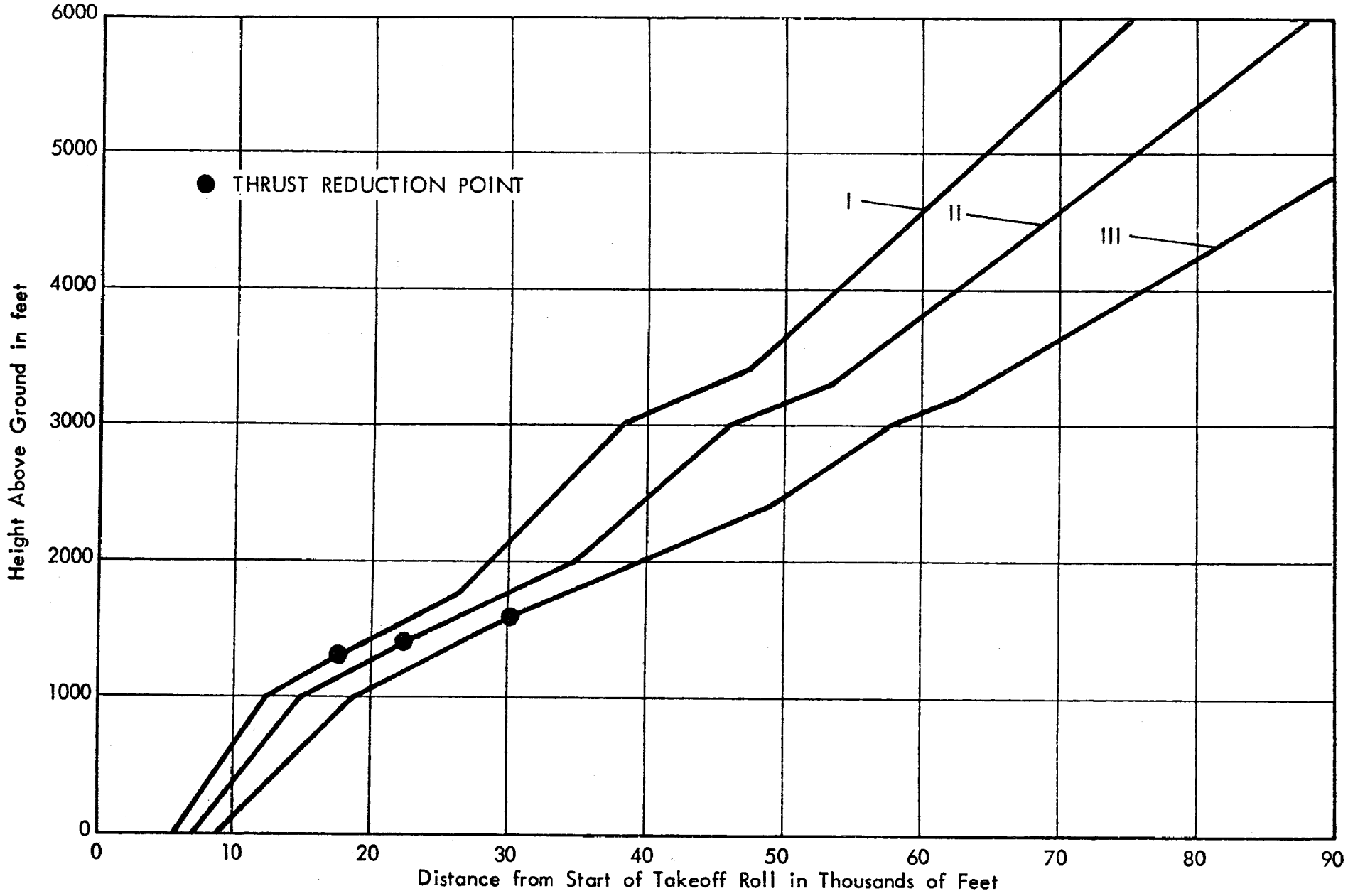


FIGURE 5. ATA TAKEOFF PROFILES FOR 4-ENGINE HBPR TURBOFAN TRANSPORT AIRCRAFT - 747 SERIES (4-T-TFH) - REVISED PROCEDURES ADOPTED DECEMBER 1976

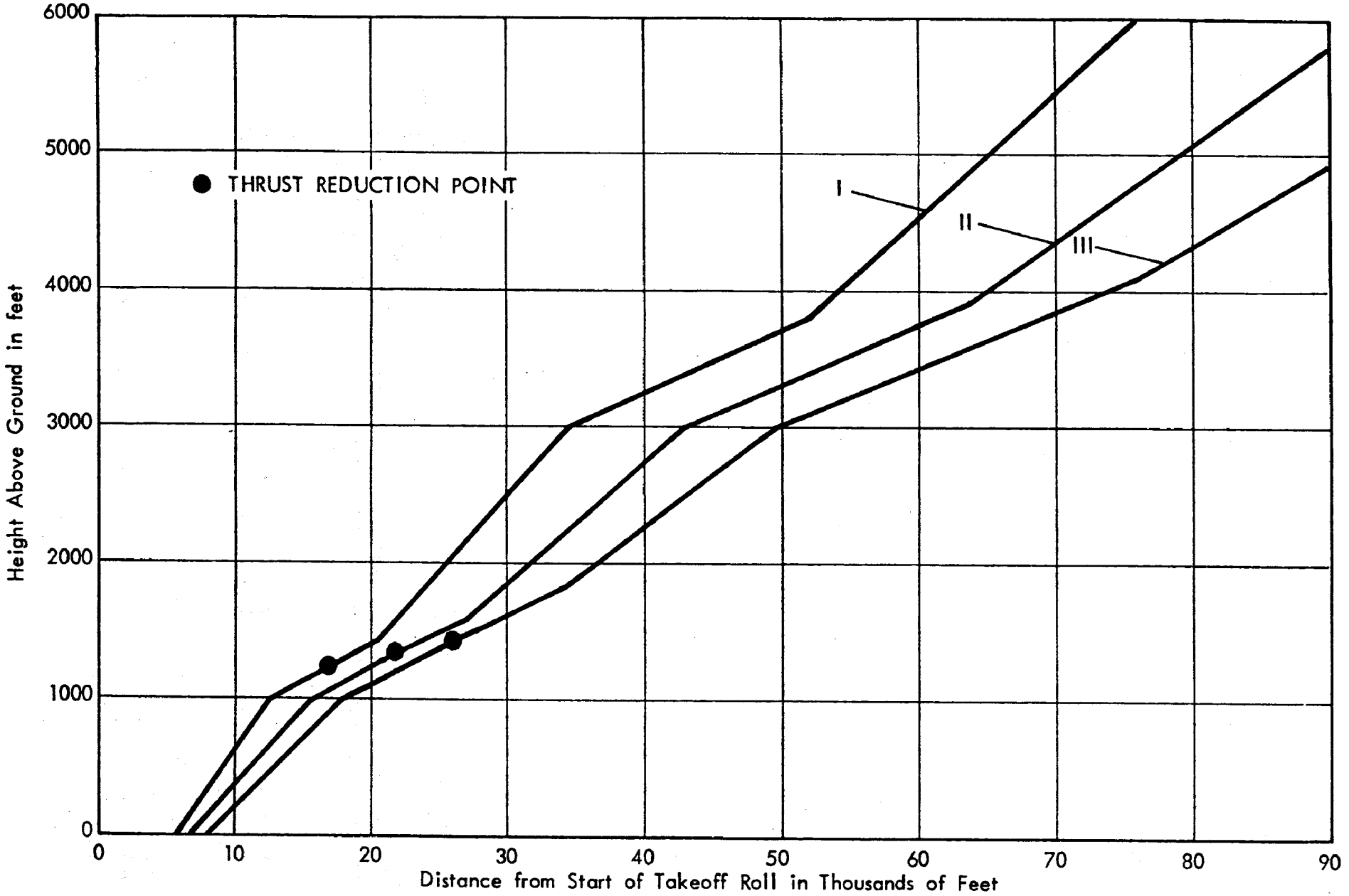
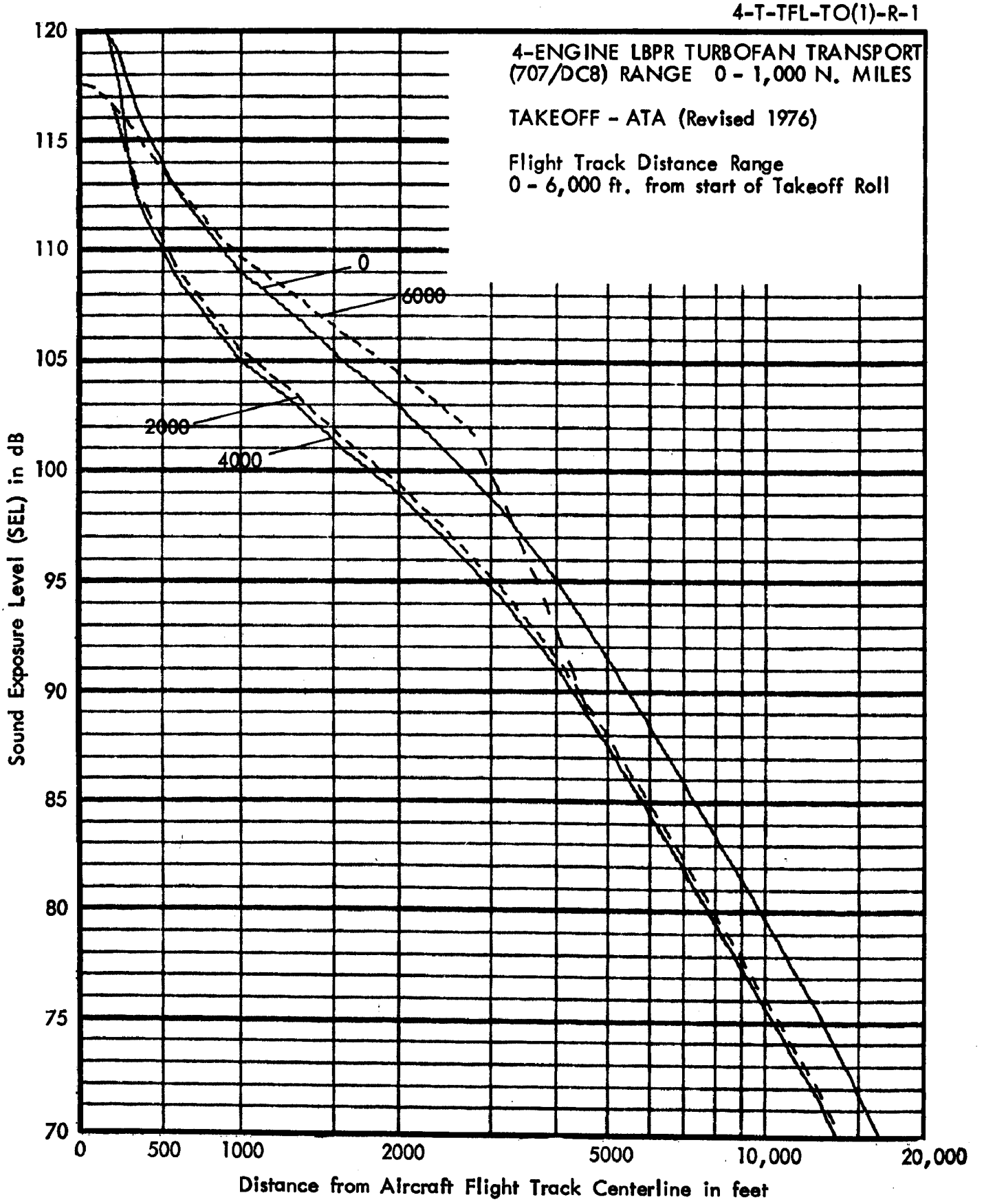
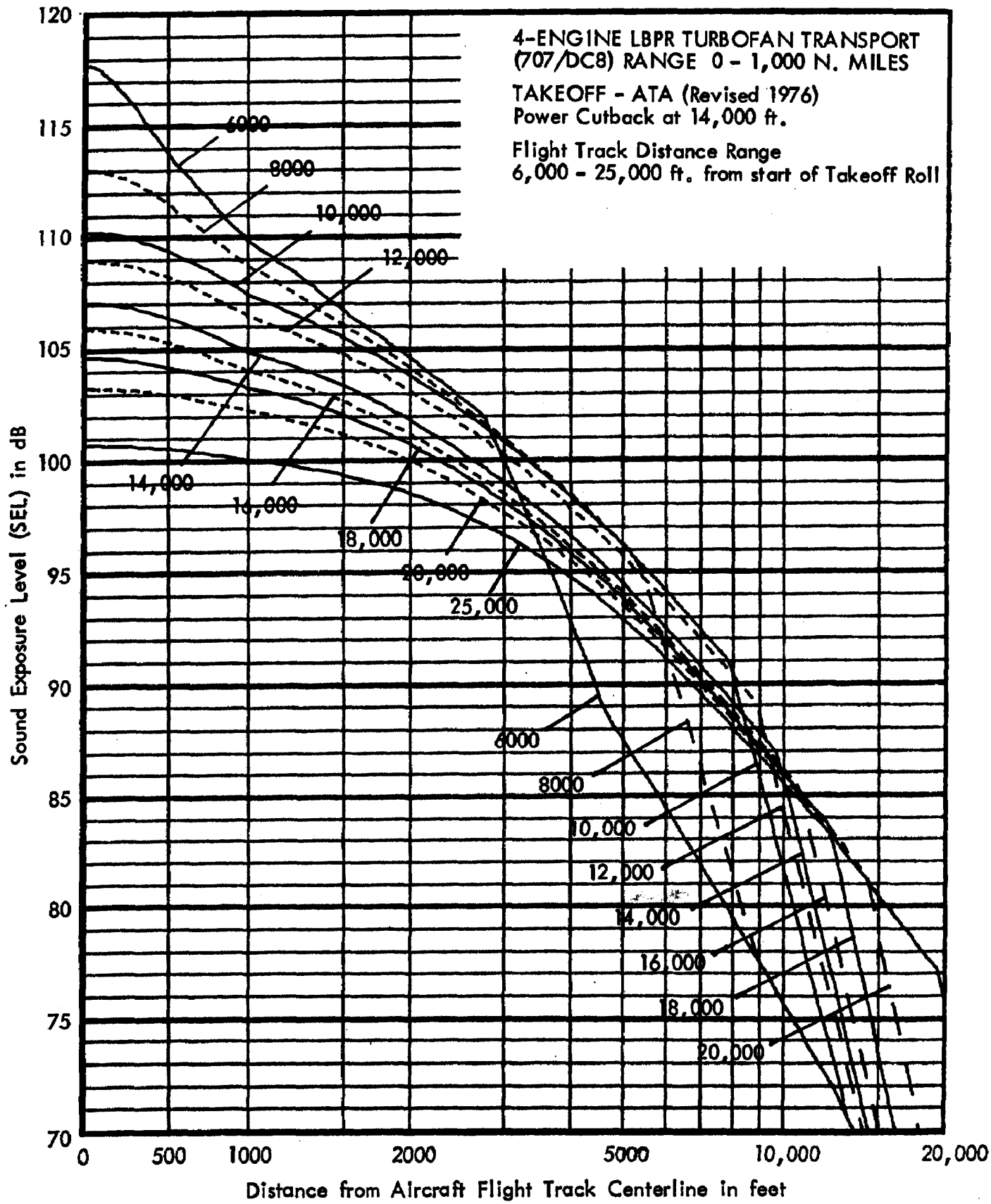
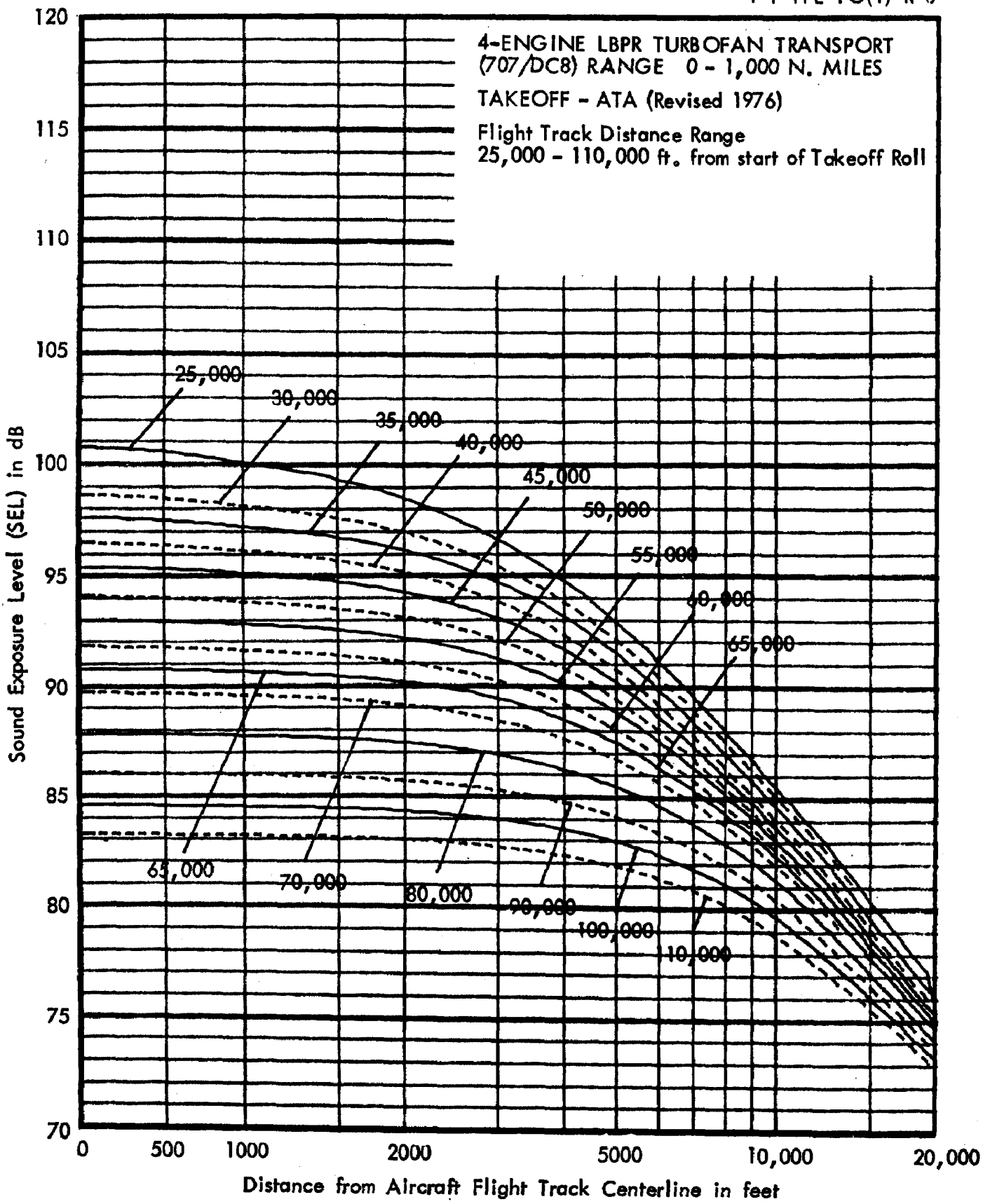
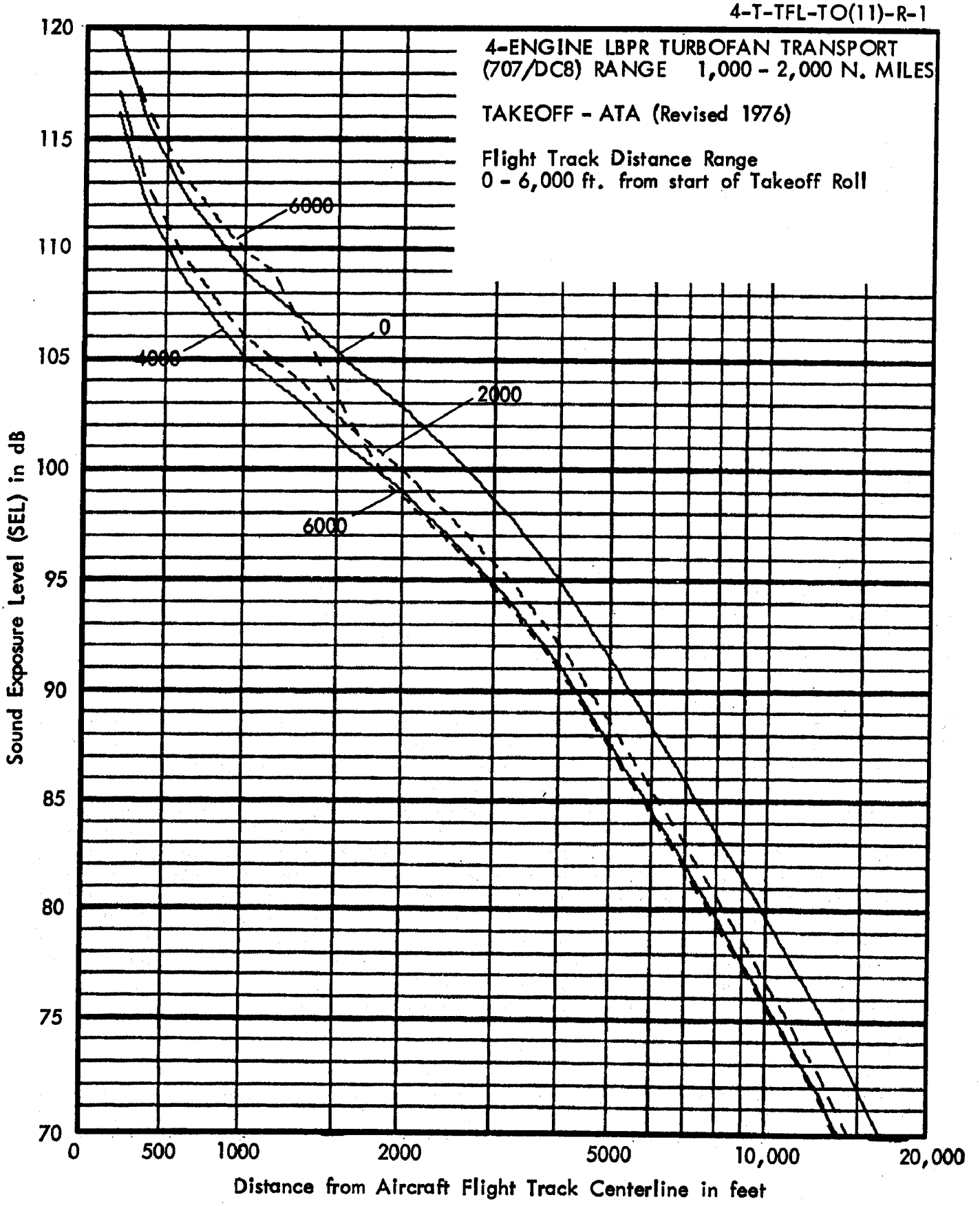


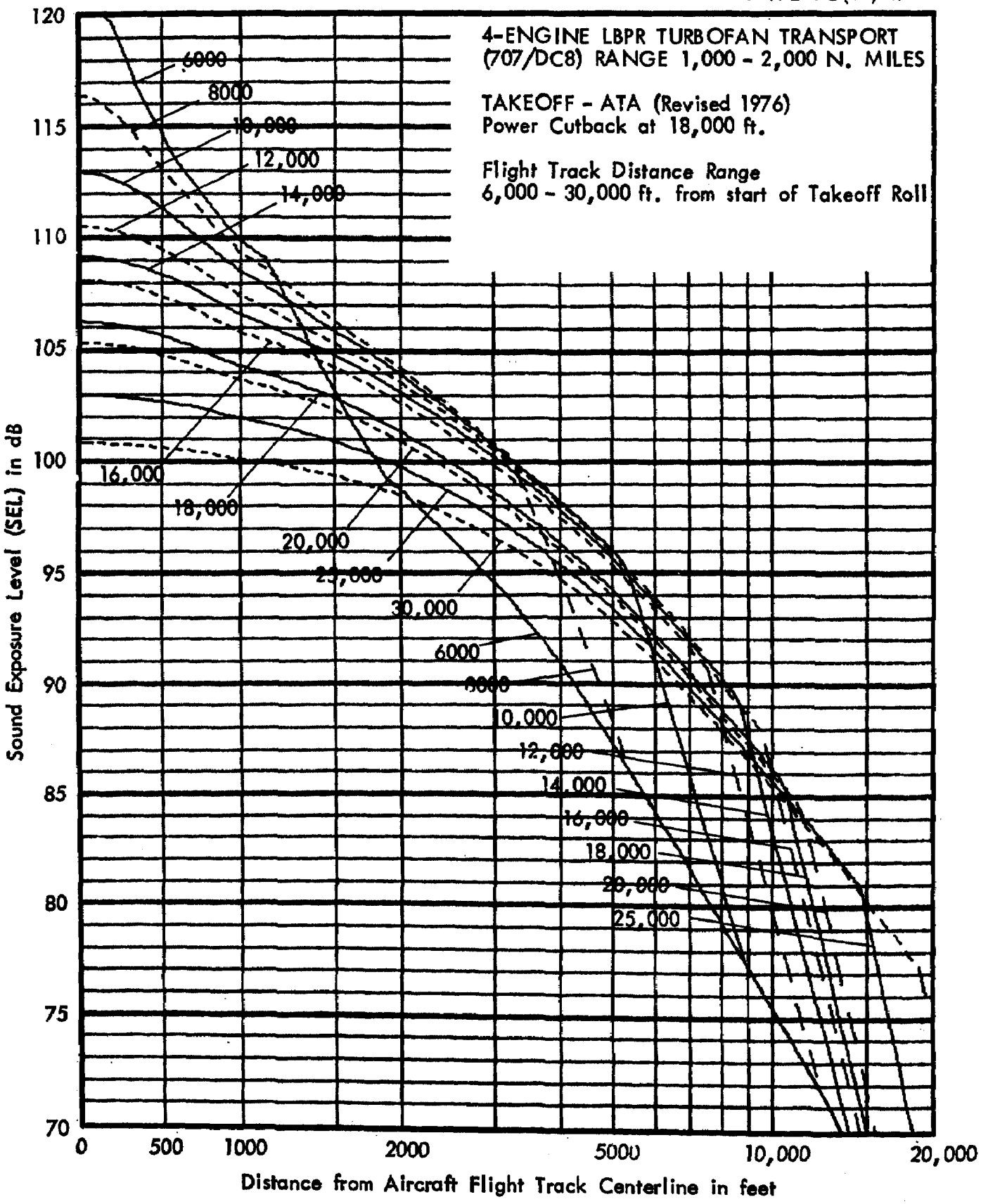
FIGURE 6. ATA TAKEOFF PROFILES FOR 3-ENGINE HBPR TURBOFAN TRANSPORT - DC-10, L-1011 SERIES (3-T-TFH) - REVISED PROCEDURES ADOPTED DECEMBER 1976

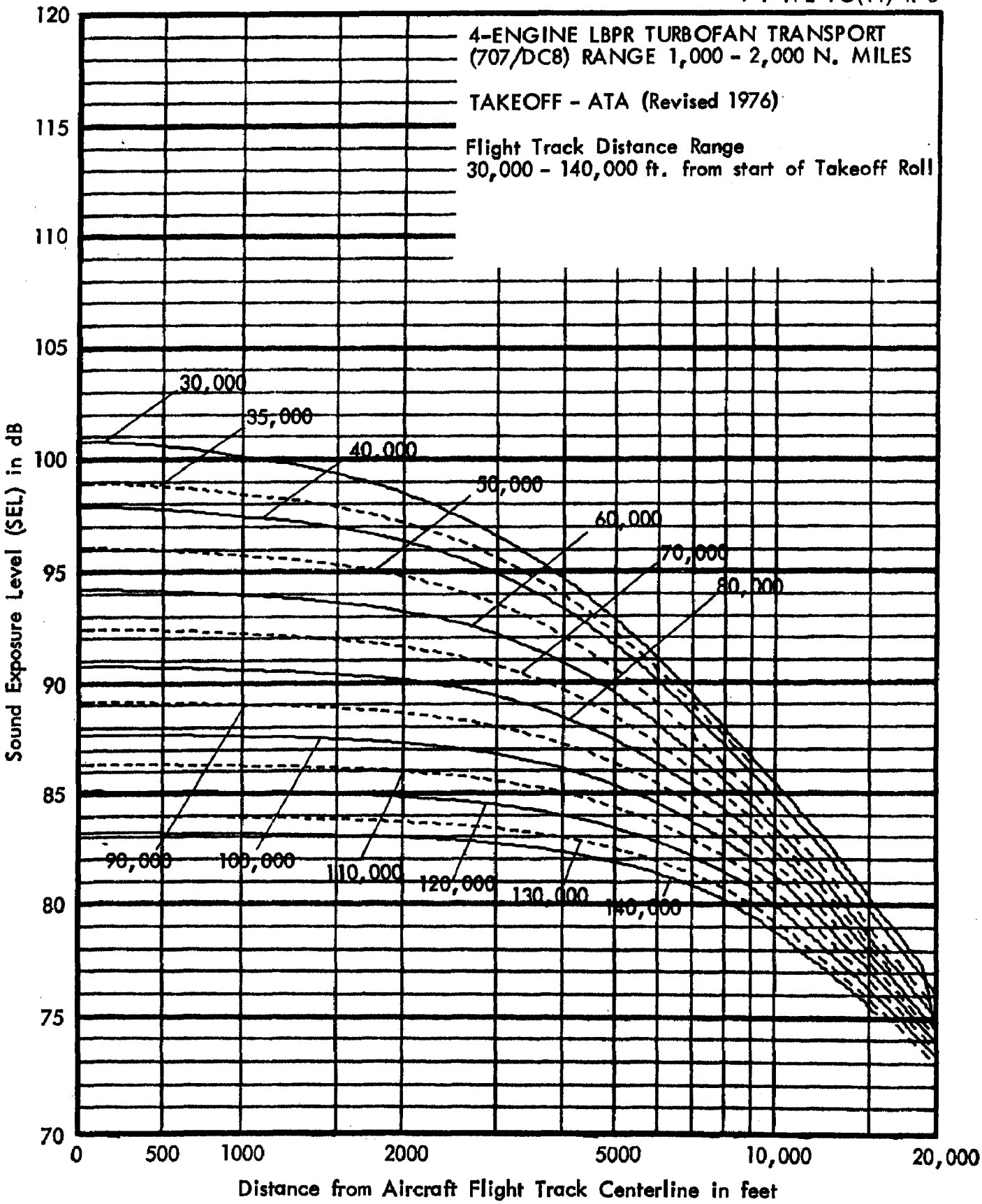

4-T-TFL-TO(1)-R-1
4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 6,000 ft. from start of Takeoff Roll
0
6000
2000
4000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

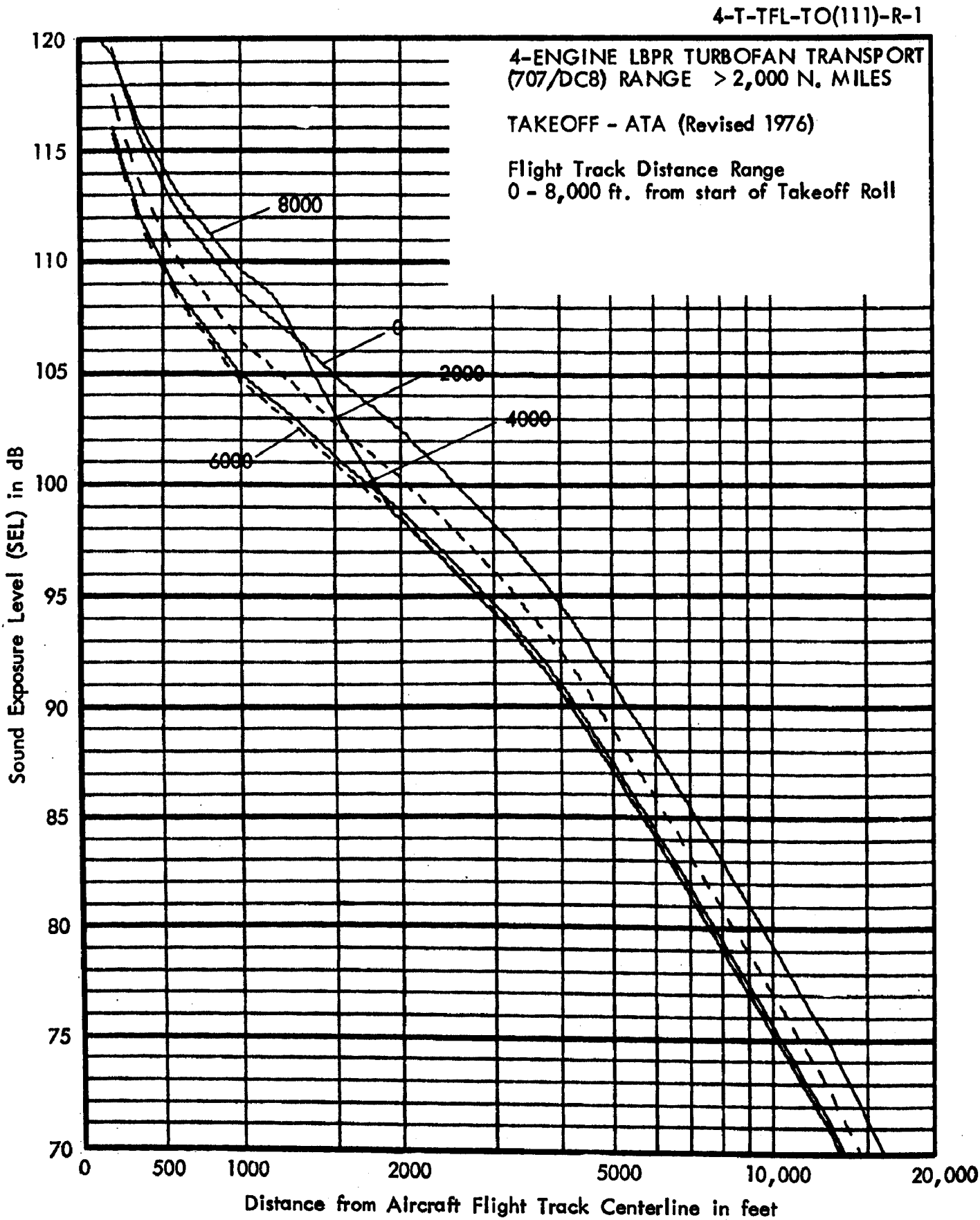

4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 14,000 ft.
Flight Track Distance Range
6,000 - 25,000 ft. from start of Takeoff Roll
6000
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
6000
8000
10,000
12,000
14,000
16,000
18,000
20,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

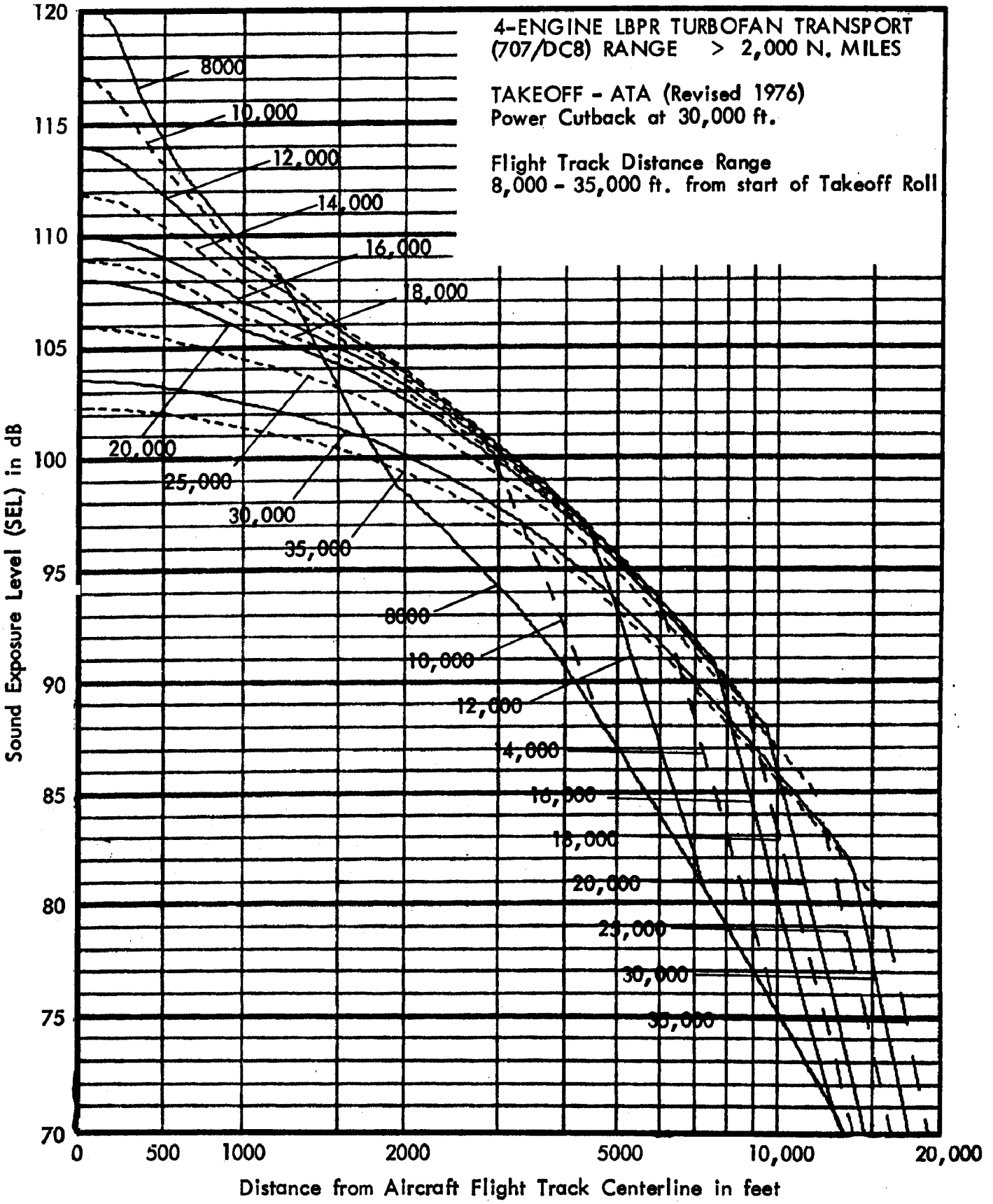

4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
25,000 - 110,000 ft. from start of Takeoff Roll
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
65,000
70,000
80,000
90,000
100,000
110,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

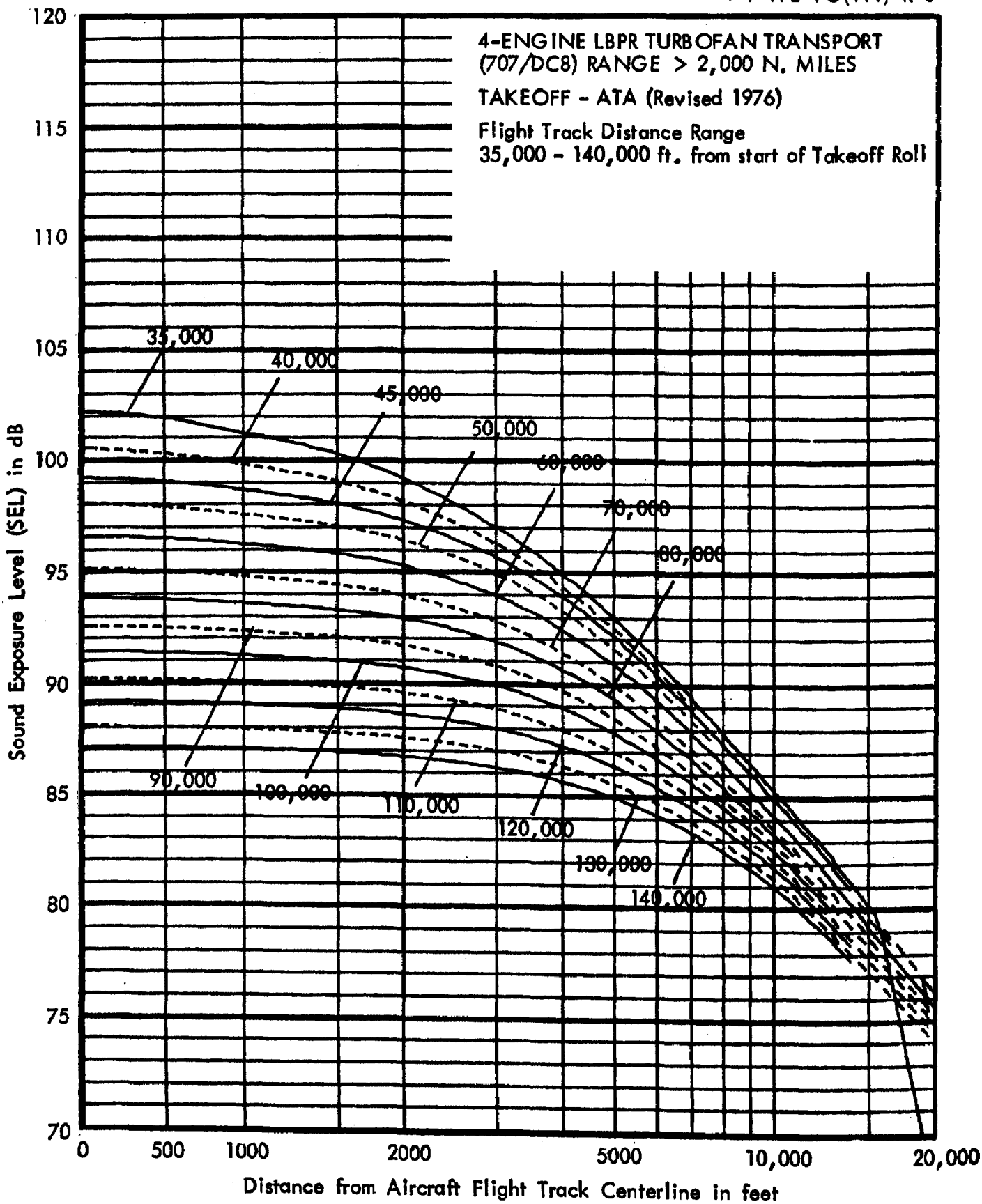

4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 6,000 ft. from start of Takeoff Roll
6000
0
4000
2000
6000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

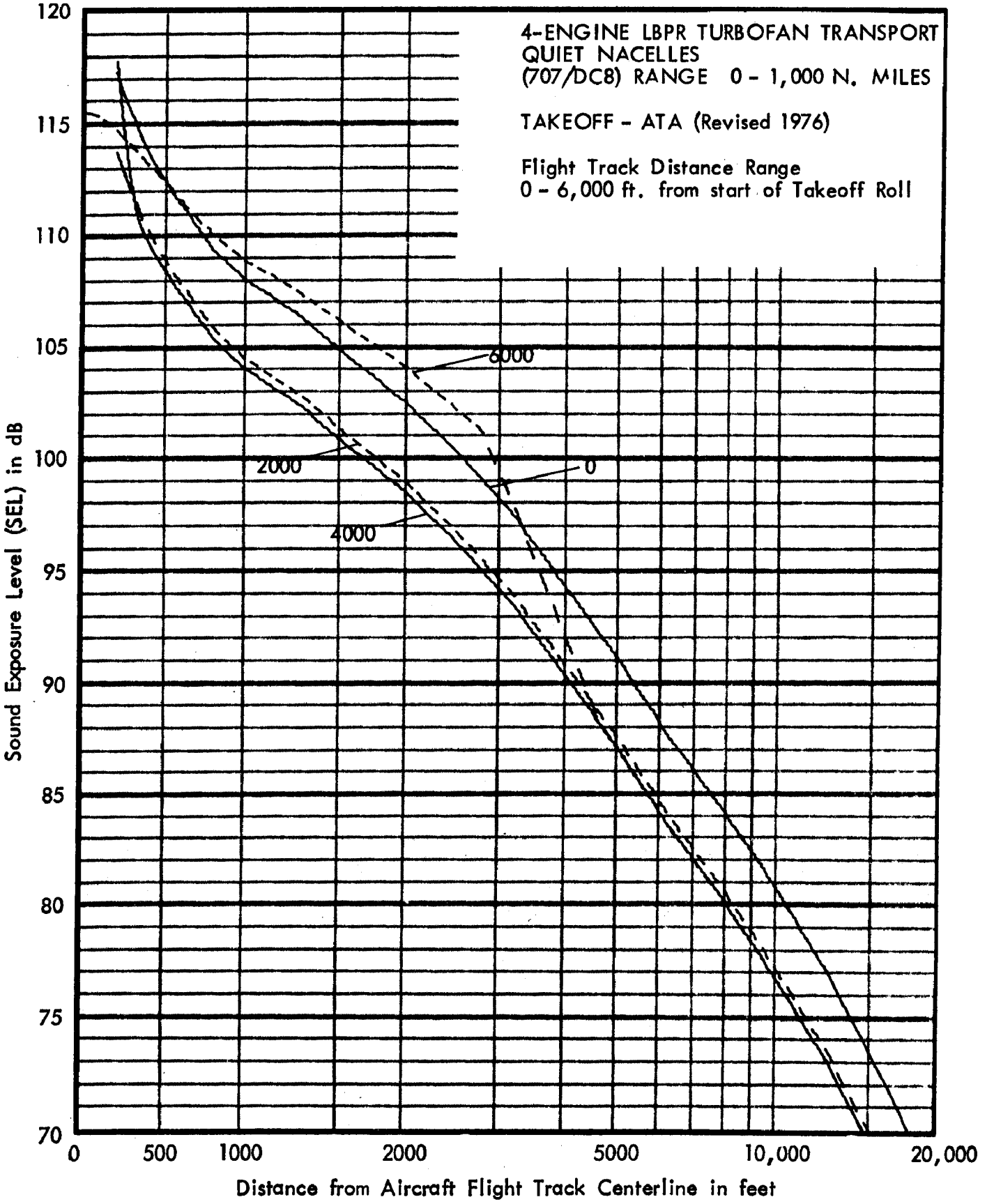

4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 18,000 ft.
Flight Track Distance Range
6,000 - 30,000 ft. from start of Takeoff Roll
6000
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
6000
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

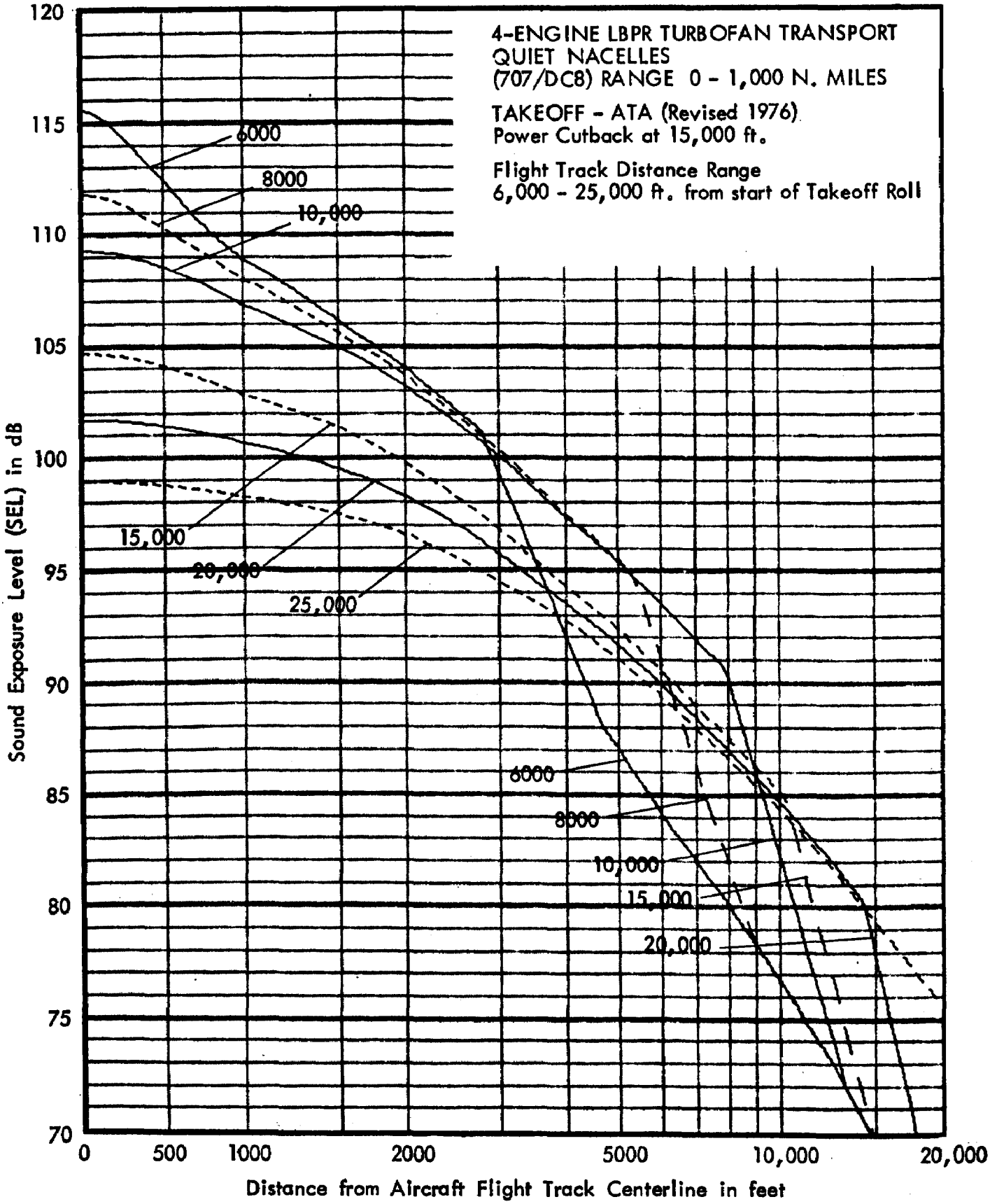

4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
30,000 - 140,000 ft. from start of Takeoff Roll
30,000
35,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
130,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

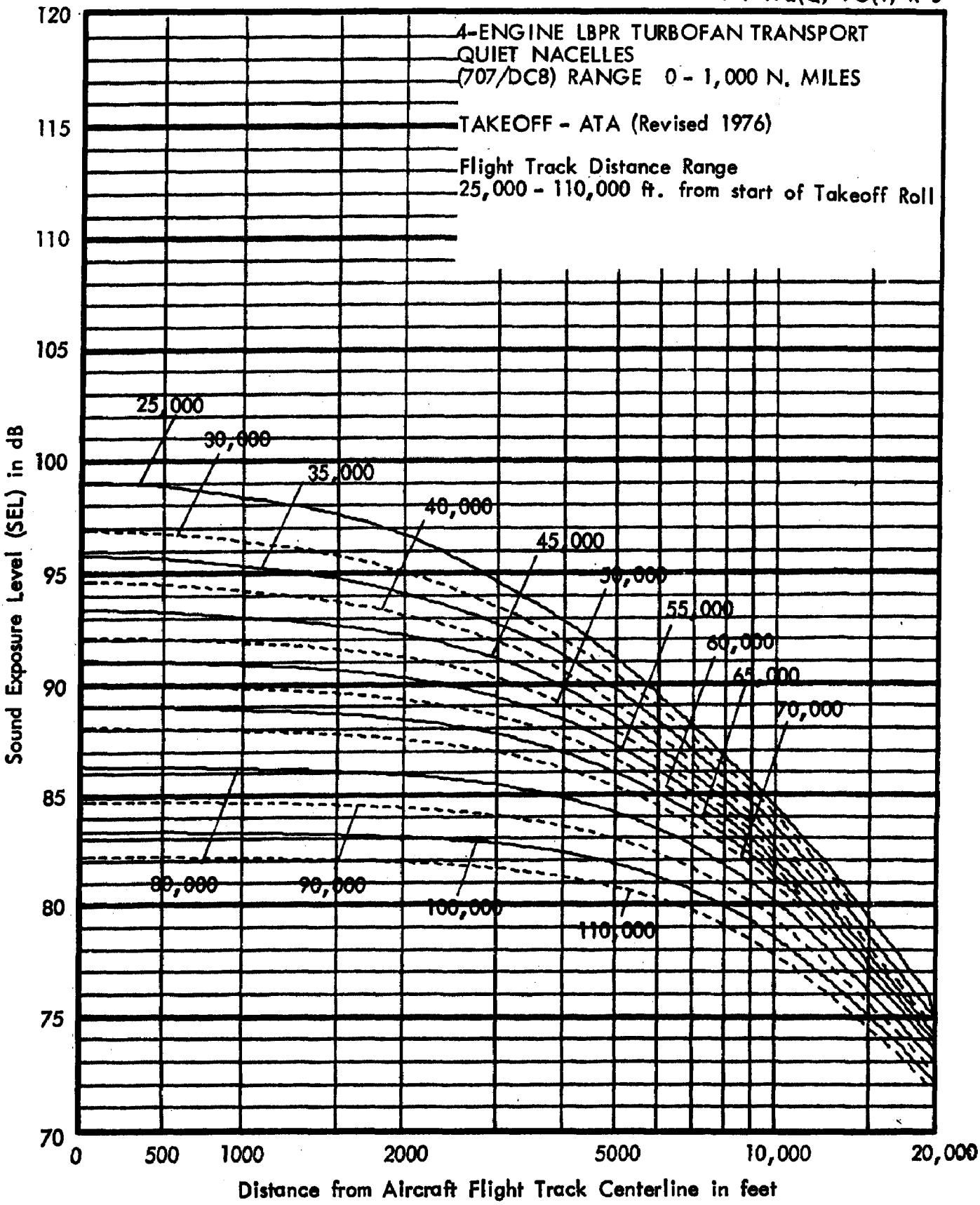

4-T-TFL-TO(111)-R-1
4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
0
2000
4000
6000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

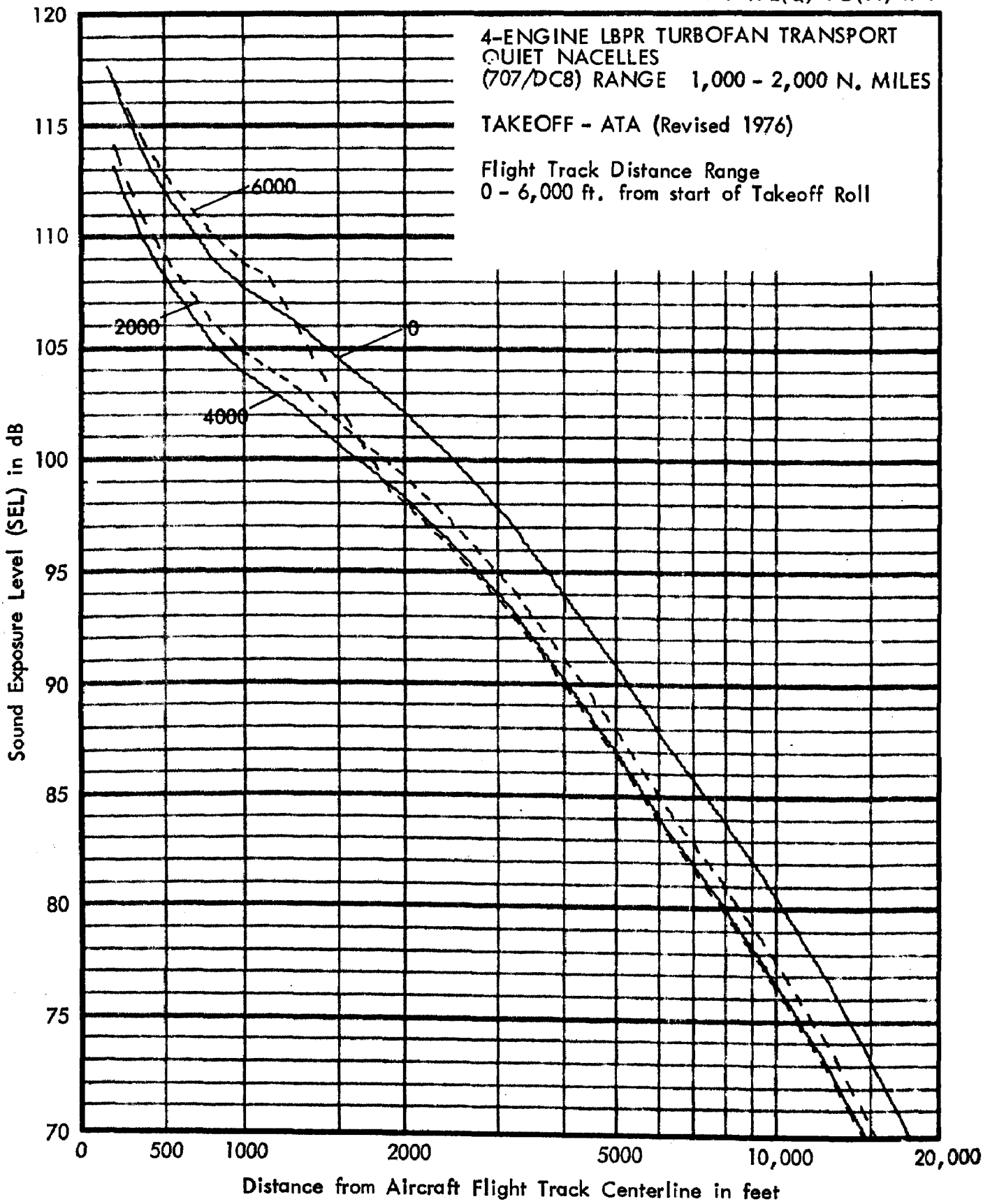

4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 30,000 ft.
Flight Track Distance Range
8,000 - 35,000 ft. from start of Takeoff Roll
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

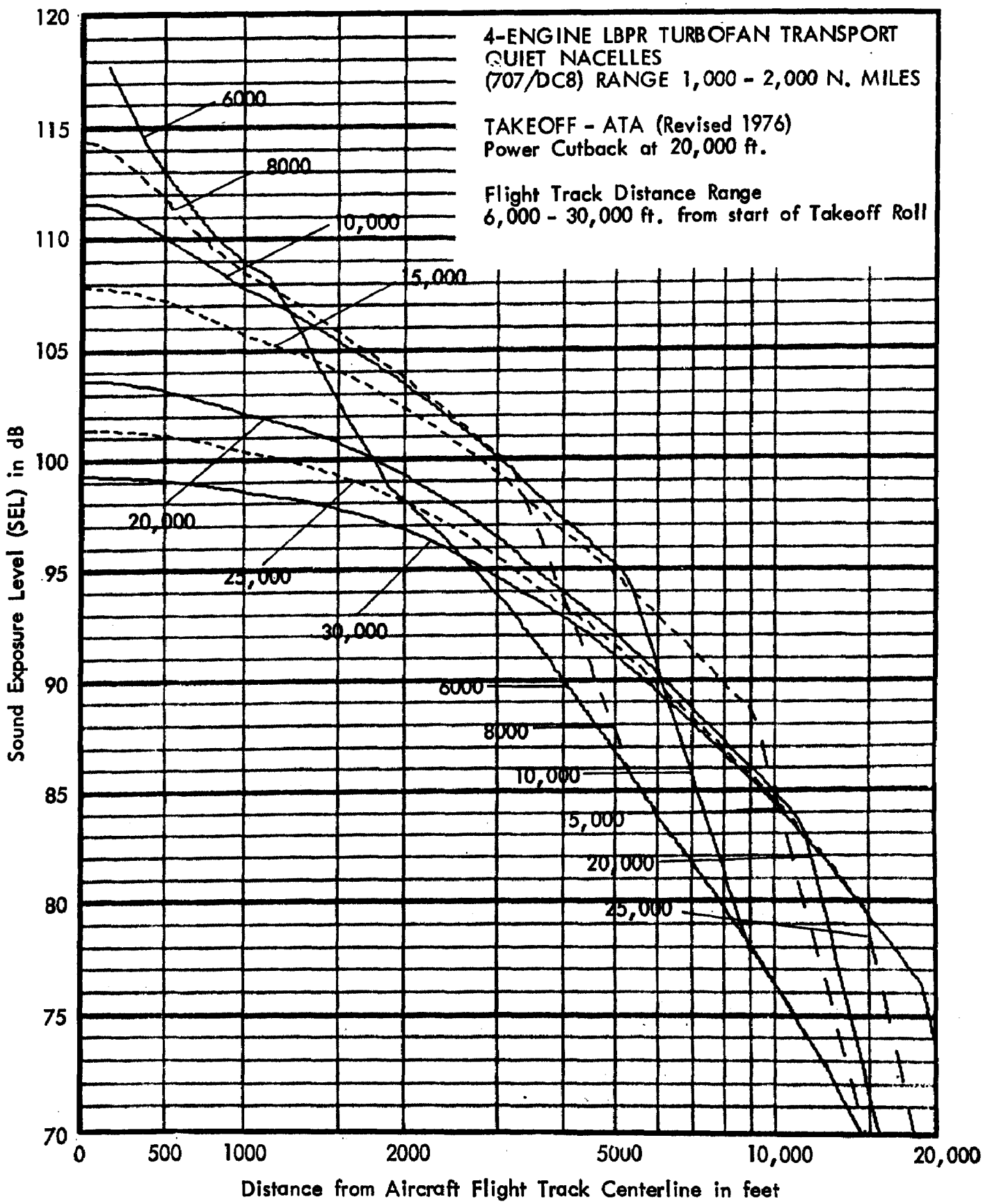

4-ENGINE LBPR TURBOFAN TRANSPORT
(707/DC8) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
35,000 - 140,000 ft. from start of Takeoff Roll
35,000
40,000
45,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
130,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

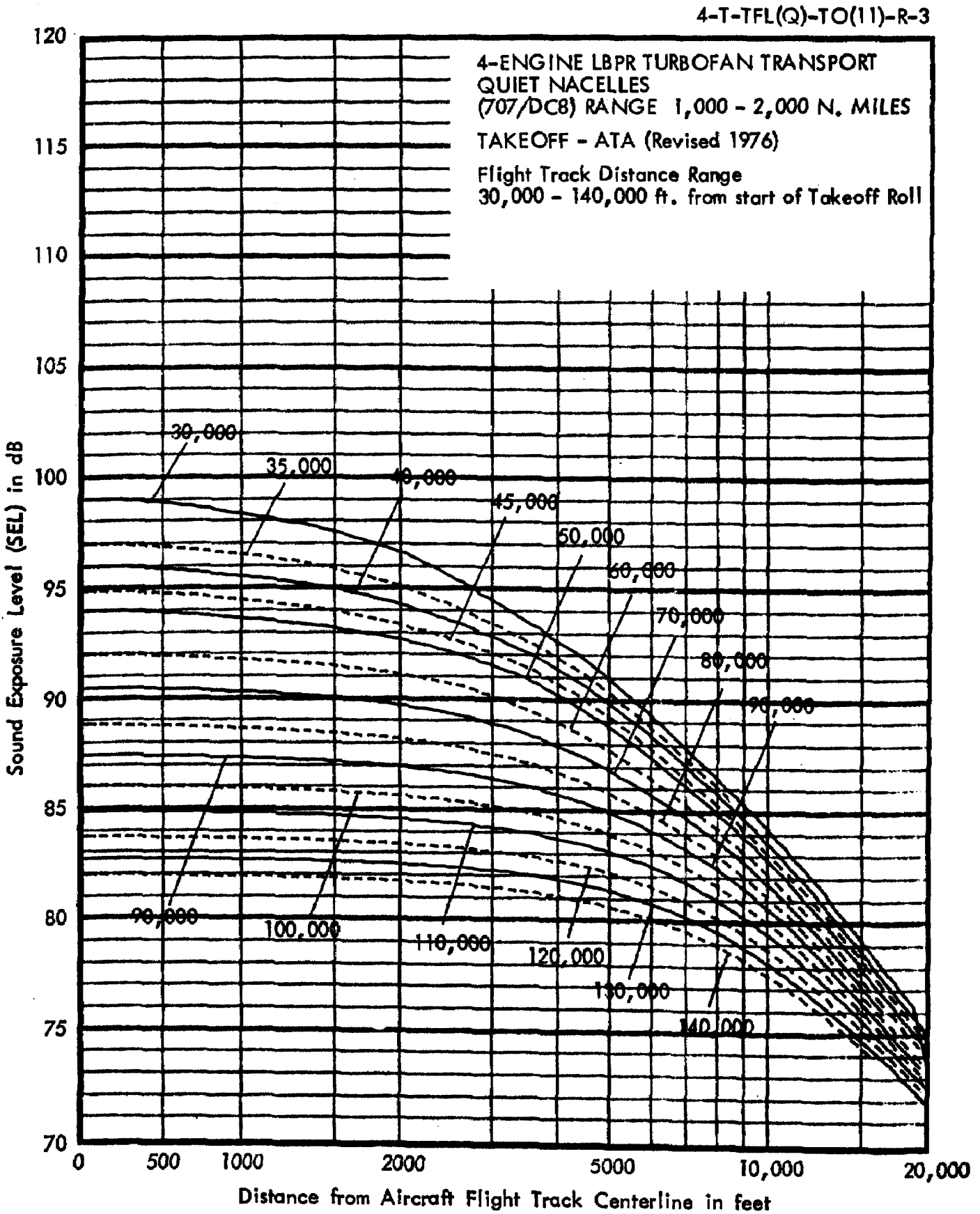

4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 6,000 ft. from start of Takeoff Roll
6000
2000
0
4000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

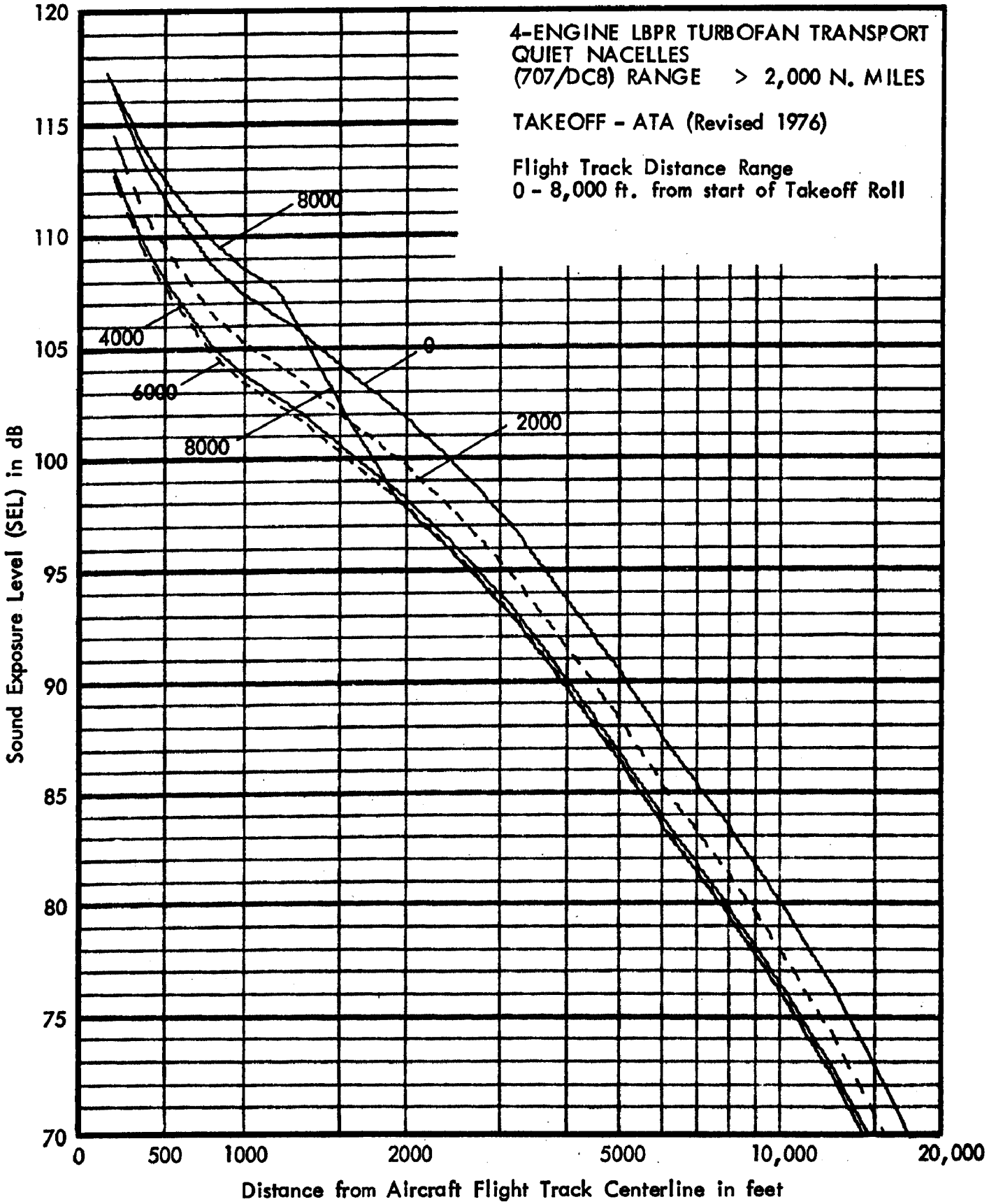

4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 15,000 ft.
Flight Track Distance Range
6,000 - 25,000 ft. from start of Takeoff Roll
6000
8000
10,000
15,000
20,000
25,000
6000
8000
10,000
15,000
20,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

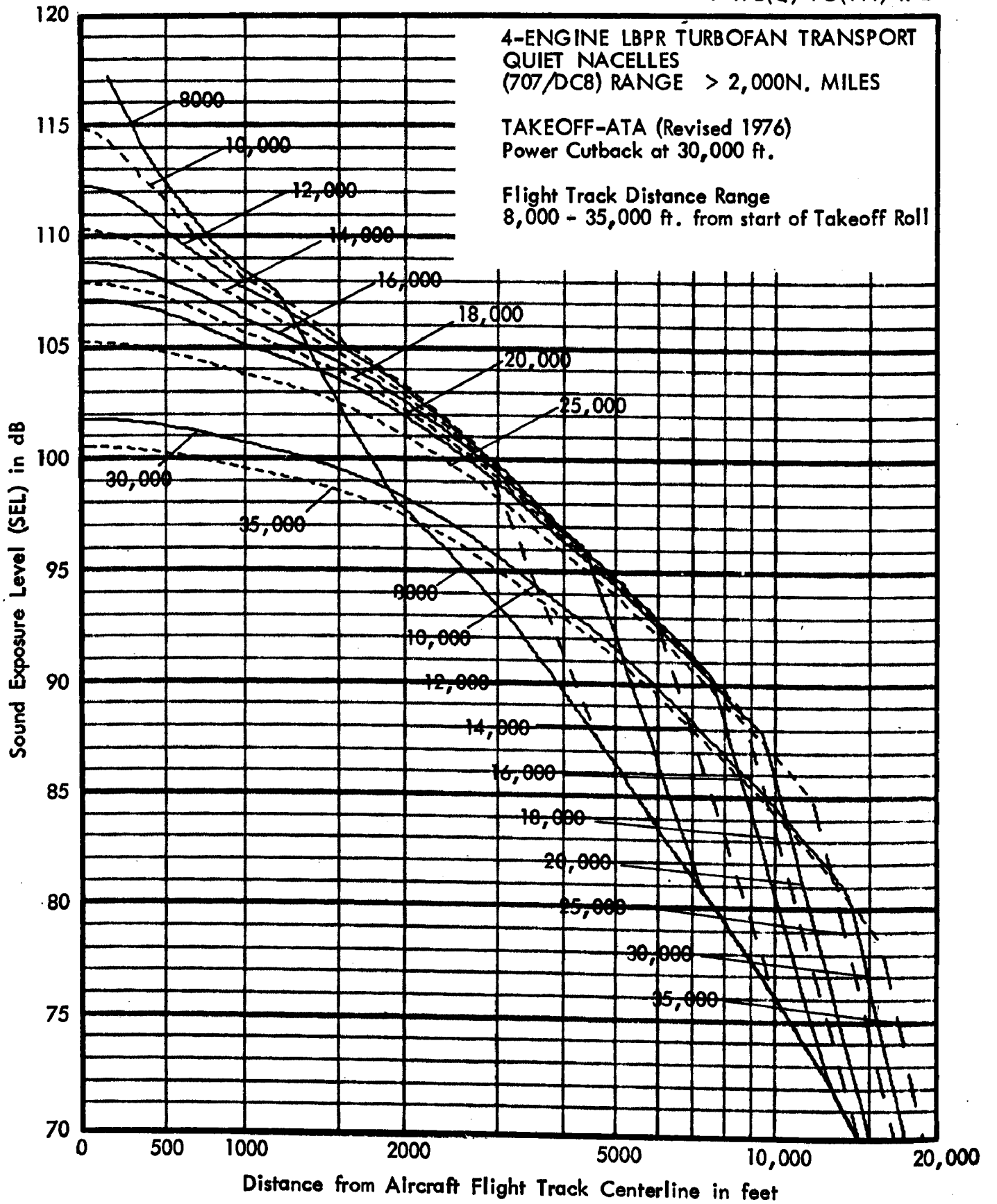

4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
25,000 - 110,000 ft. from start of Takeoff Roll
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
80,000
90,000
100,000
110,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

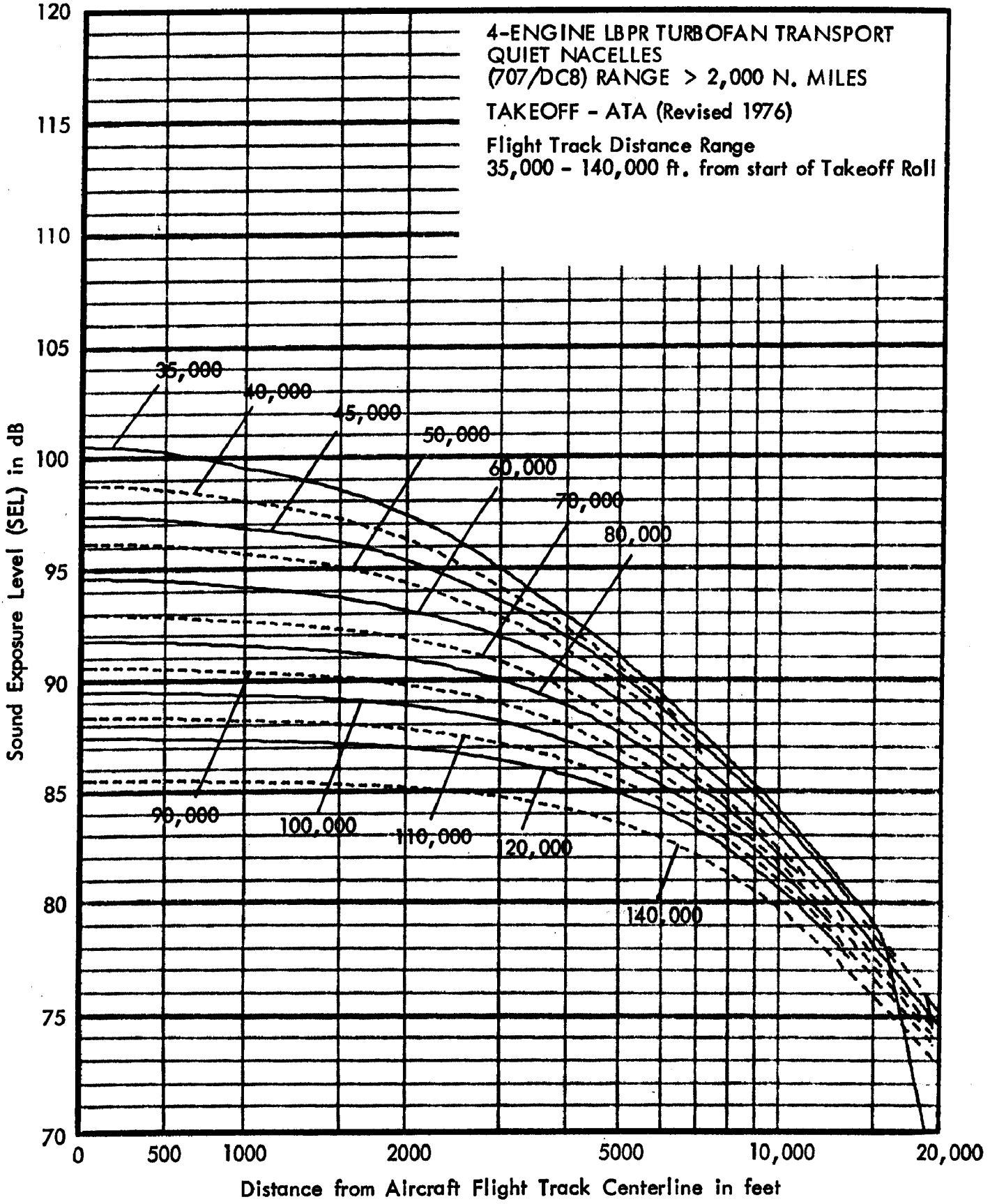

4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 6,000 ft. from start of Takeoff Roll
6000
2000
0
4000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

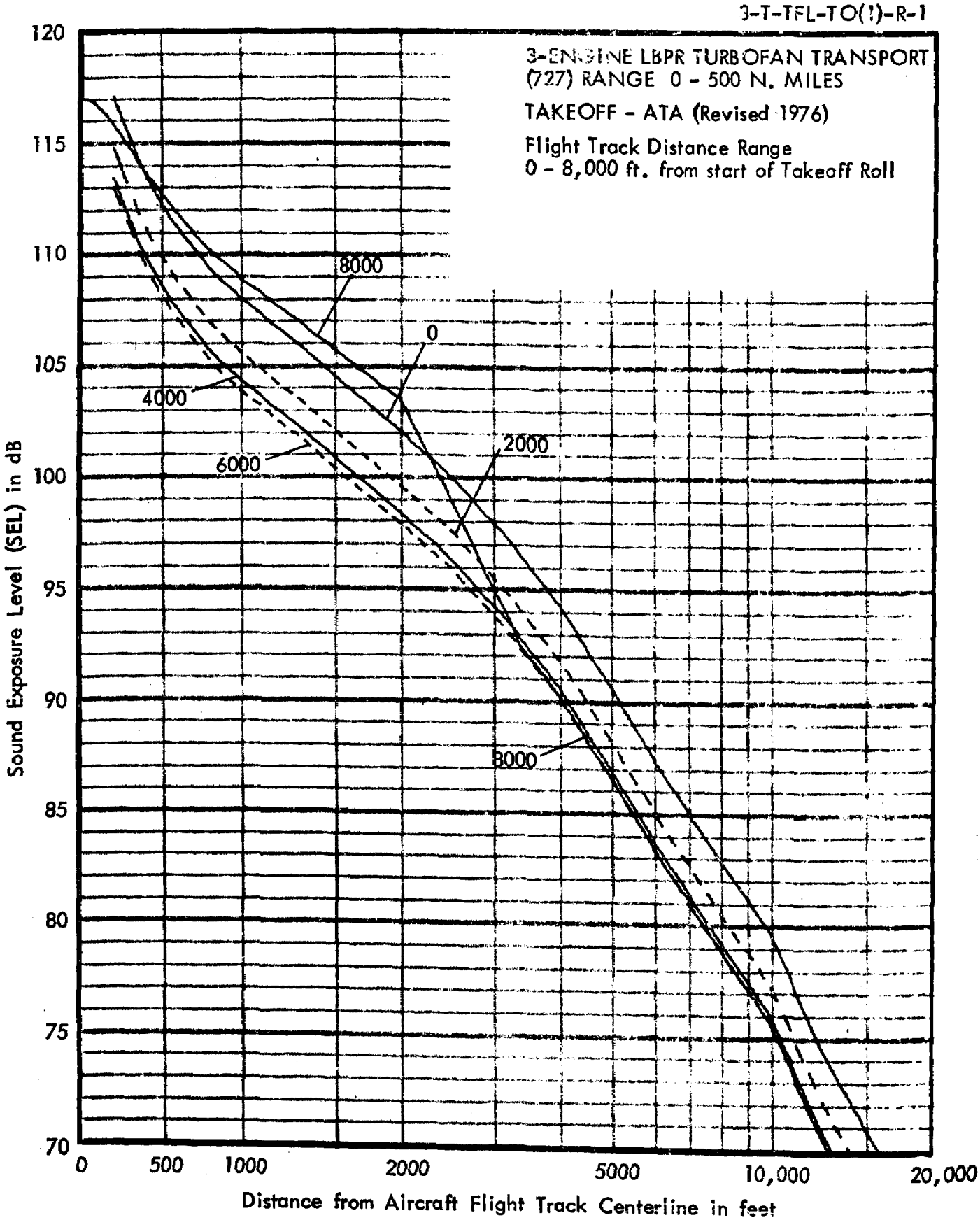

4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 20,000 ft.
Flight Track Distance Range
6,000 - 30,000 ft. from start of Takeoff Roll
6000
8000
10,000
15,000
20,000
25,000
30,000
6000
8000
10,000
5,000
20,000
25,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

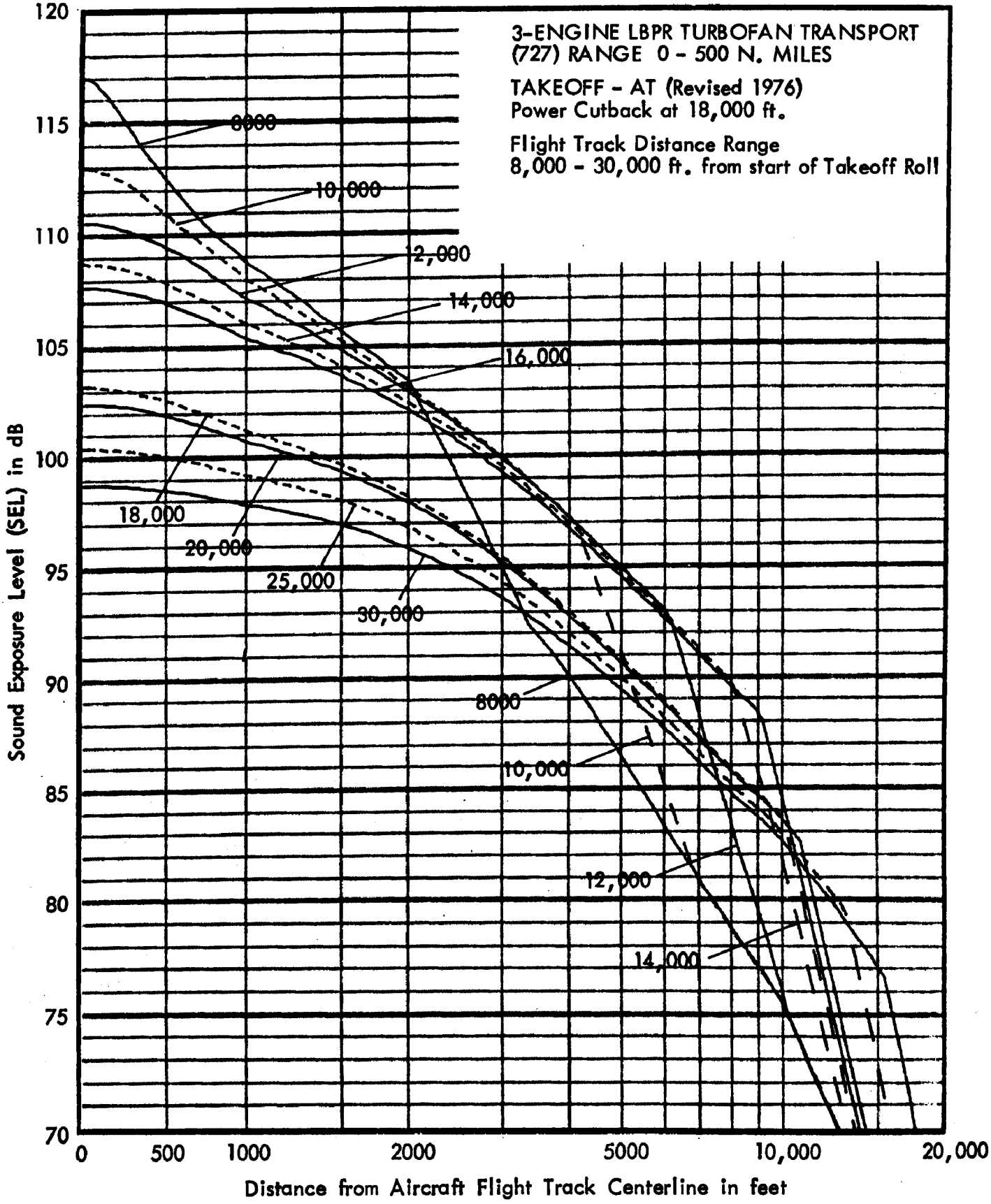

4-T-TFL(Q)-TO(11)-R-3
4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
30,000 - 140,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet
30,000
35,000
40,000
45,000
50,000
60,000
70,000
80,000
90,000
90,000
100,000
110,000
120,000
130,000
140,000

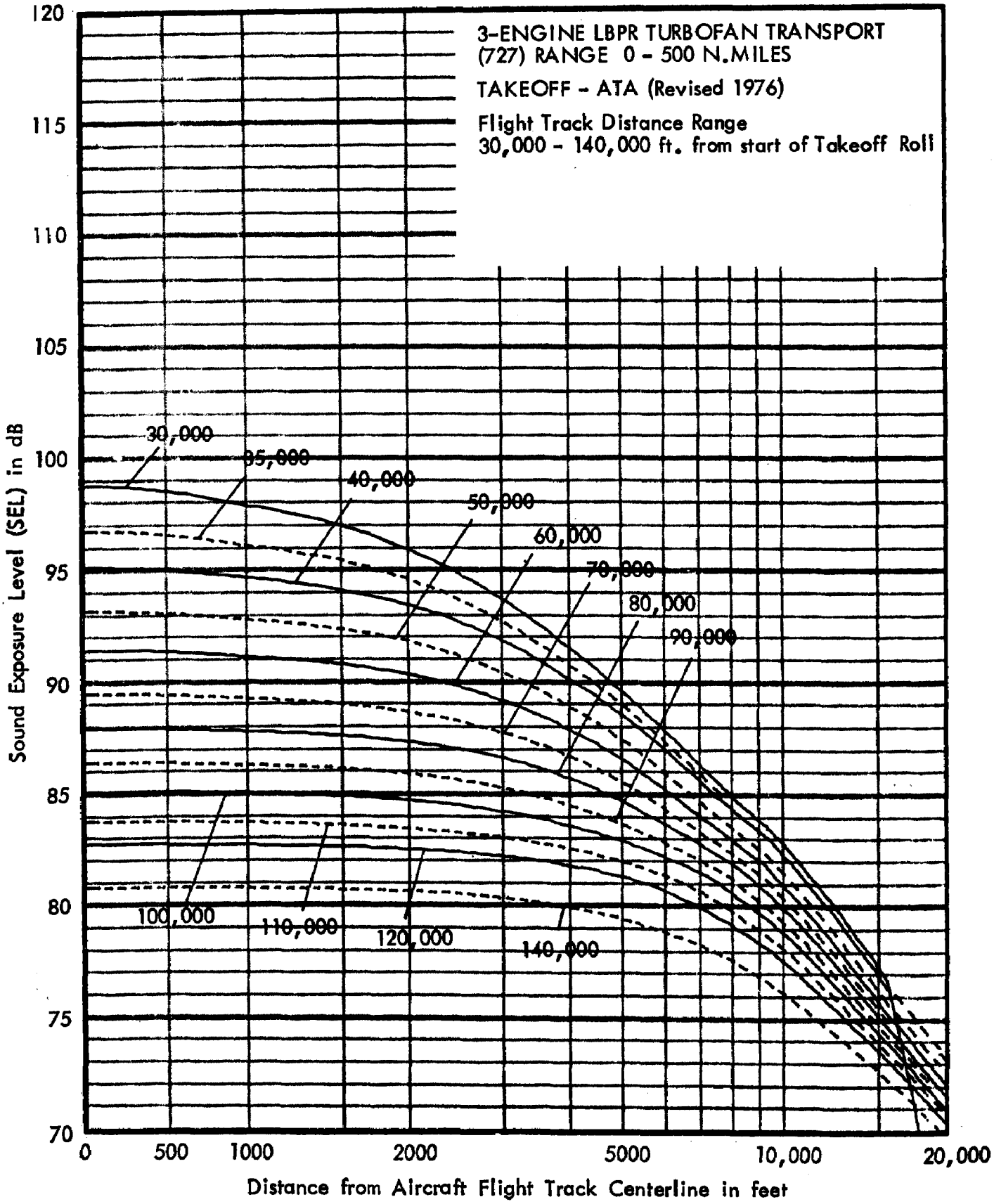

4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
4000
6000
8000
0
2000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

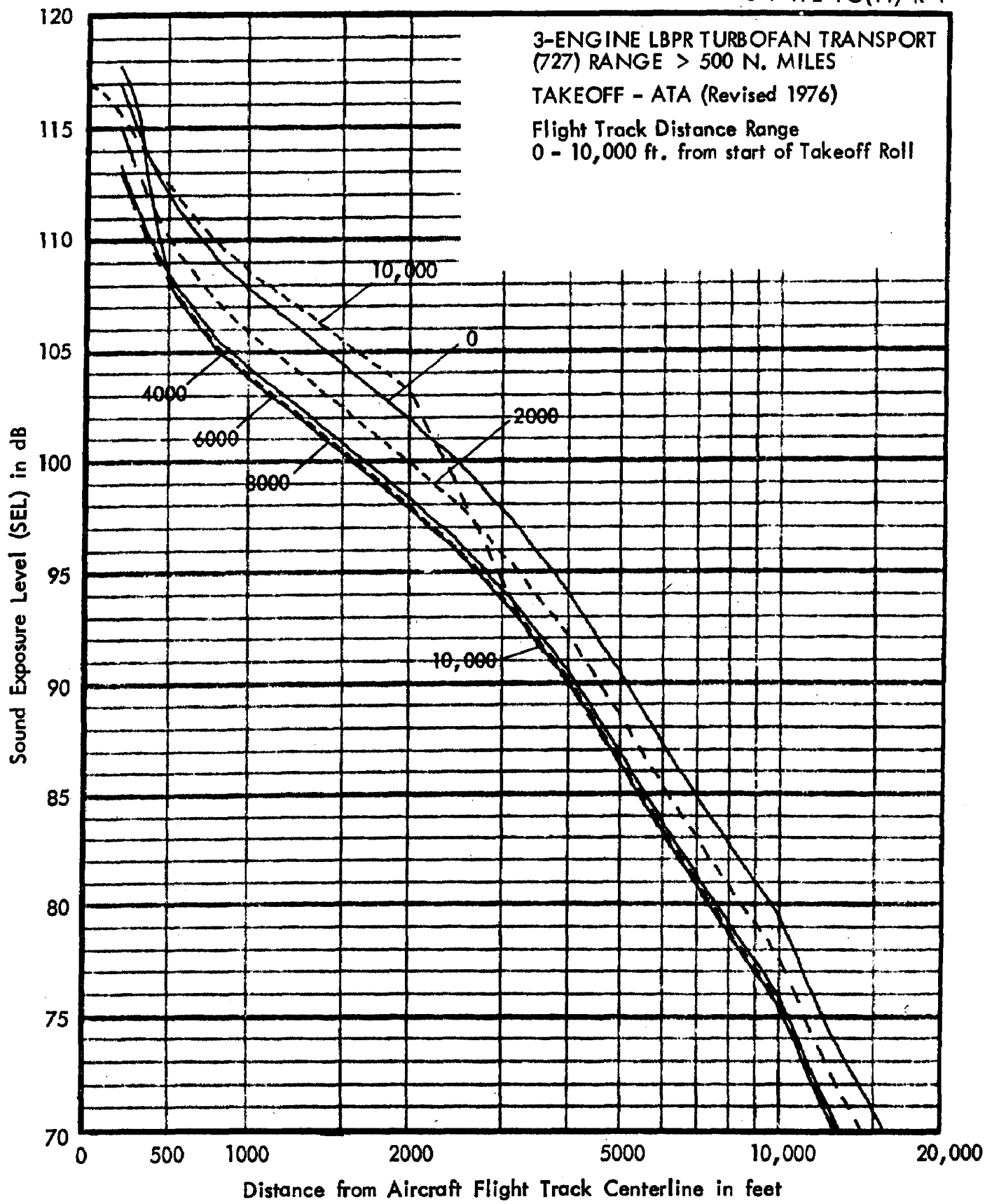

4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE > 2,000N. MILES
TAKEOFF-ATA (Revised 1976)
Power Cutback at 30,000 ft.
Flight Track Distance Range
8,000 - 35,000 ft. from start of Takeoff Roll
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

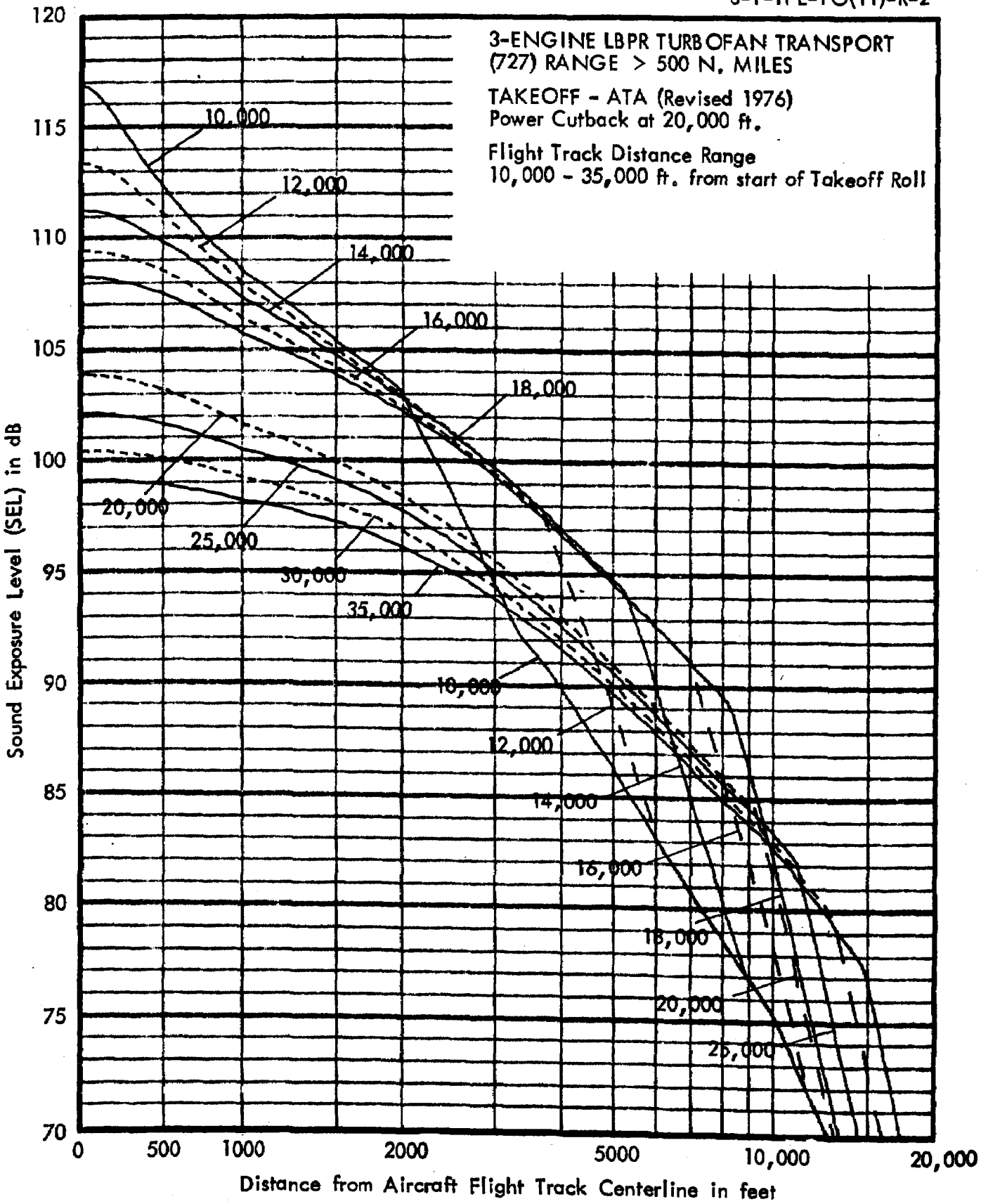

4-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(707/DC8) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
35,000 - 140,000 ft. from start of Takeoff Roll
35,000
40,000
45,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

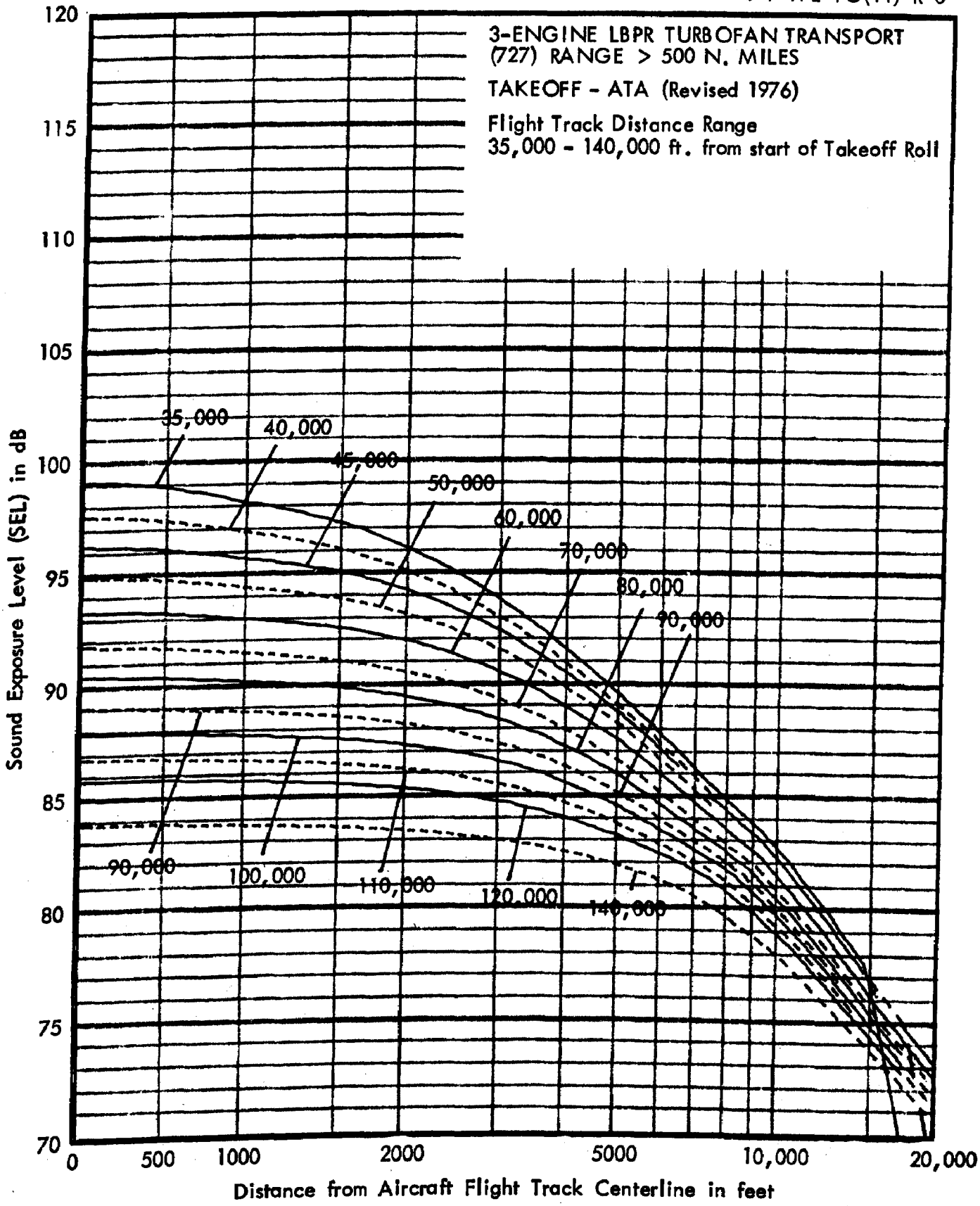

3-T-TFL-TO(!)-R-1
3-ENGINE LBPR TURBOFAN TRANSPORT
(727) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
0
4000
2000
6000
8000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

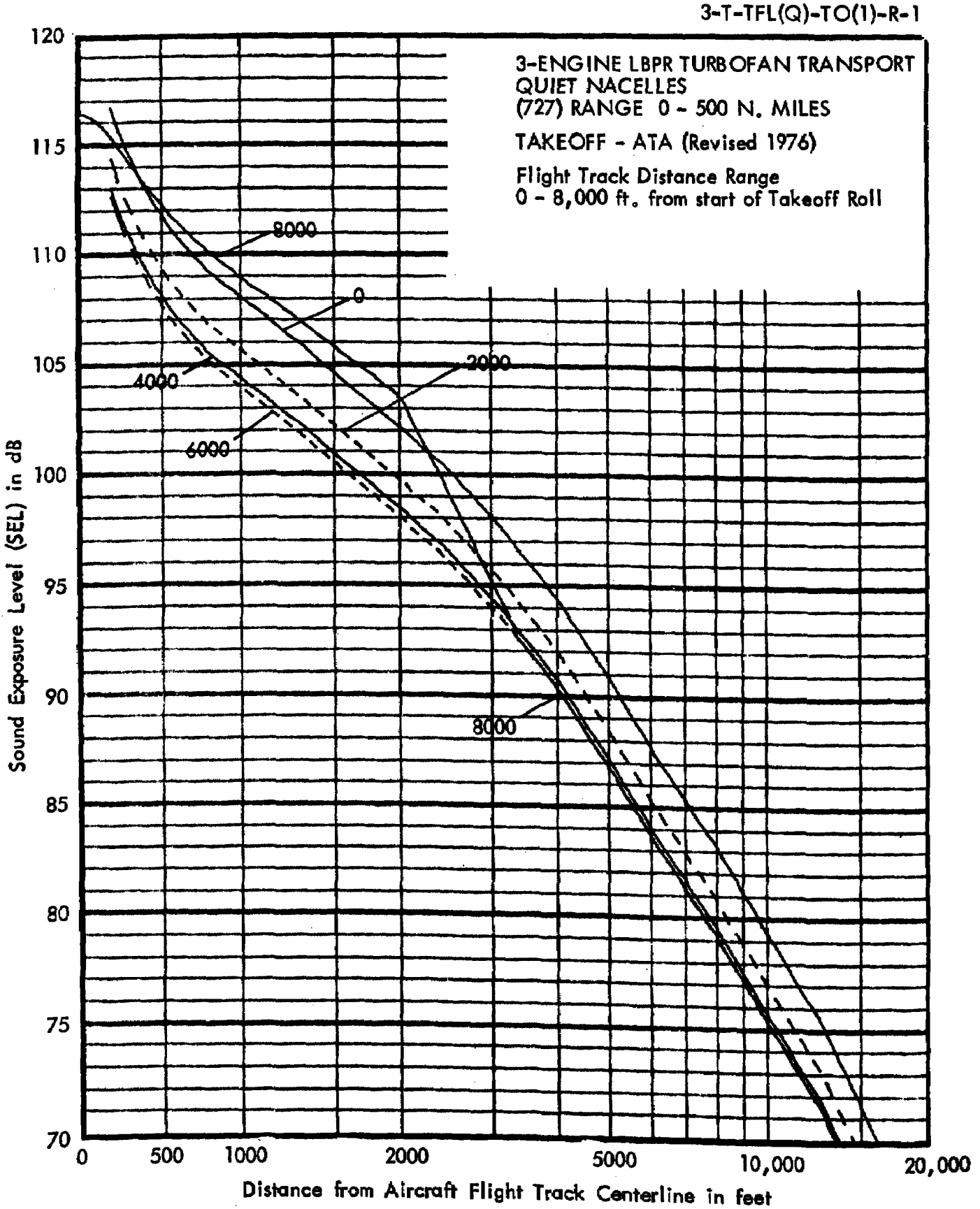

3-ENGINE LBPR TURBOFAN TRANSPORT
(727) RANGE 0 - 500 N. MILES
TAKEOFF - AT (Revised 1976)
Power Cutback at 18,000 ft.
Flight Track Distance Range
8,000 - 30,000 ft. from start of Takeoff Roll
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
8000
10,000
12,000
14,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

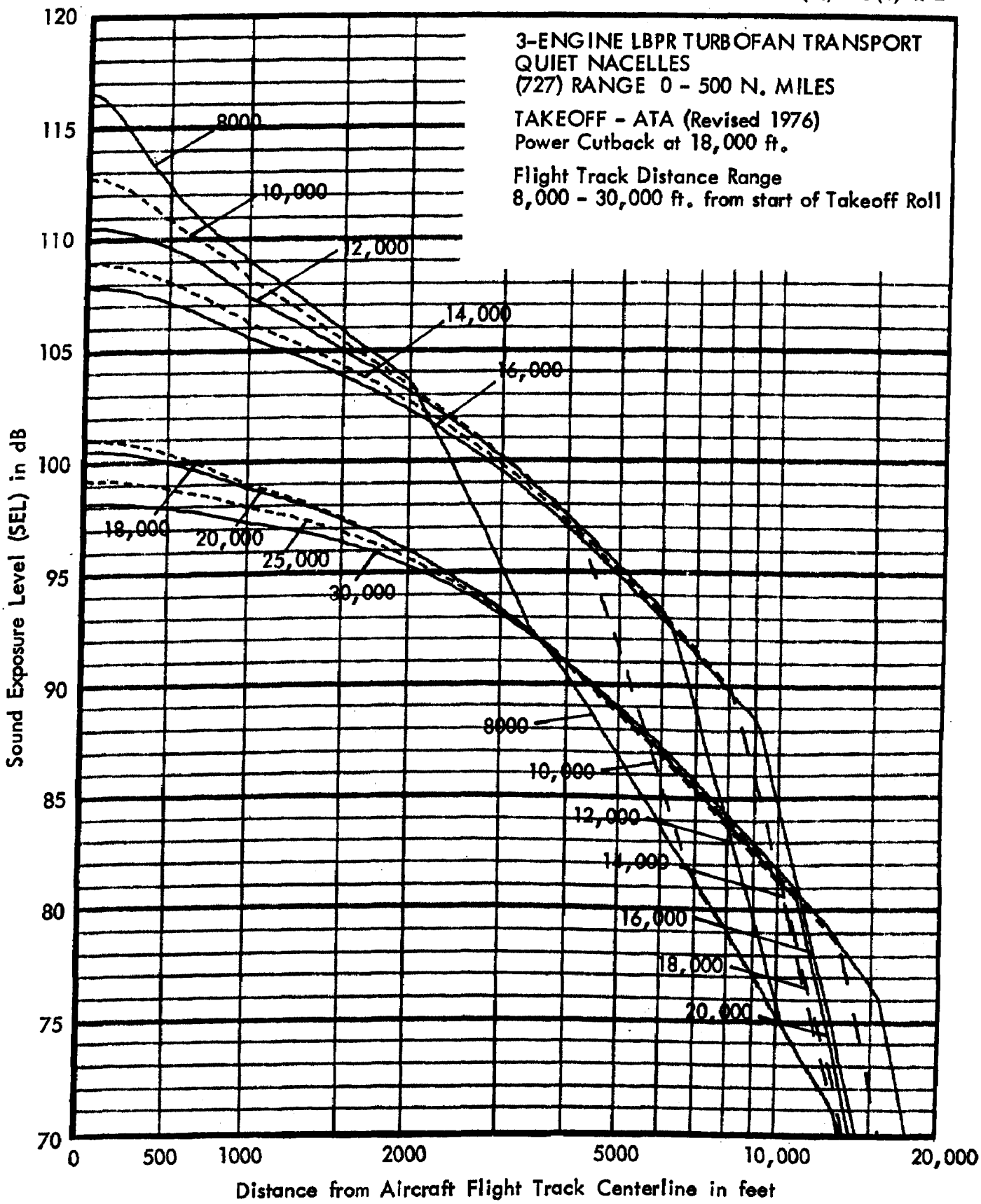

3-ENGINE LBPR TURBOFAN TRANSPORT
(727) RANGE 0 - 500 N.MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
30,000 - 140,000 ft. from start of Takeoff Roll
30,000
35,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
140,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

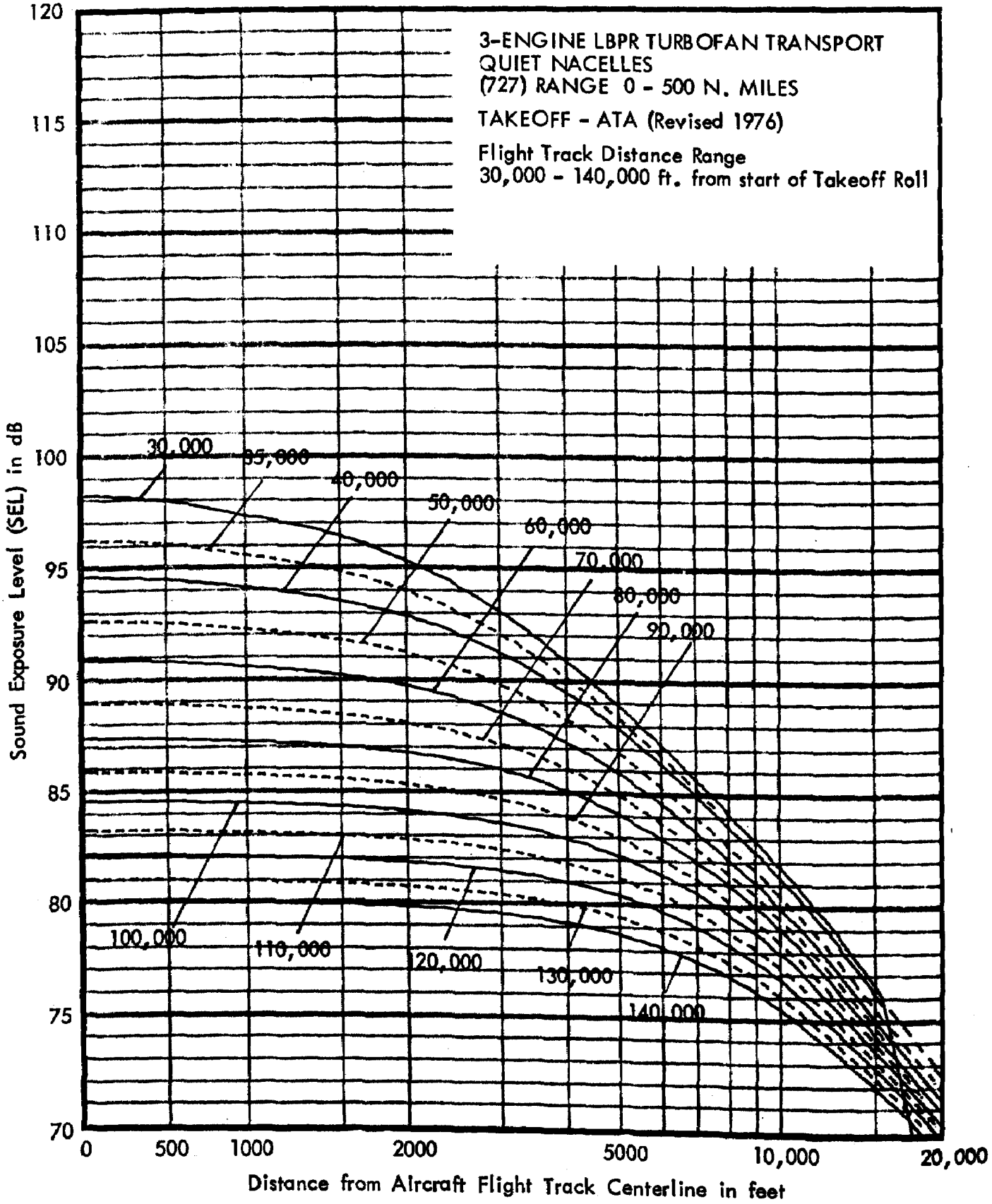

3-ENGINE LBPR TURBOFAN TRANSPORT
(727) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 10,000 ft. from start of Takeoff Roll
10,000
0
4000
2000
6000
8000
10,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

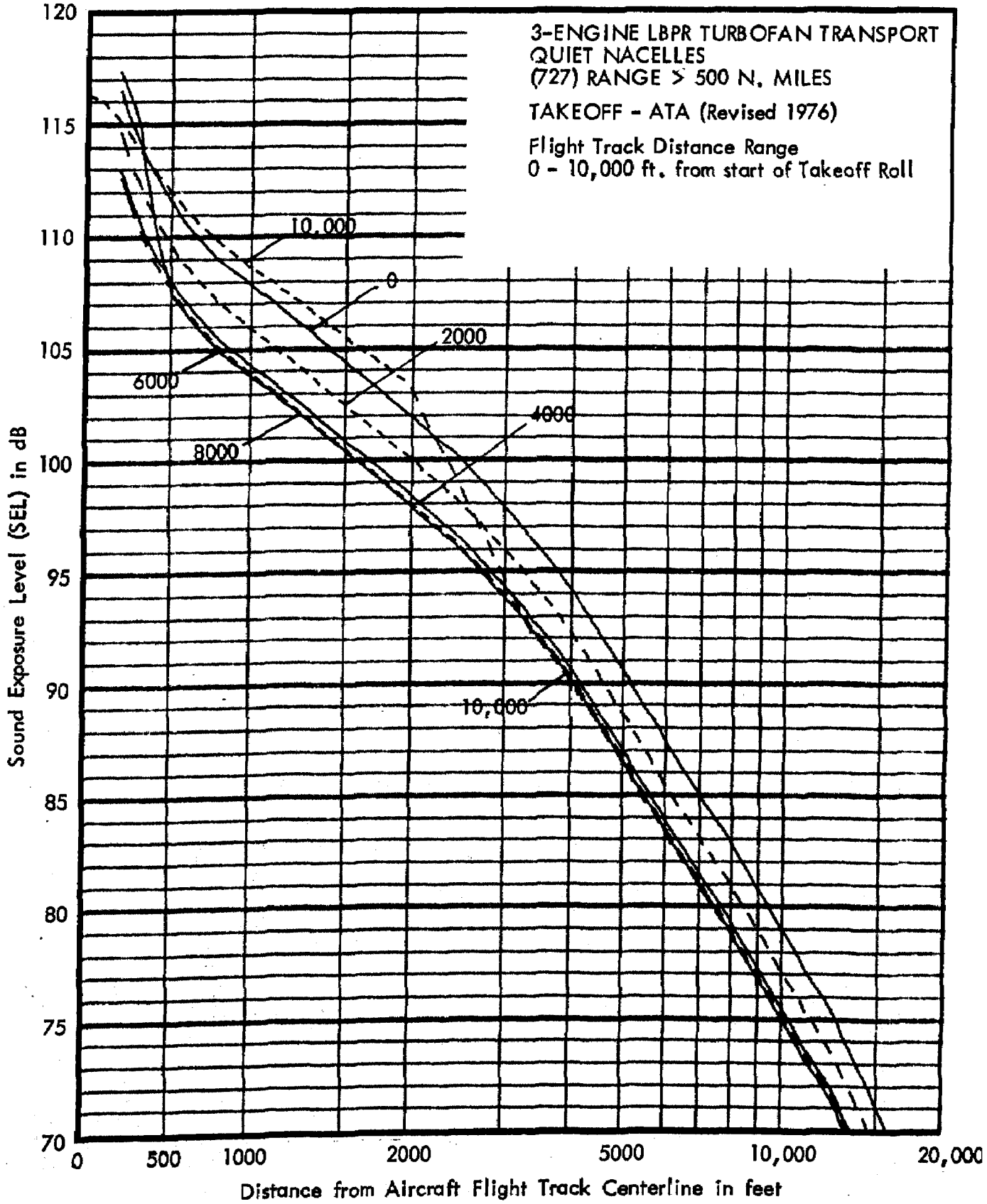

3-ENGINE LBPR TURBOFAN TRANSPORT
(727) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 20,000 ft.
Flight Track Distance Range
10,000 - 35,000 ft. from start of Takeoff Roll
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

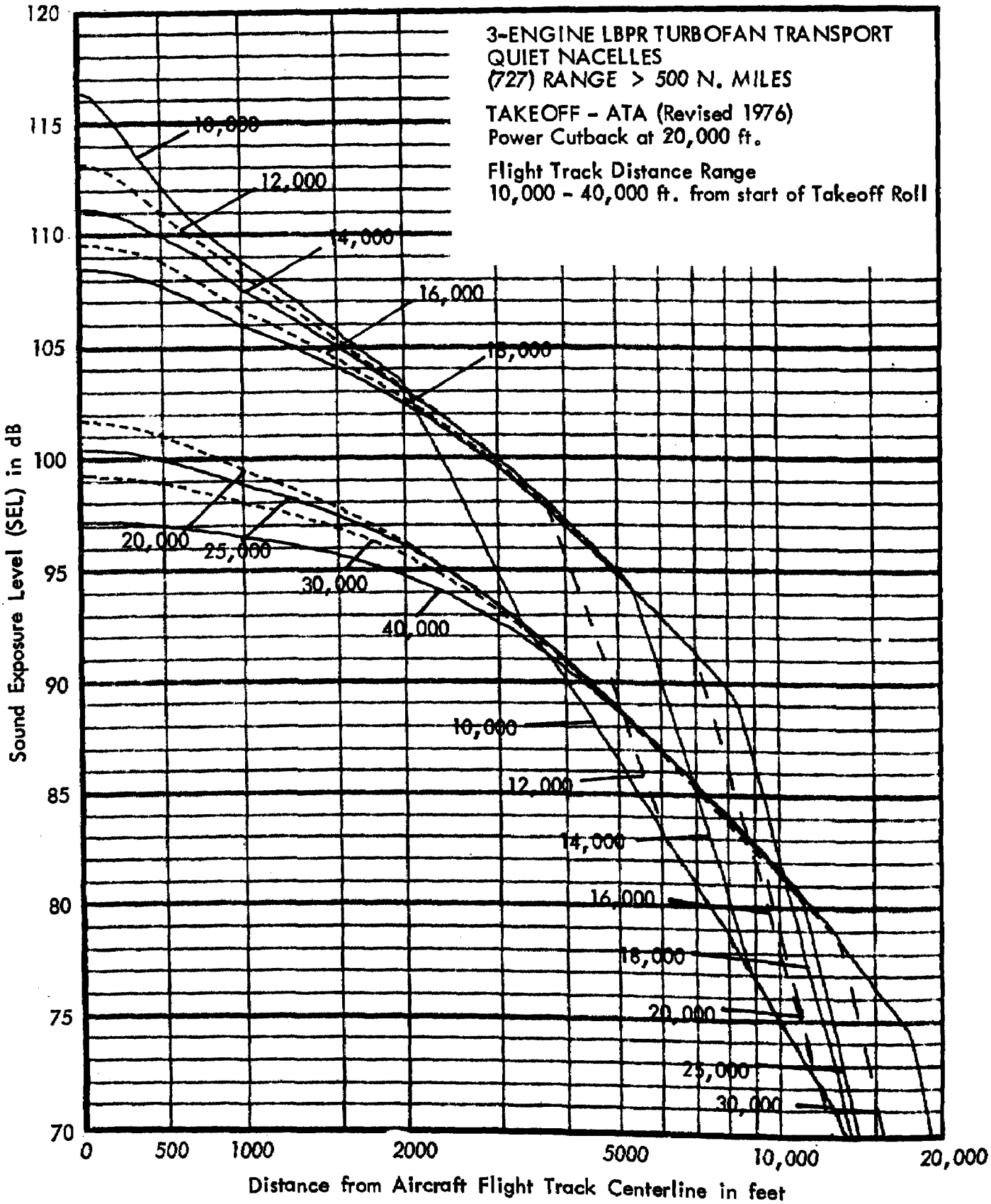

3-ENGINE LBPR TURBOFAN TRANSPORT
(727) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
35,000 - 140,000 ft. from start of Takeoff Roll
35,000
40,000
45,000
50,000
60,000
70,000
80,000
90,000
90,000
100,000
110,000
120,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

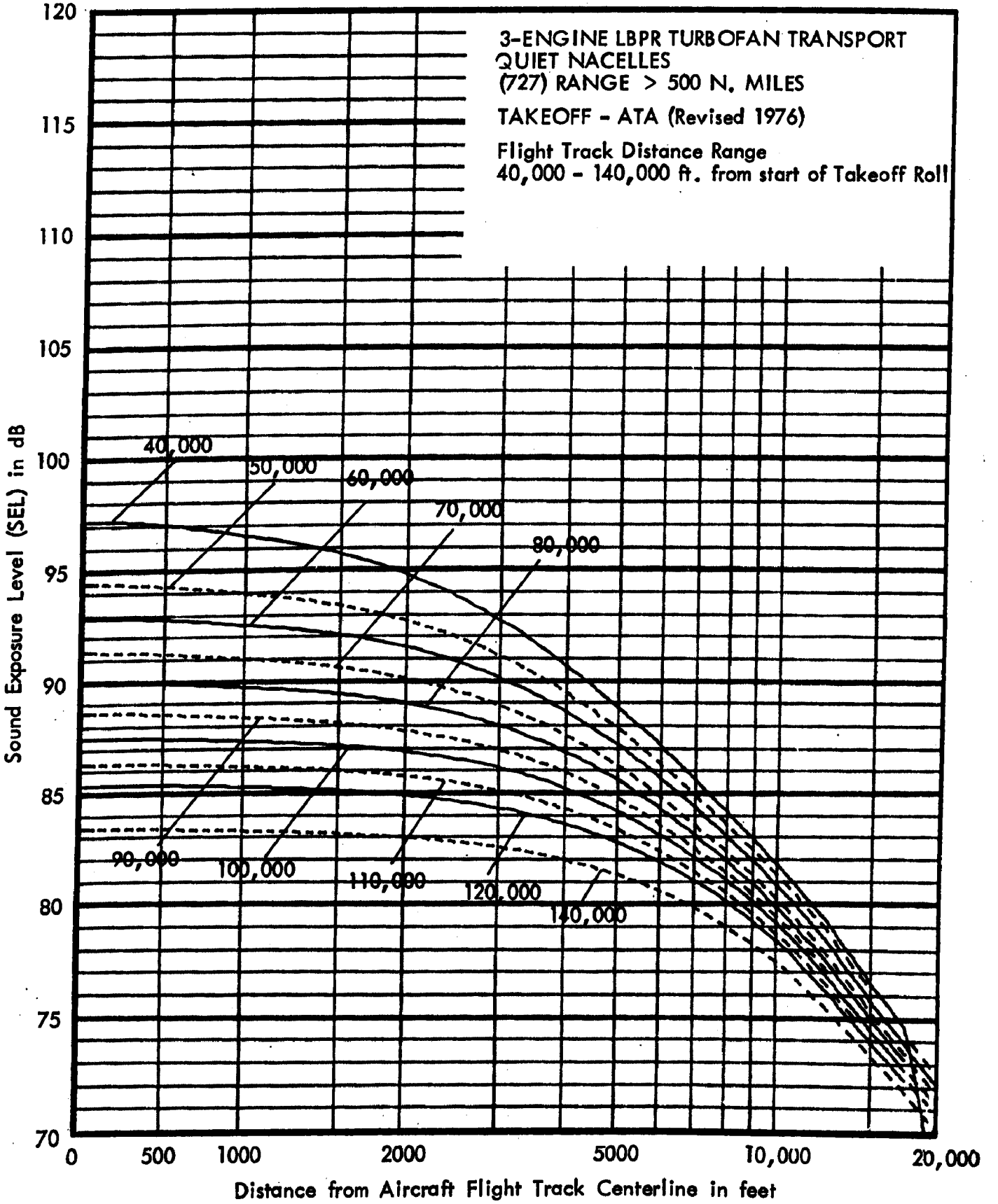

3-T-TFL(Q)-TO(1)-R-1
3-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(727) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
0
2000
4000
6000
8000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

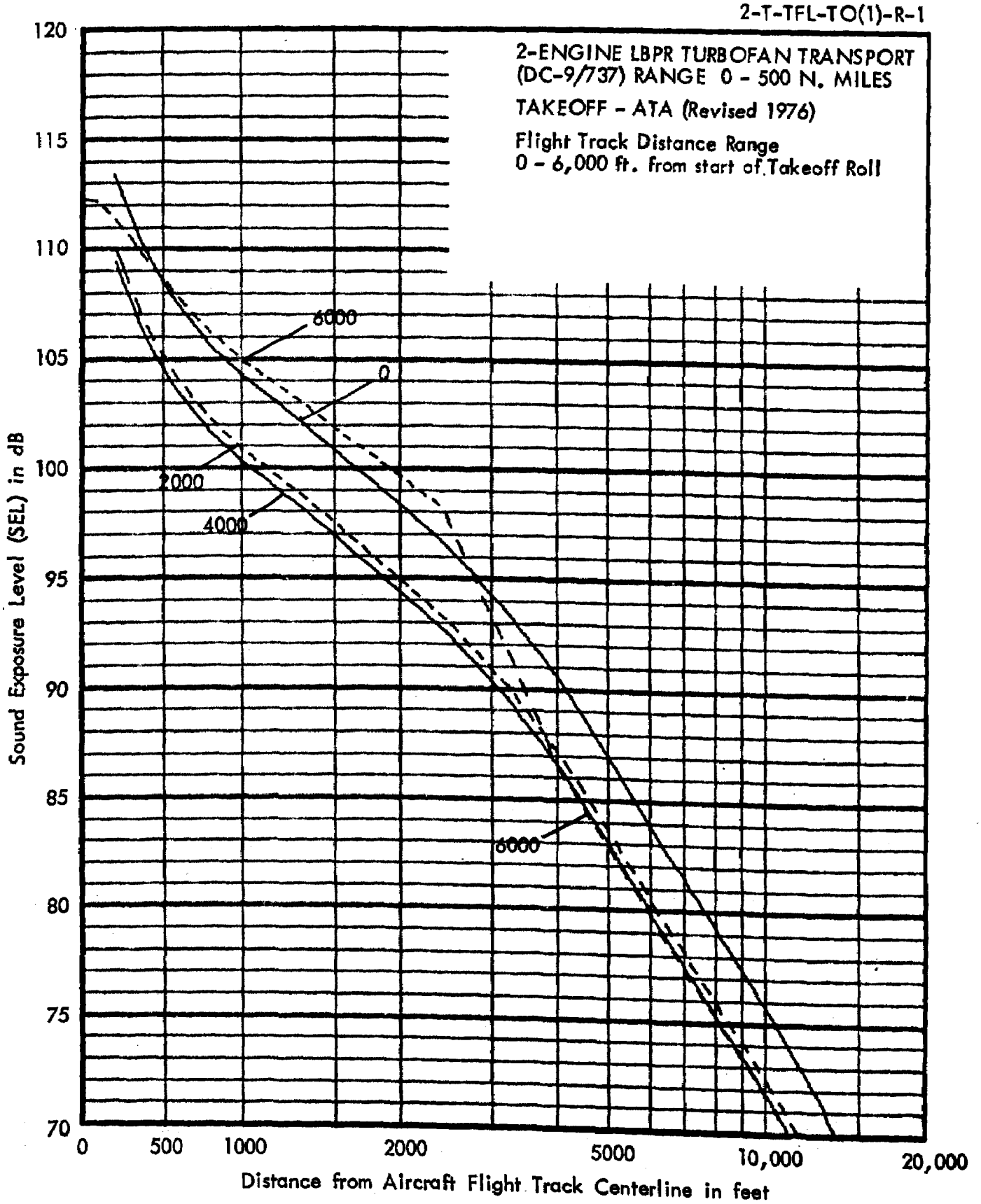

3-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(727) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 18,000 ft.
Flight Track Distance Range
8,000 - 30,000 ft. from start of Takeoff Roll
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
8000
10,000
12,000
14,000
16,000
18,000
20,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

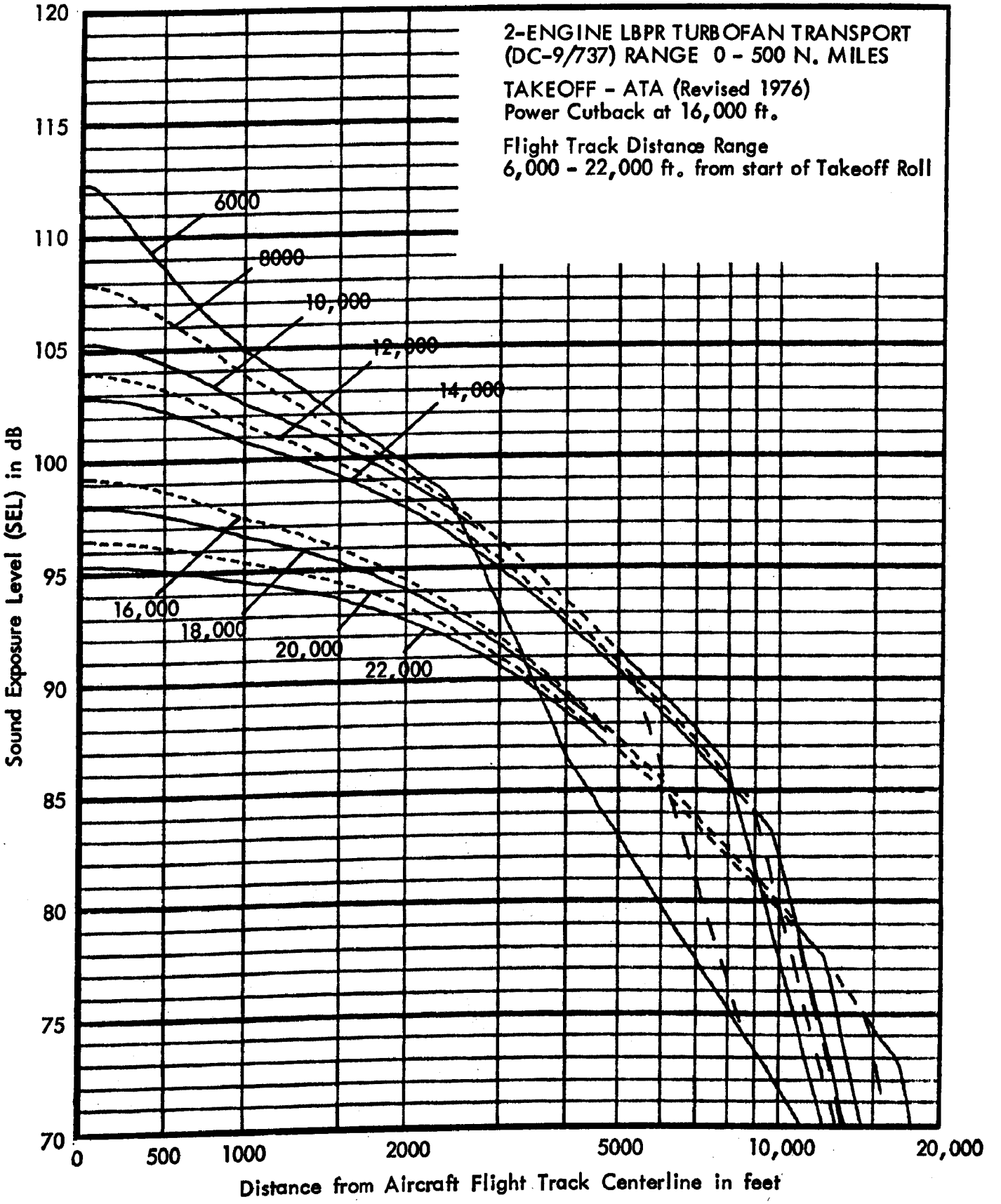

3-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(727) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
30,000 - 140,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
30,000
35,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
130,000
140,000
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

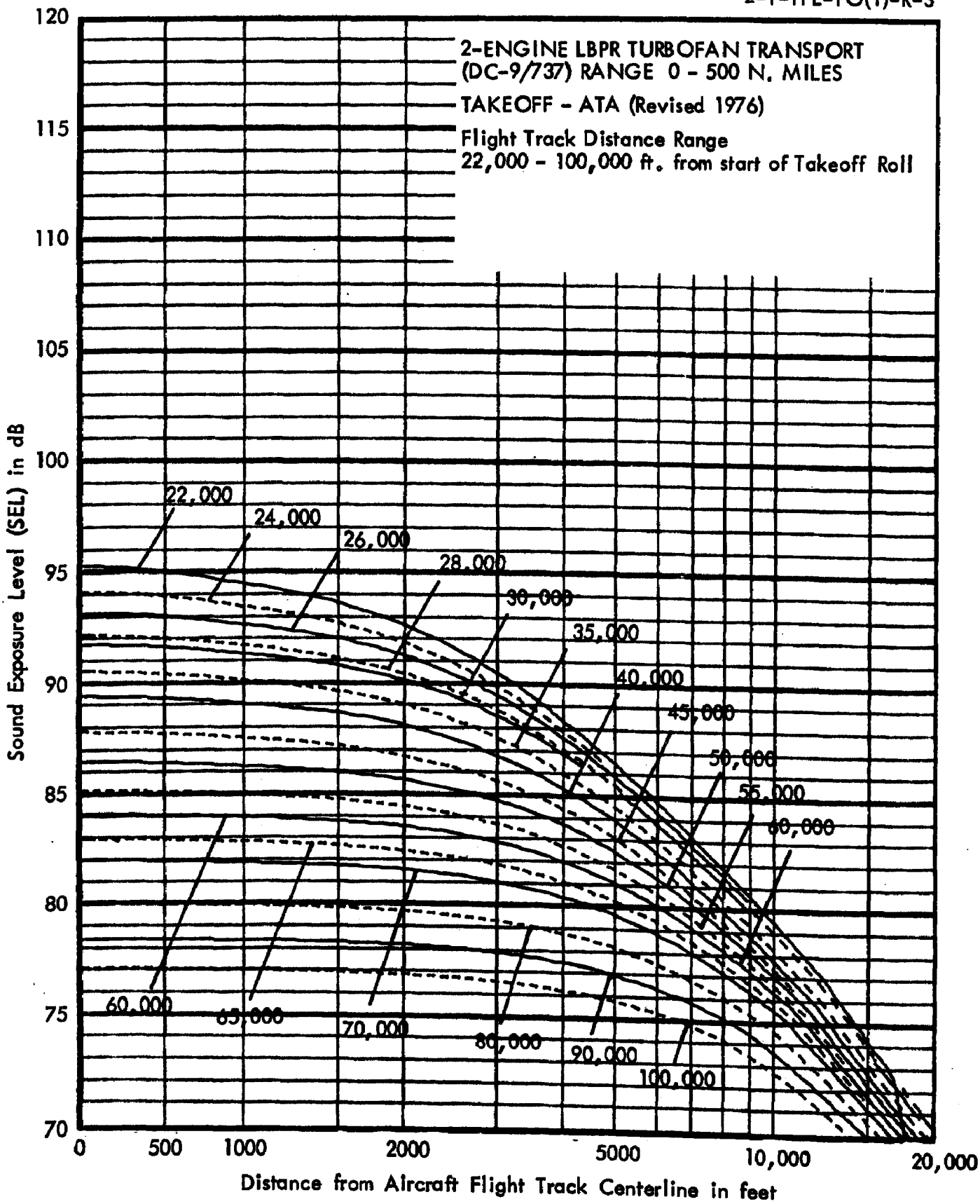

3-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(727) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 10,000 ft. from start of Takeoff Roll
10,000
0
2000
6000
4000
8000
10,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

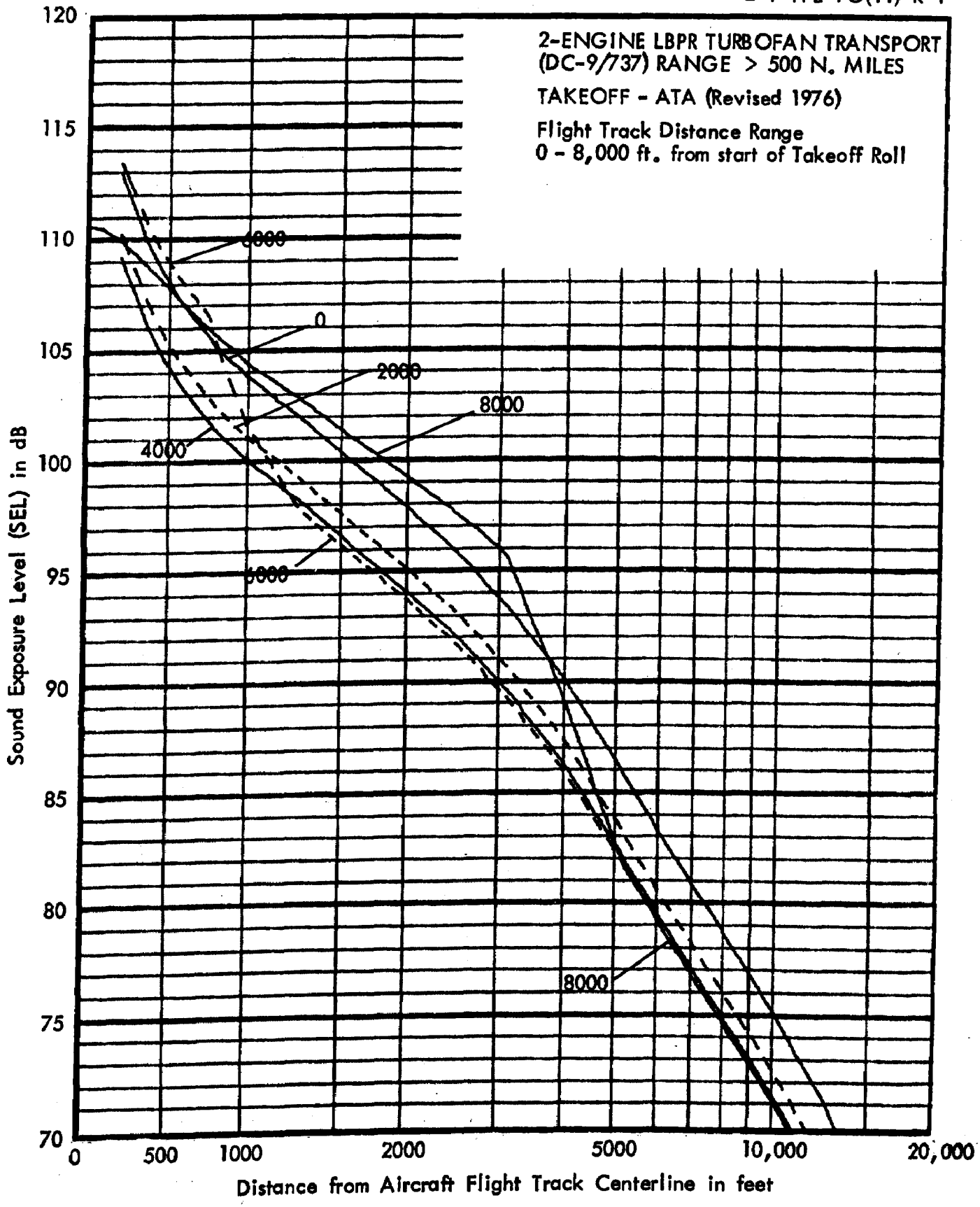

3-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(727) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 20,000 ft.
Flight Track Distance Range
10,000 - 40,000 ft. from start of Takeoff Roll
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
40,000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

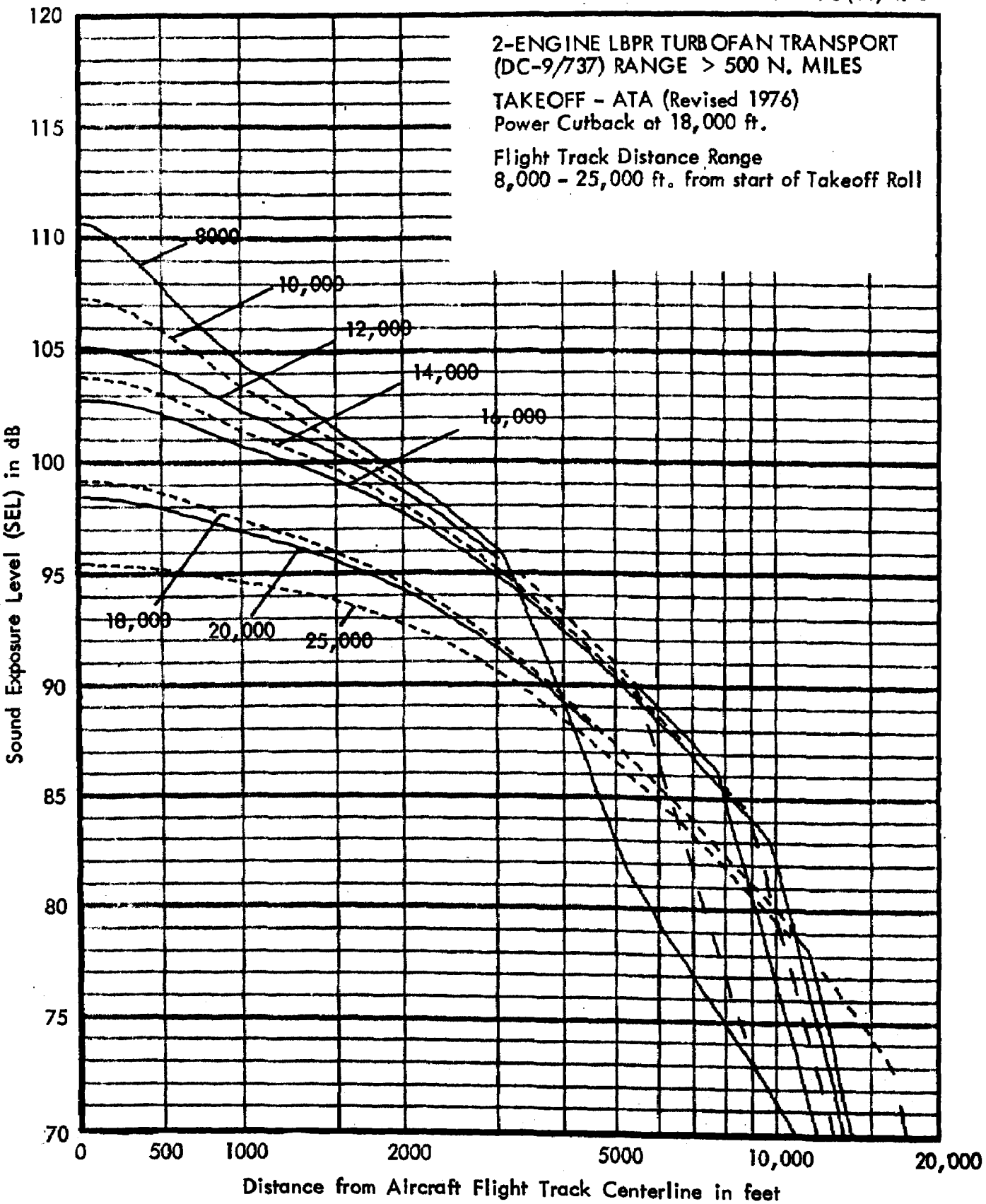

3-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(727) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
40,000 - 140,000 ft. from start of Takeoff Roll
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

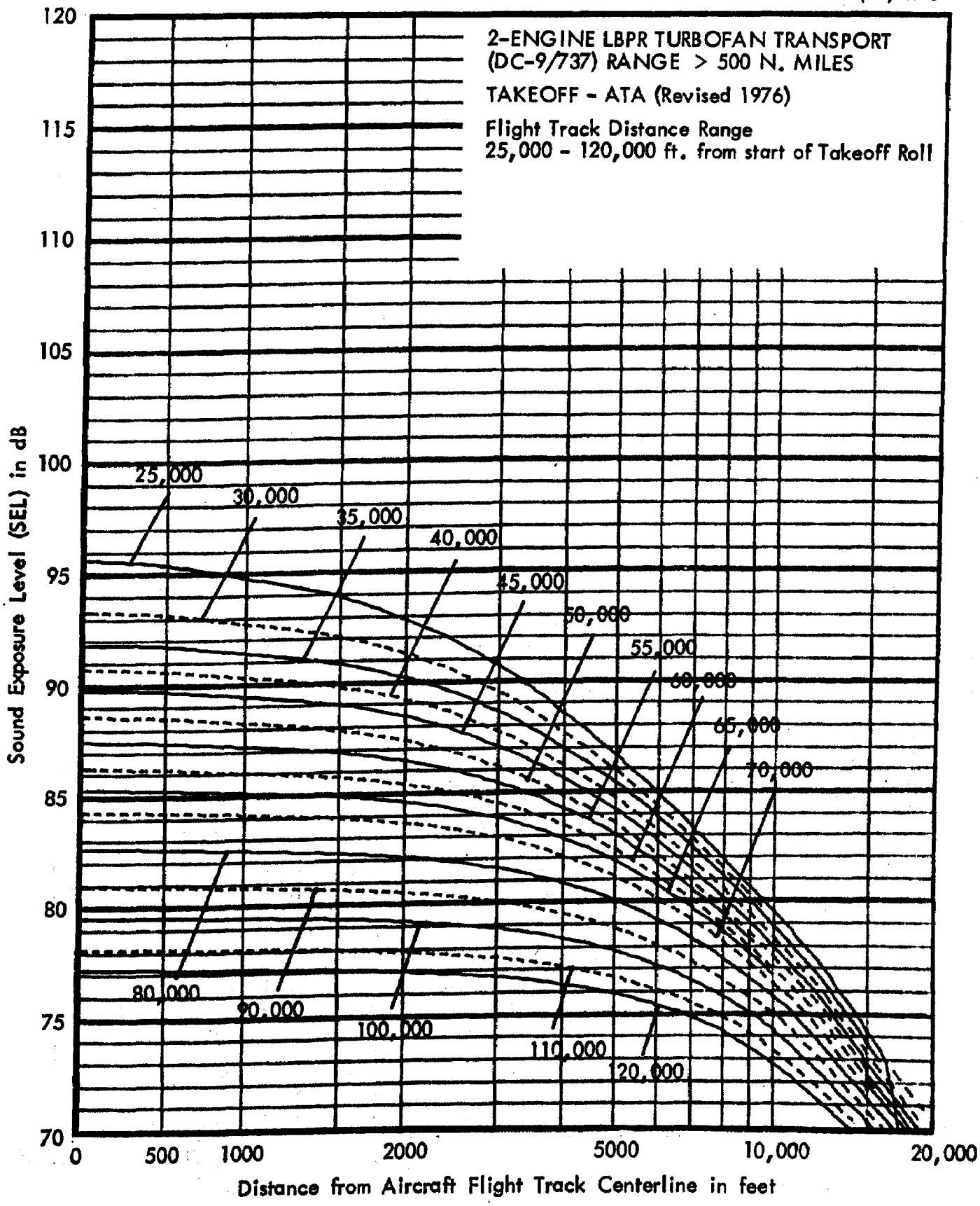

2-T-TFL-TO(1)-R-1
2-ENGINE LBPR TURBOFAN TRANSPORT
(DC-9/737) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 6,000 ft. from start of Takeoff Roll
6000
0
2000
4000
6000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet


2-ENGINE LBPR TURBOFAN TRANSPORT
(DC-9/737) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 16,000 ft.
Flight Track Distance Range
6,000 - 22,000 ft. from start of Takeoff Roll
6000
8000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

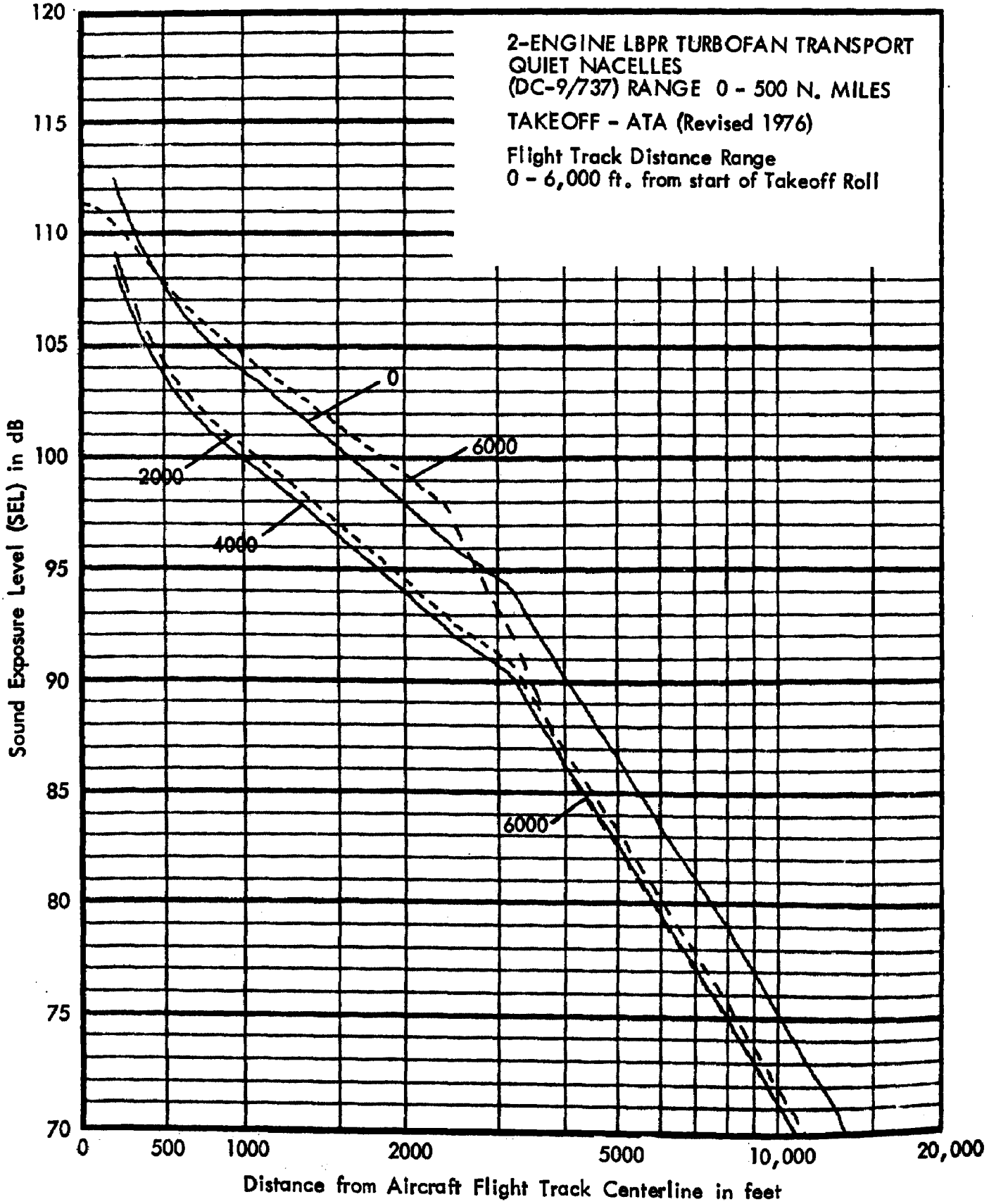

2-ENGINE LBPR TURBOFAN TRANSPORT
(DC-9/737) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
22,000 - 100,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet
22,000
24,000
26,000
28,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
60,000
65,000
70,000
80,000
90,000
100,000

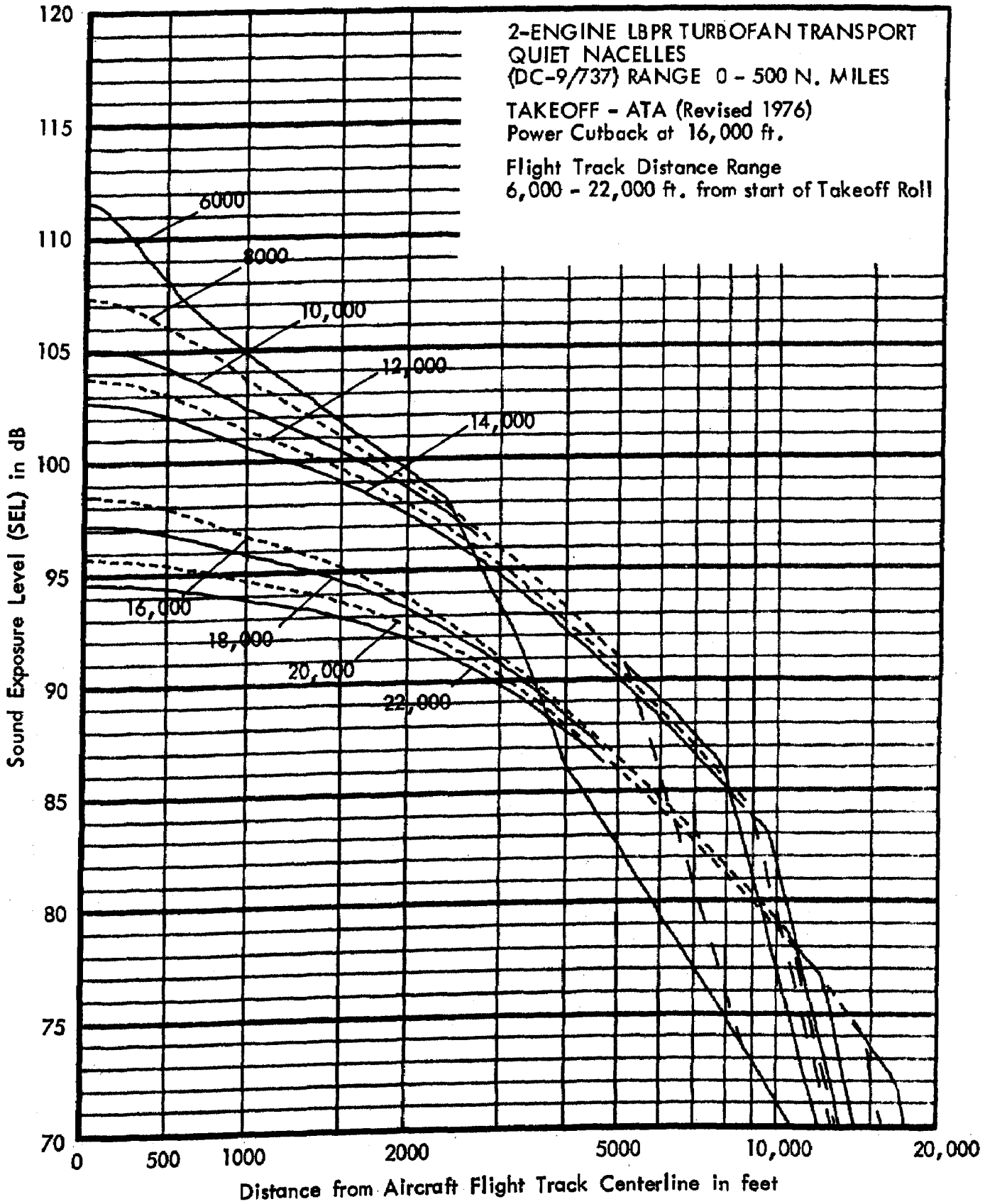

2-ENGINE LBPR TURBOFAN TRANSPORT
(DC-9/737) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
6000
0
2000
8000
4000
6000
8000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

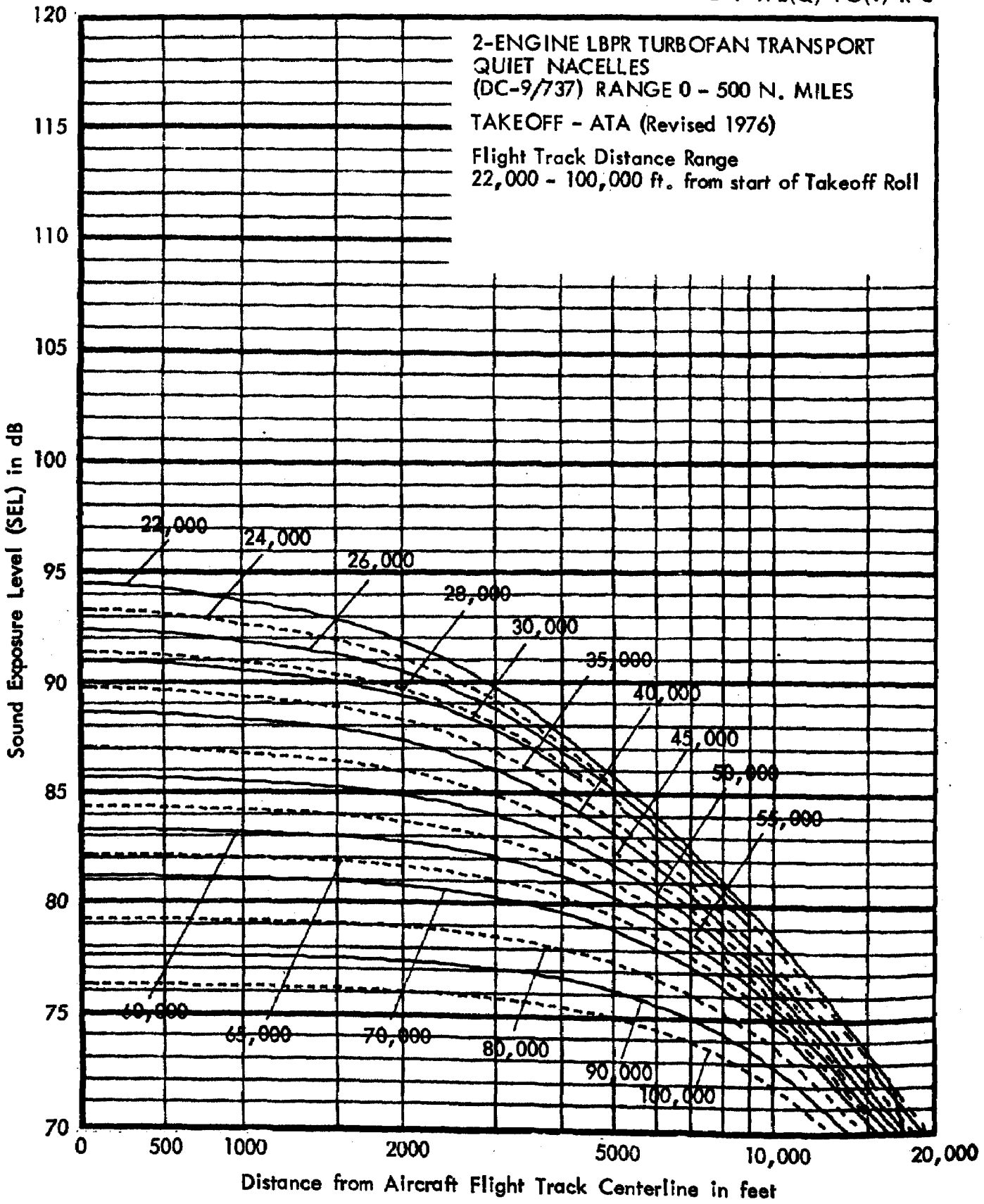

2-ENGINE LBPR TURBOFAN TRANSPORT
(DC-9/737) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 18,000 ft.
Flight Track Distance Range
8,000 - 25,000 ft. from start of Takeoff Roll
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

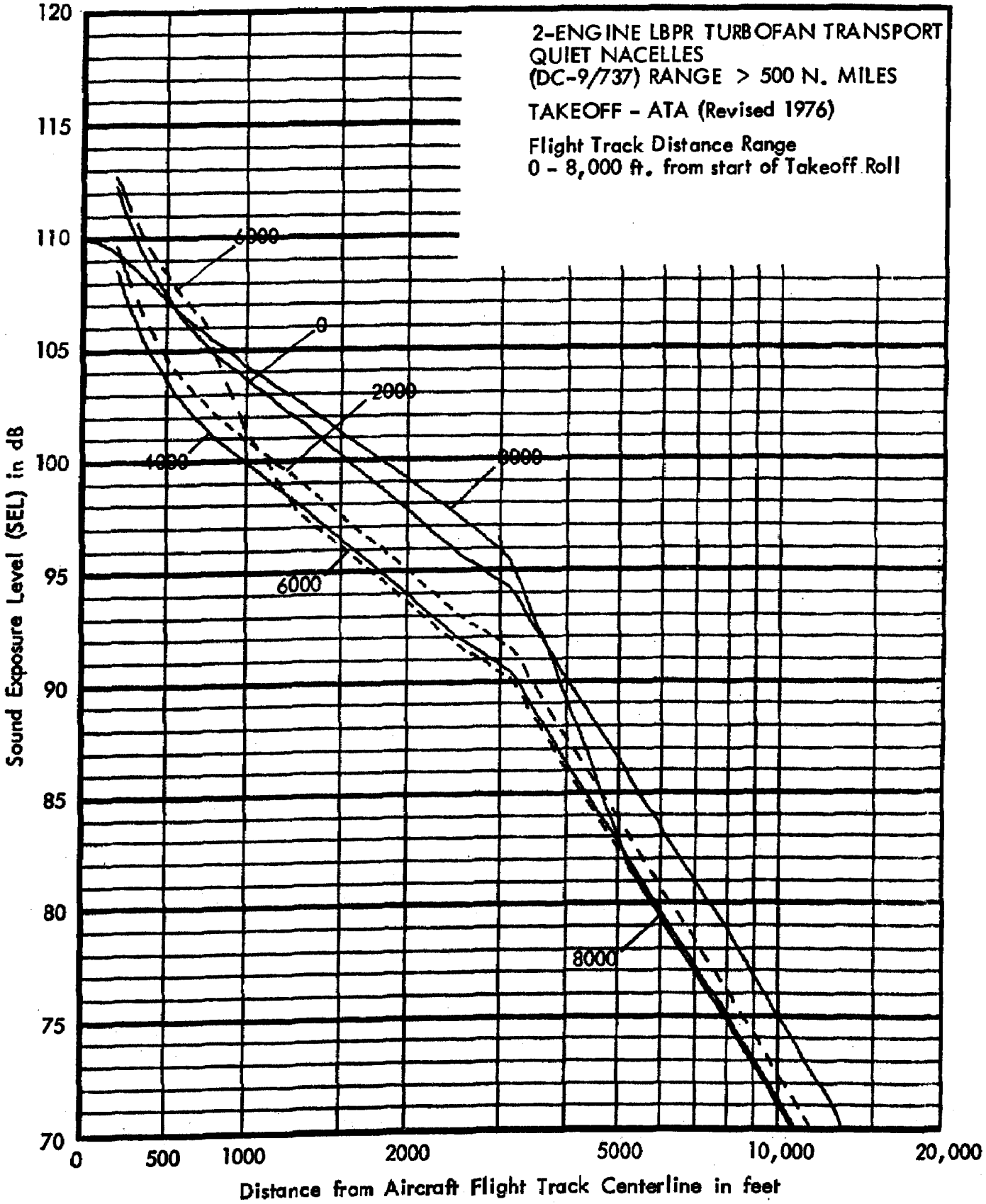

2-ENGINE LBPR TURBOFAN TRANSPORT
(DC-9/737) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
25,000 - 120,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
80,000
90,000
100,000
110,000
120,000
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

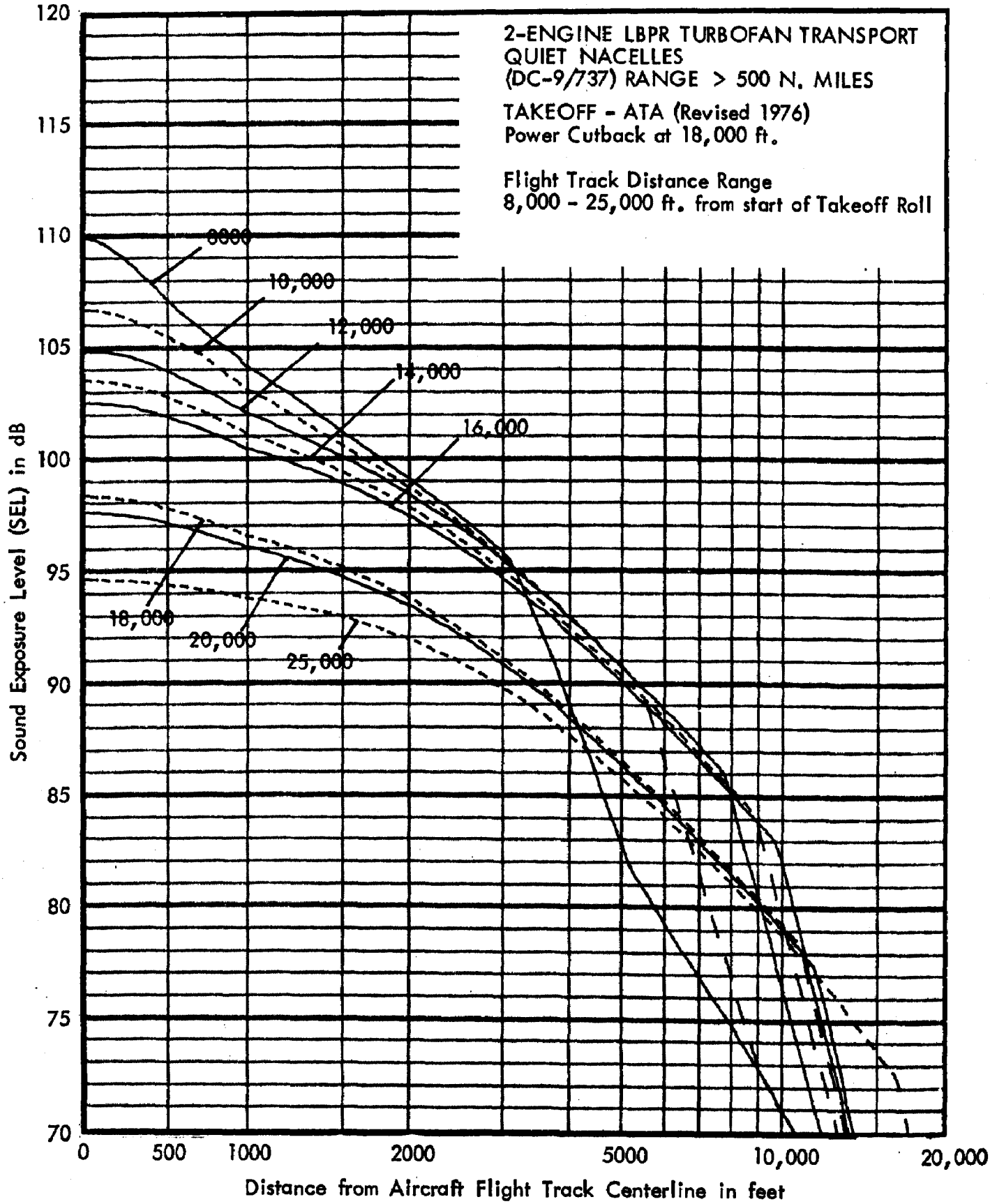
2-T-TFL(Q)-TO(1)-R-1

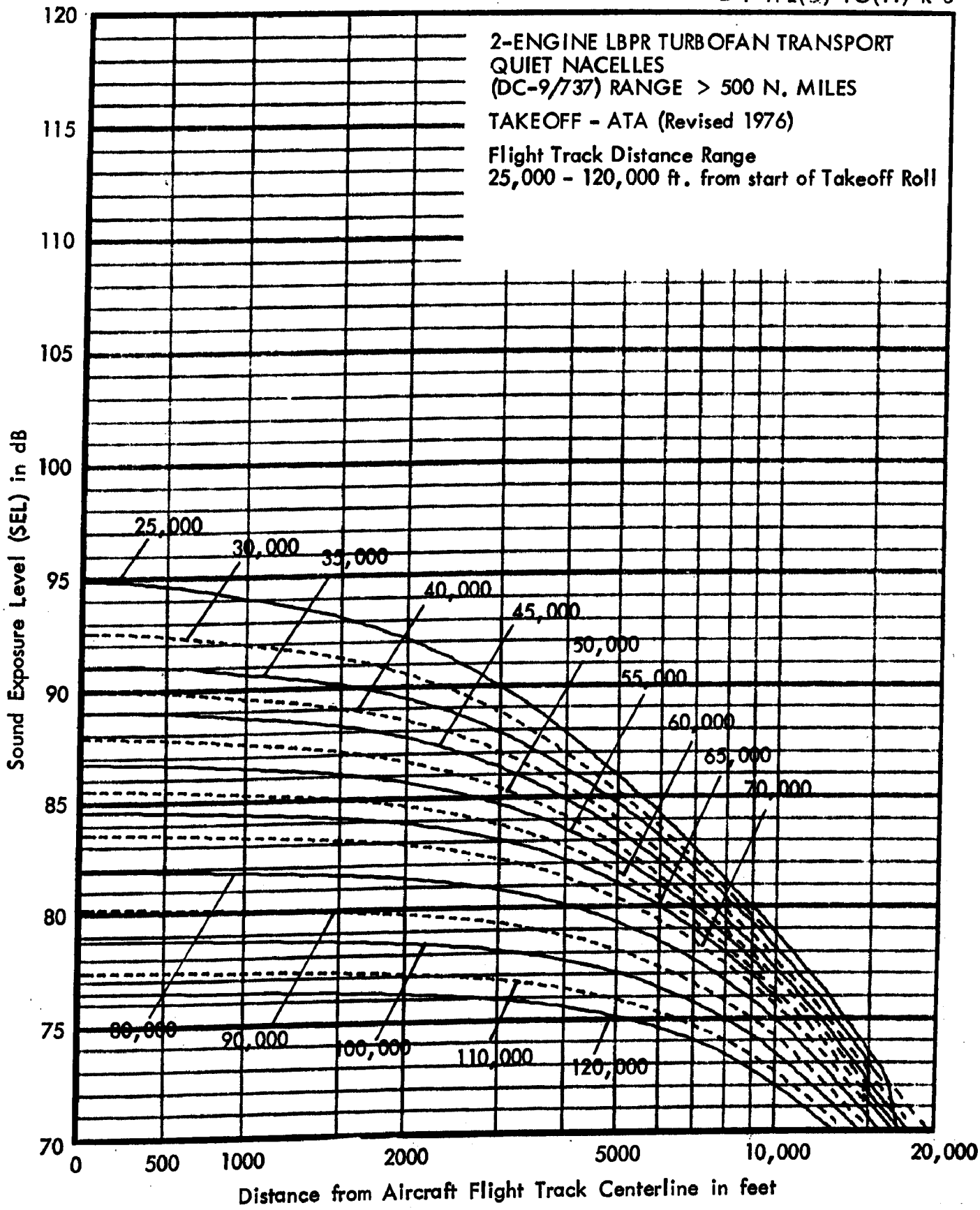


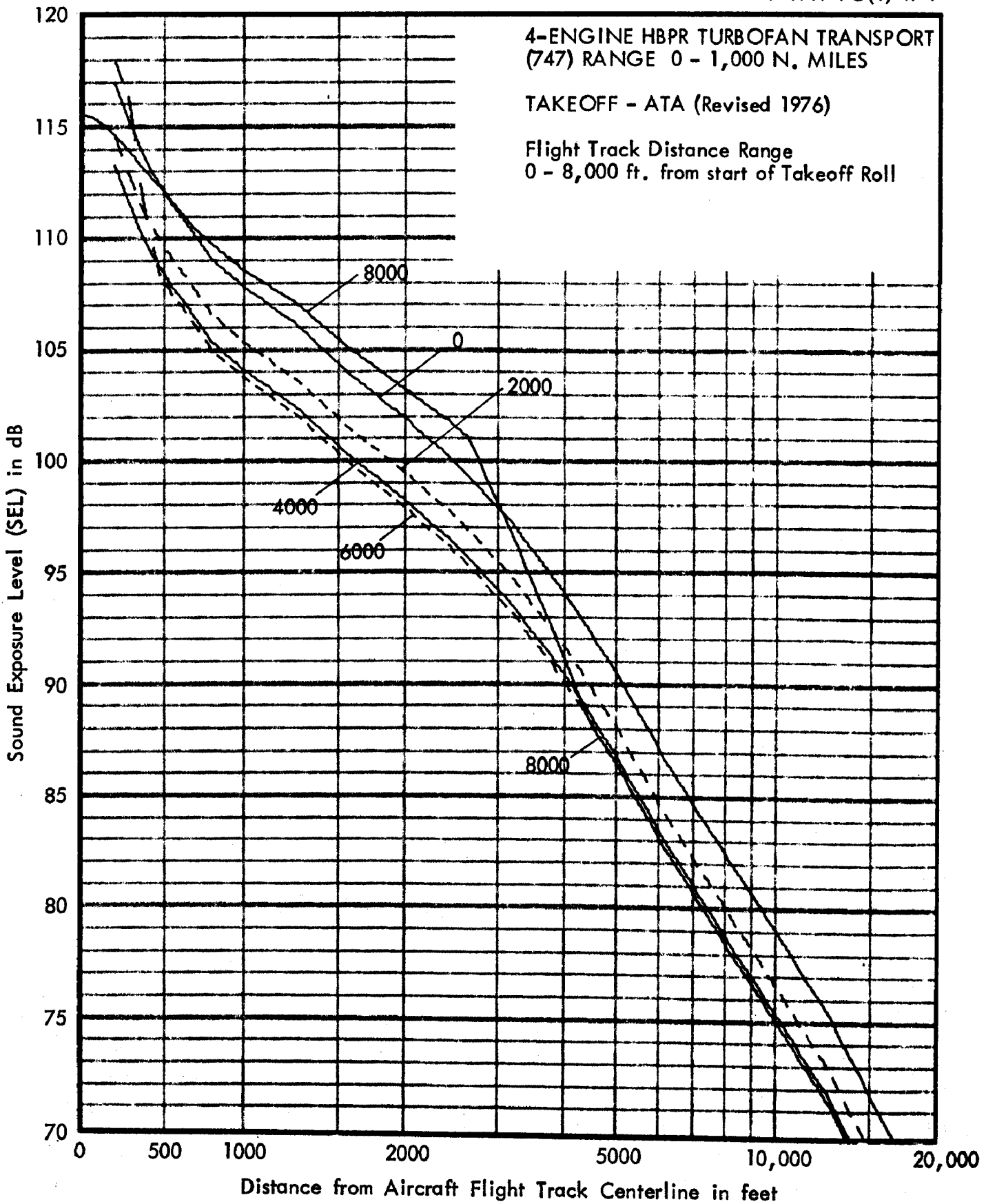

2-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(DC-9/737) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 16,000 ft.
Flight Track Distance Range
6,000 - 22,000 ft. from start of Takeoff Roll
6000
8000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

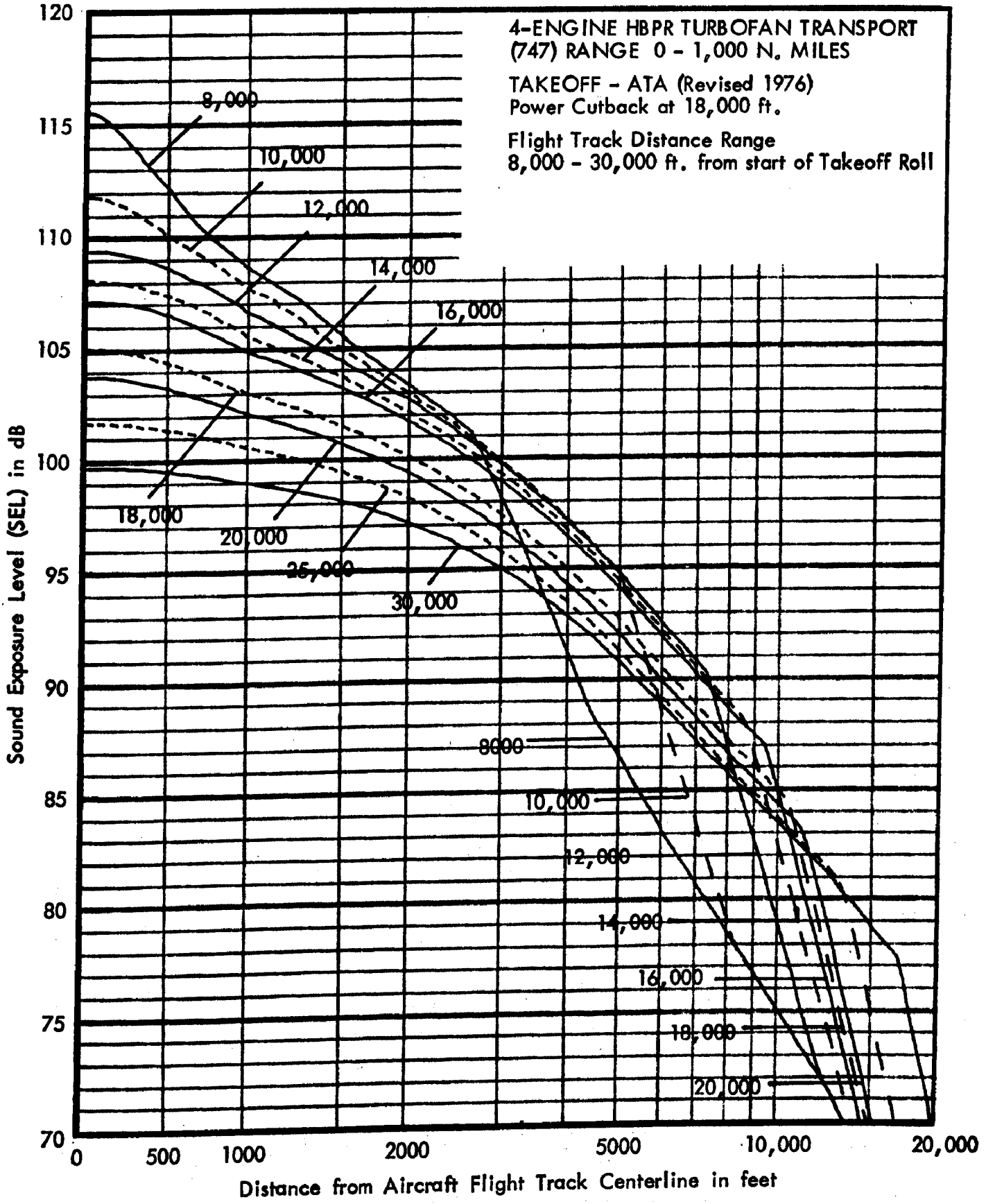

2-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(DC-9/737) RANGE 0 - 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
22,000 - 100,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
22,000
24,000
26,000
28,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
80,000
90,000
100,000
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

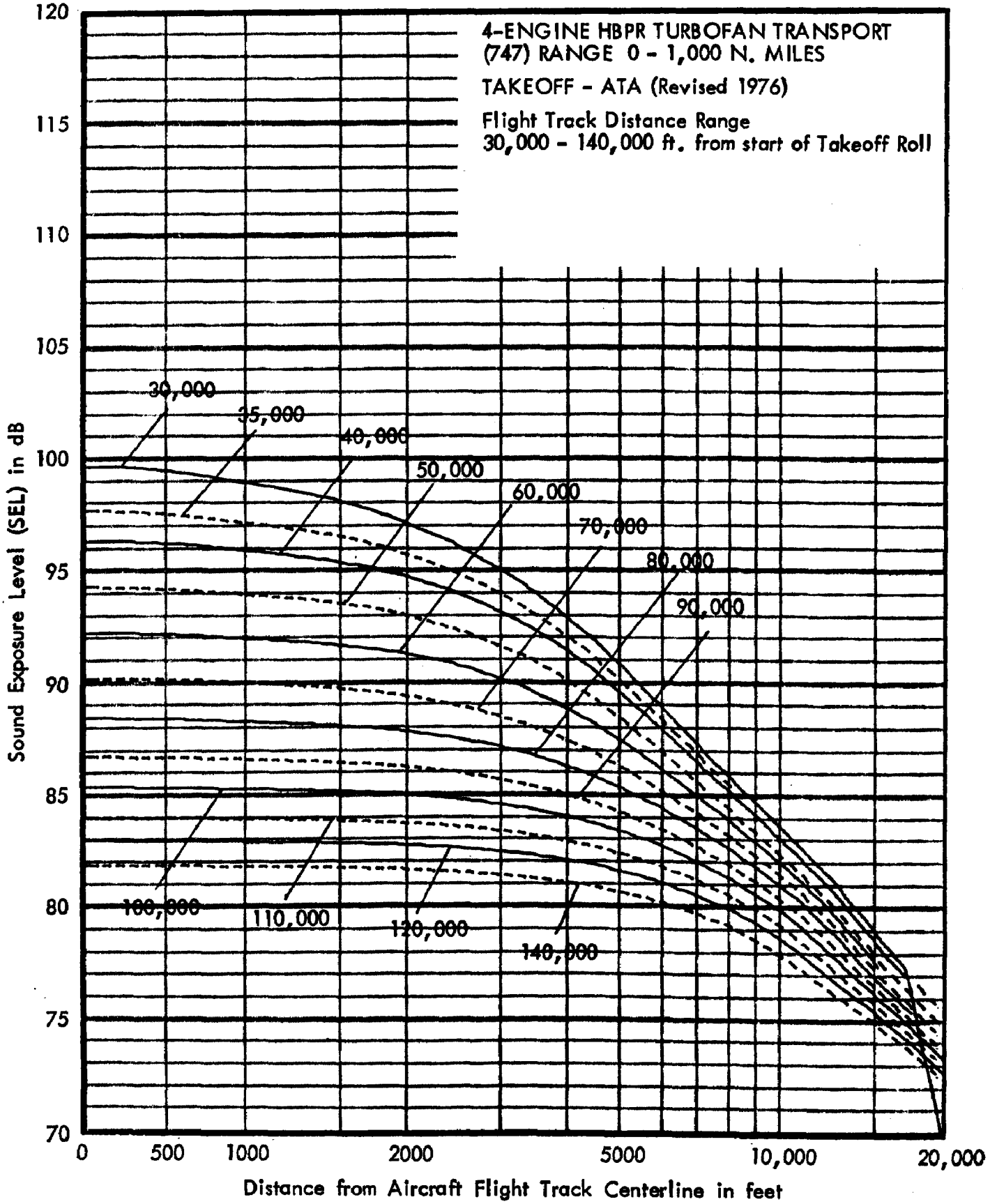

2-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(DC-9/737) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
6000
0
2000
4000
8000
6000
8000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

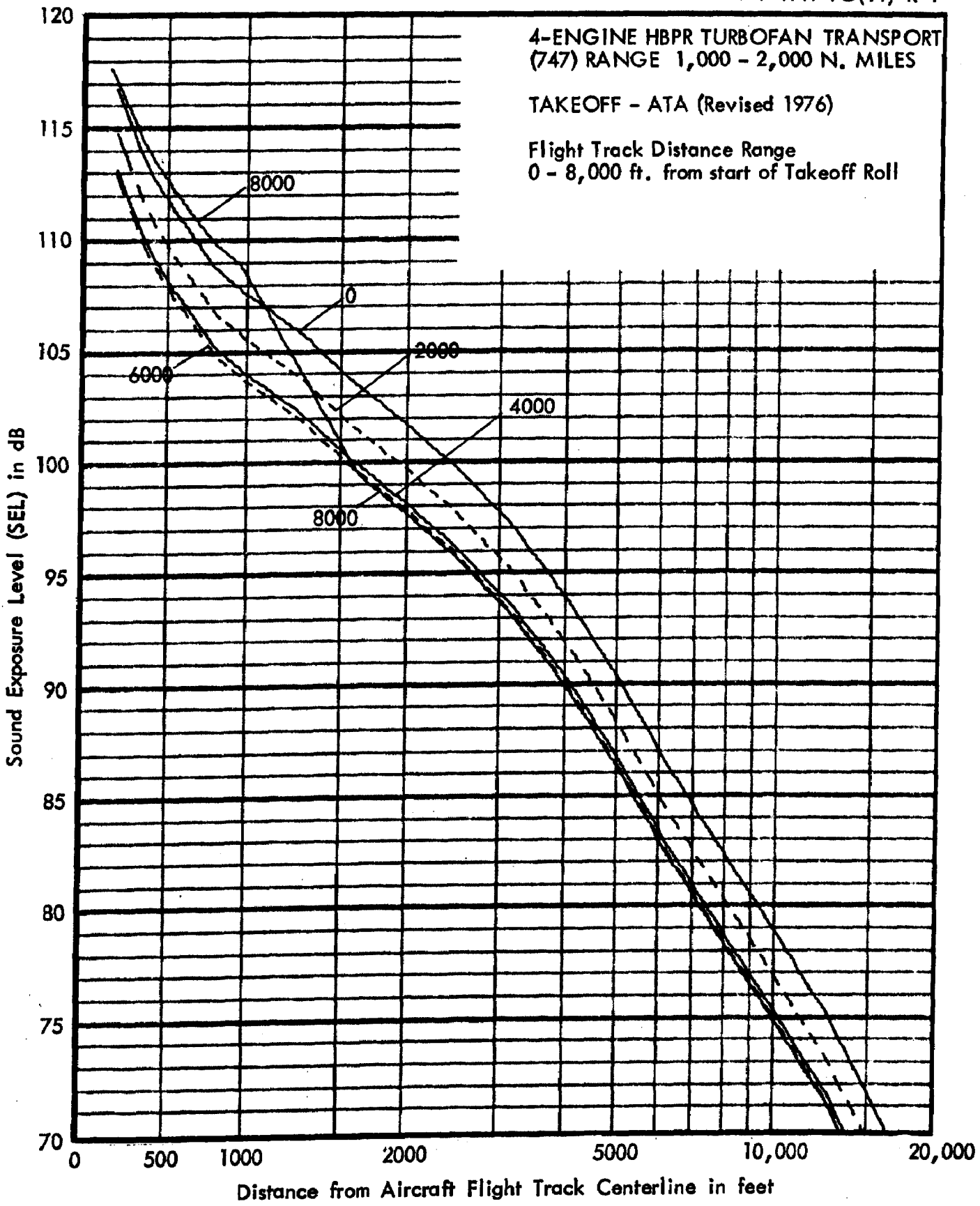

2-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(DC-9/737) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 18,000 ft.
Flight Track Distance Range
8,000 - 25,000 ft. from start of Takeoff Roll
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

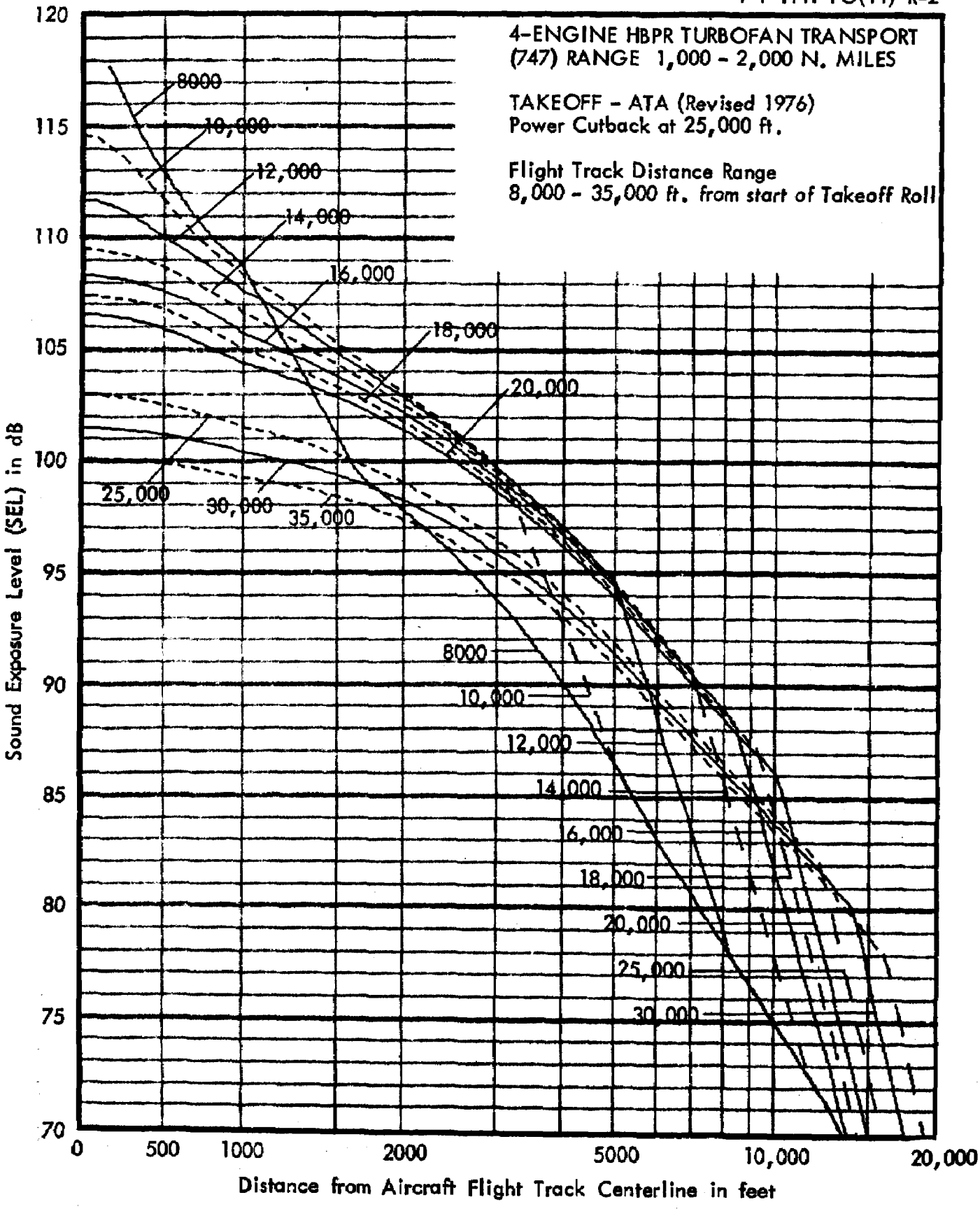

2-ENGINE LBPR TURBOFAN TRANSPORT
QUIET NACELLES
(DC-9/737) RANGE > 500 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
25,000 - 120,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
80,000
90,000
100,000
110,000
120,000
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

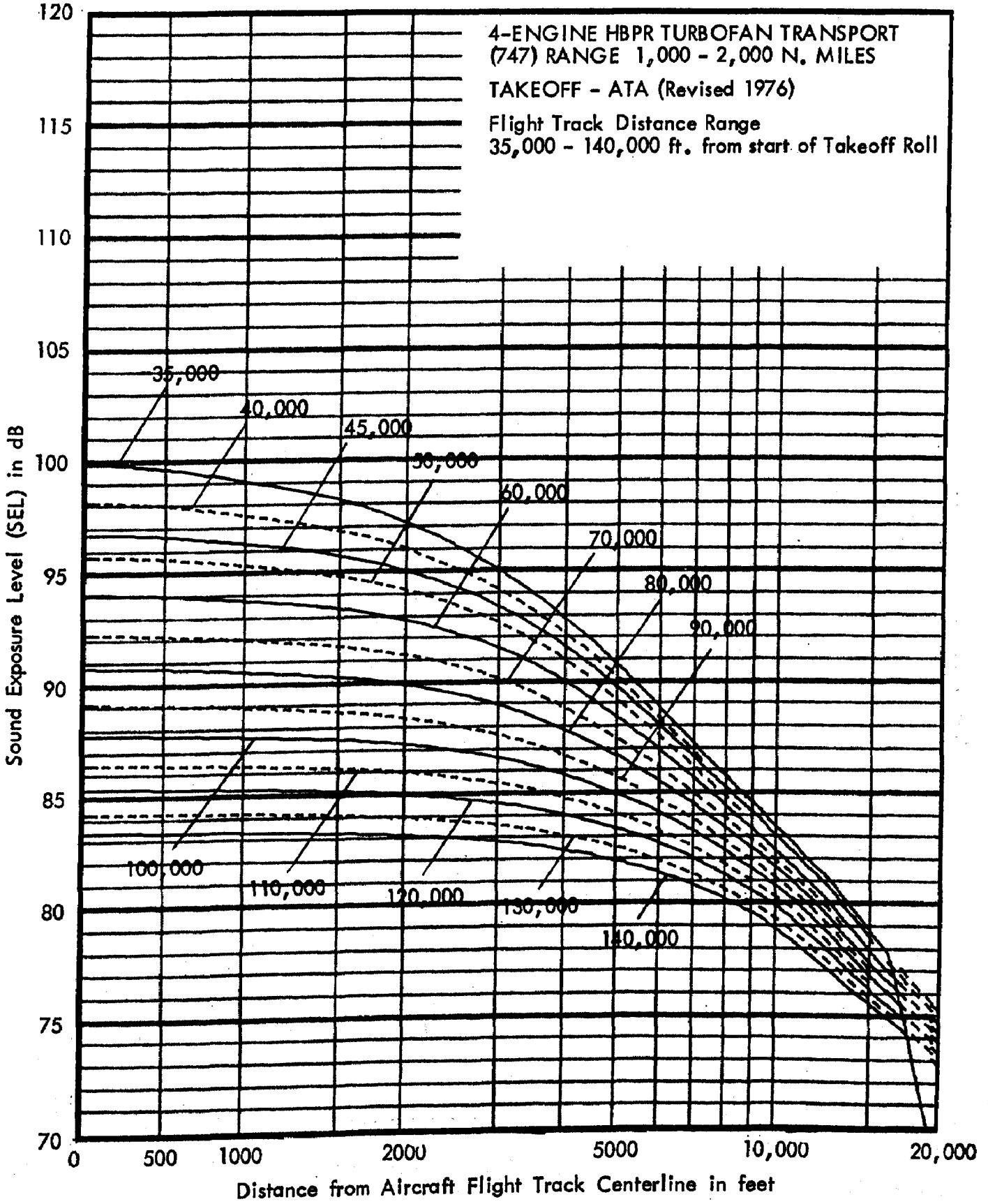

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
0
2000
4000
6000
8000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

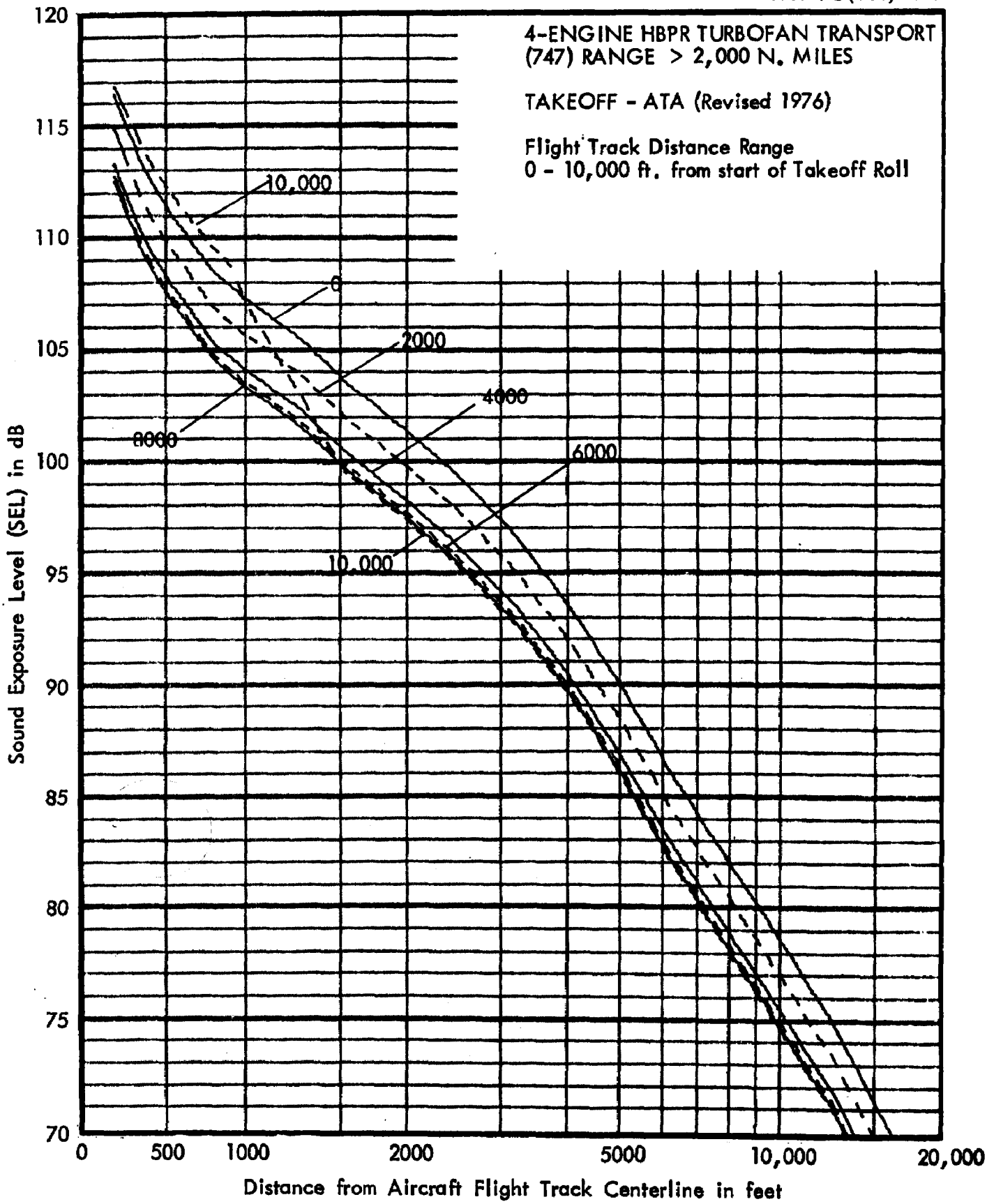

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 18,000 ft.
Flight Track Distance Range
8,000 - 30,000 ft. from start of Takeoff Roll
8,000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
8000
10,000
12,000
14,000
16,000
18,000
20,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

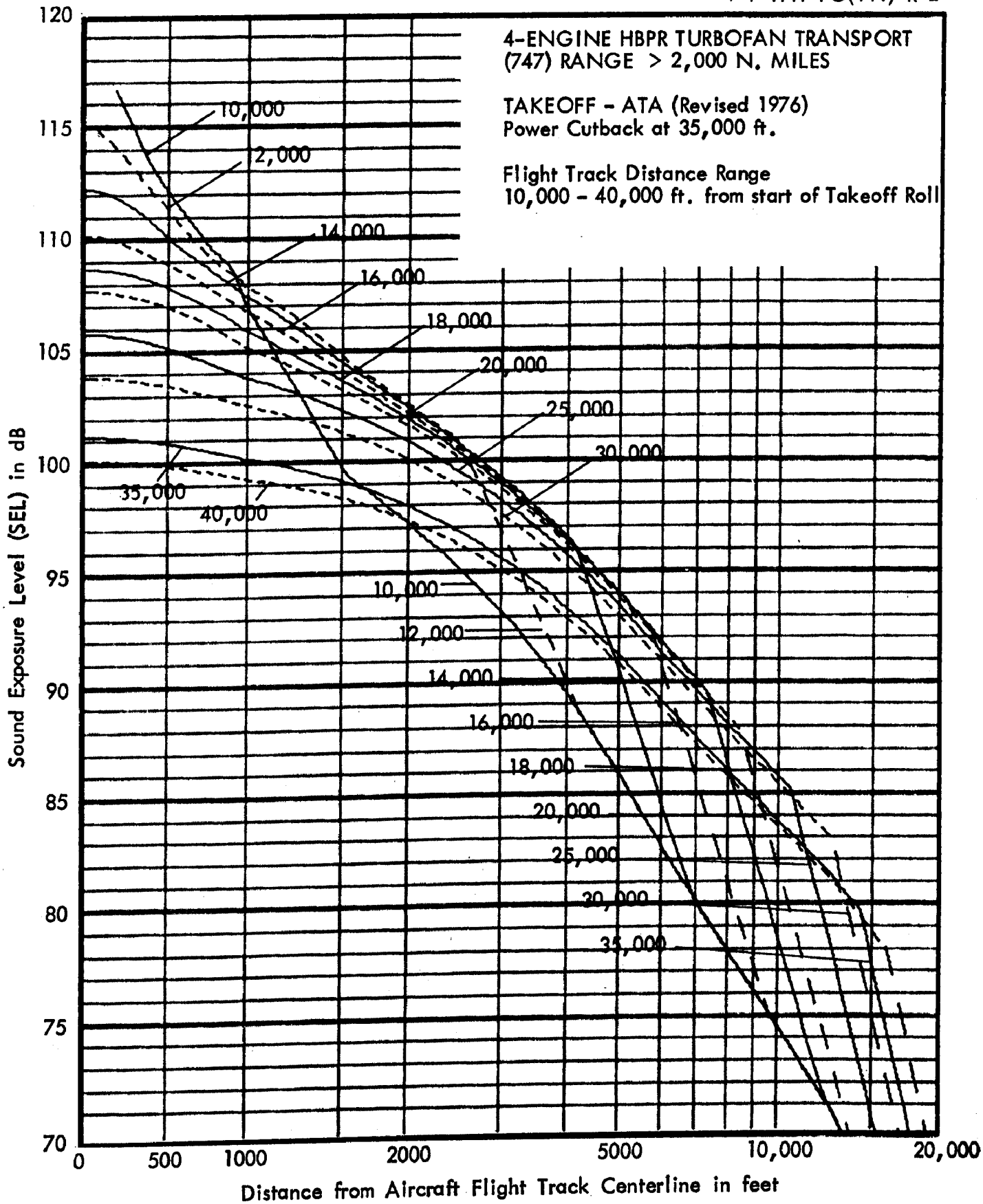

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
30,000 - 140,000 ft. from start of Takeoff Roll
30,000
35,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

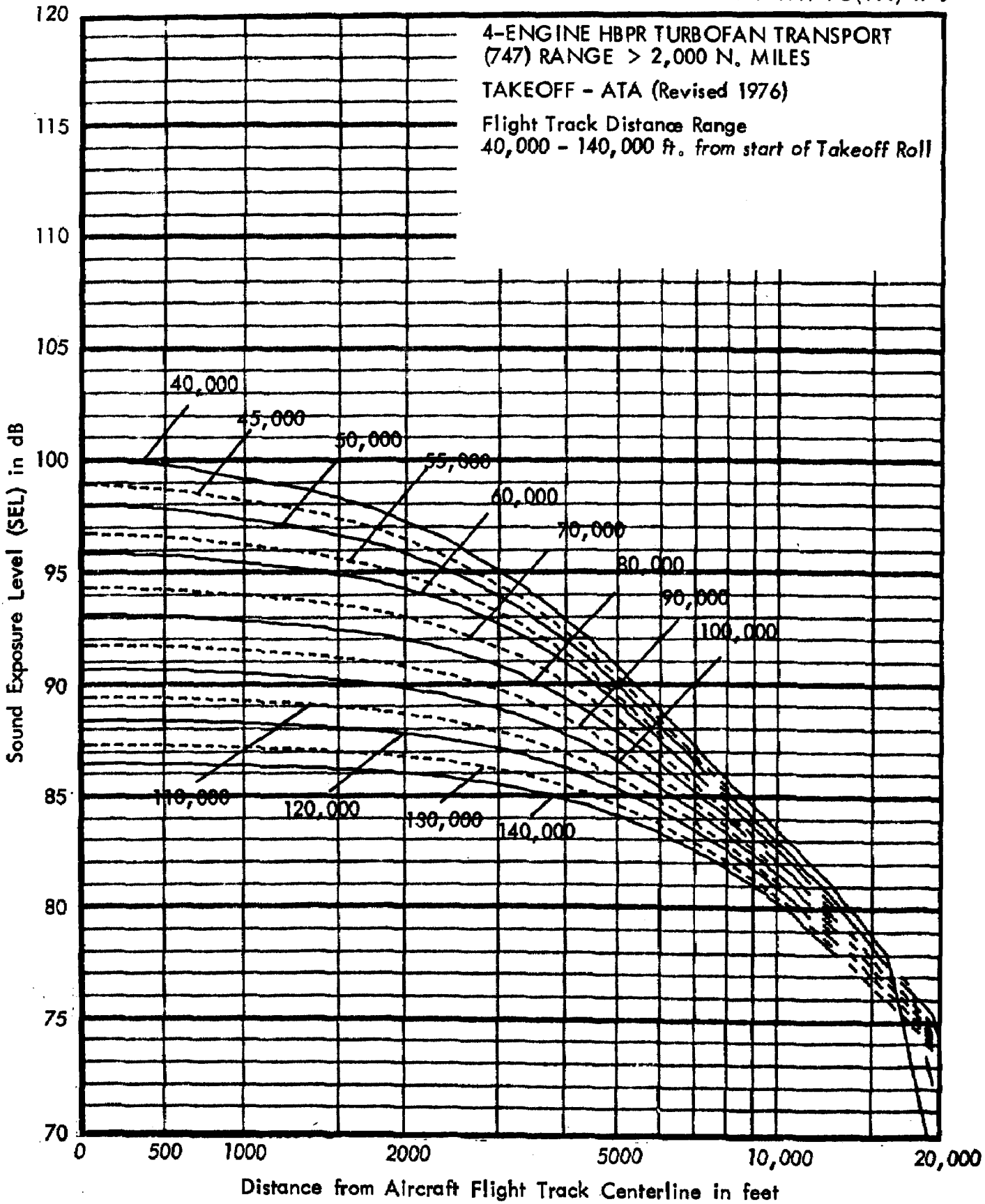

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
0
2000
6000
4000
8000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

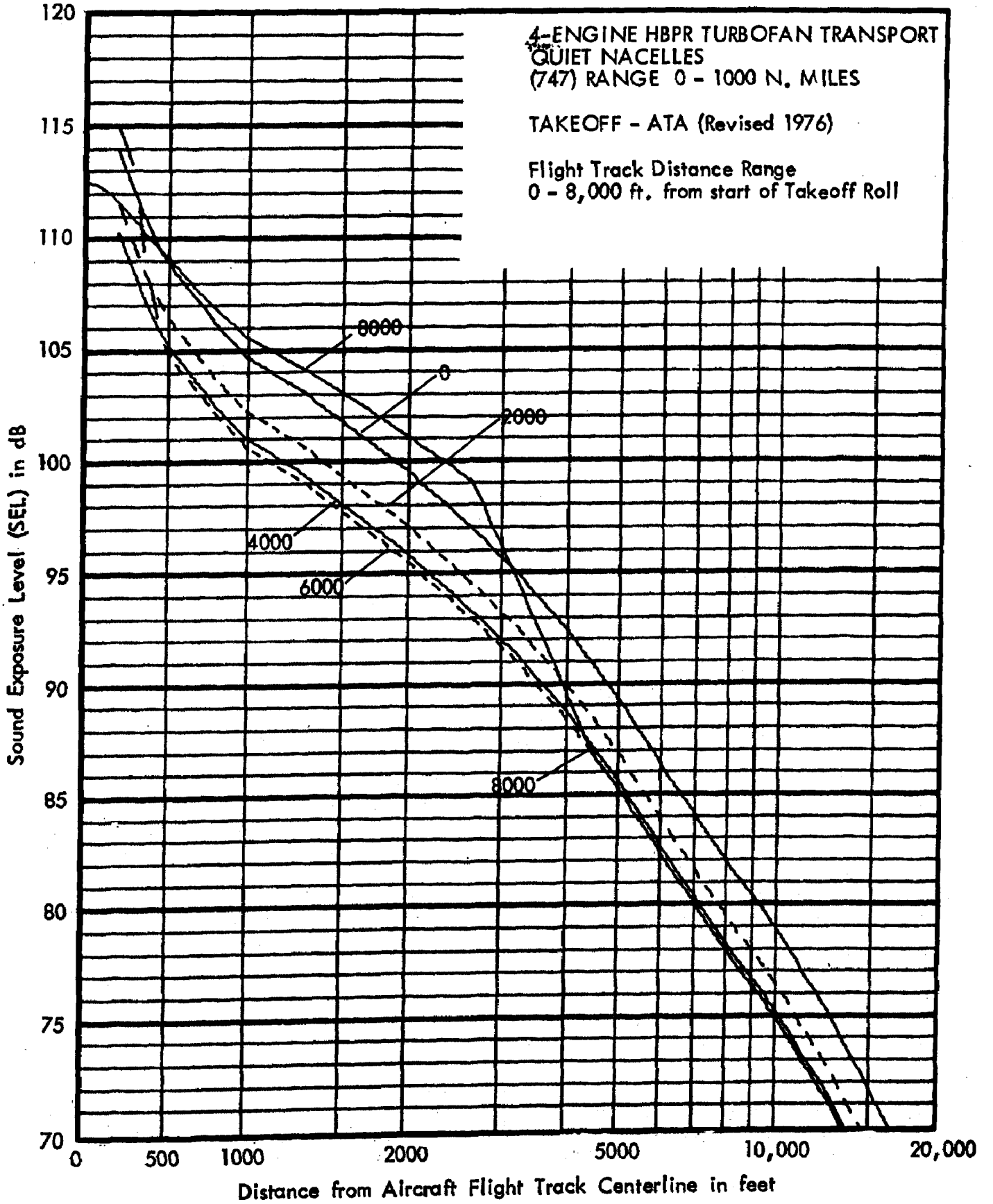

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 25,000 ft.
Flight Track Distance Range
8,000 - 35,000 ft. from start of Takeoff Roll
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

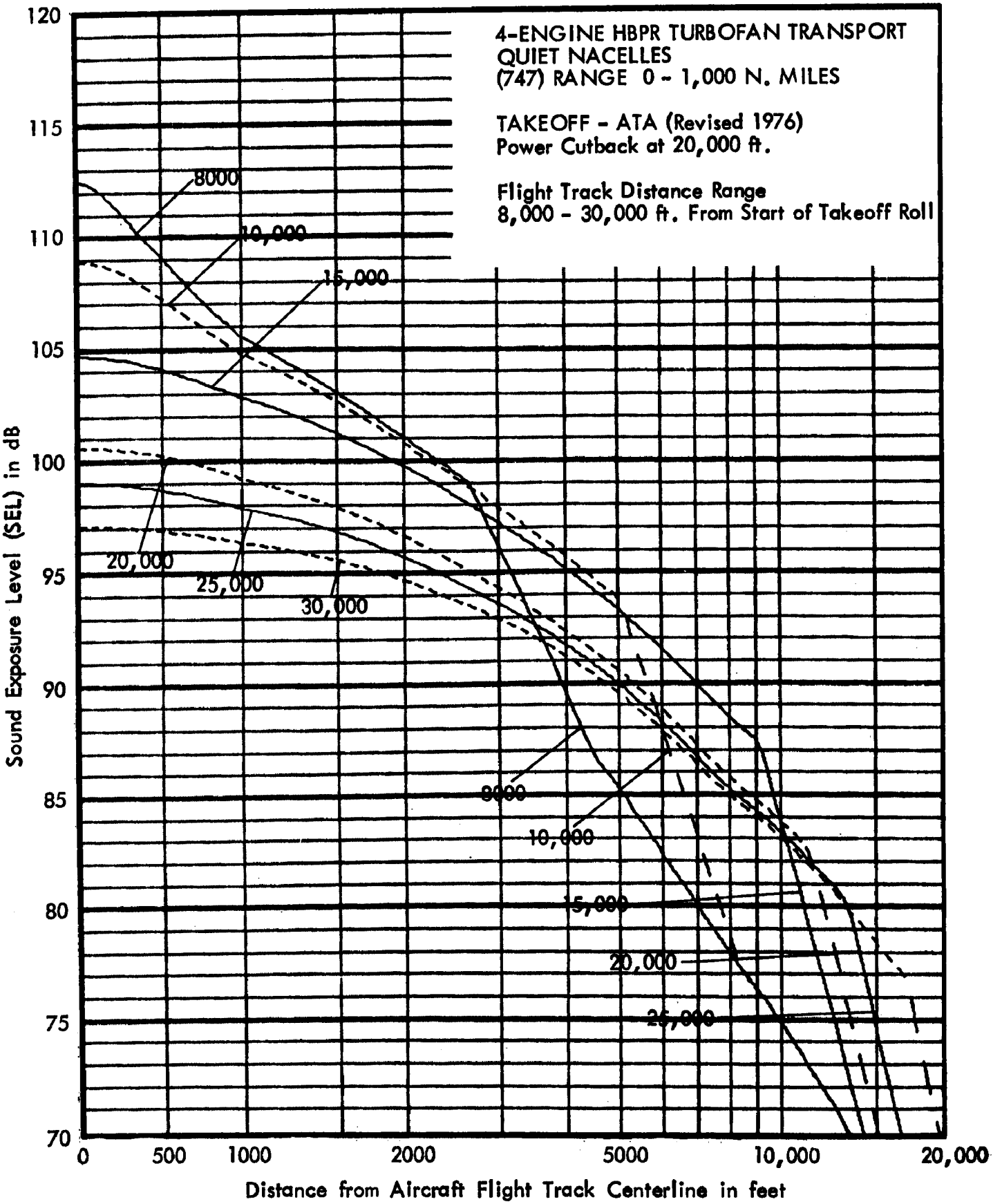

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
35,000 - 140,000 ft. from start of Takeoff Roll
35,000
40,000
45,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
130,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

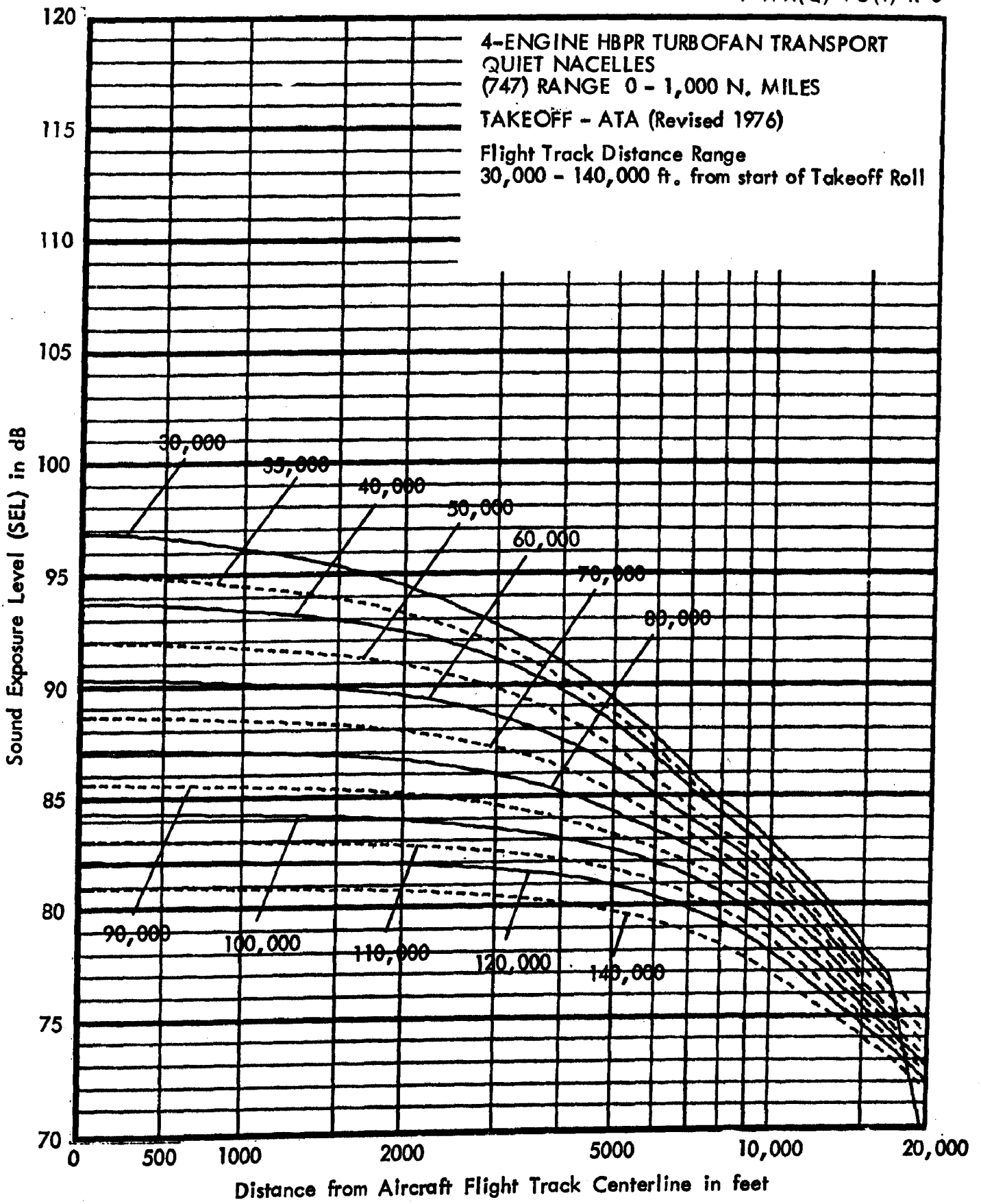

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 10,000 ft. from start of Takeoff Roll
10,000
0
2000
4000
8000
6000
10,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

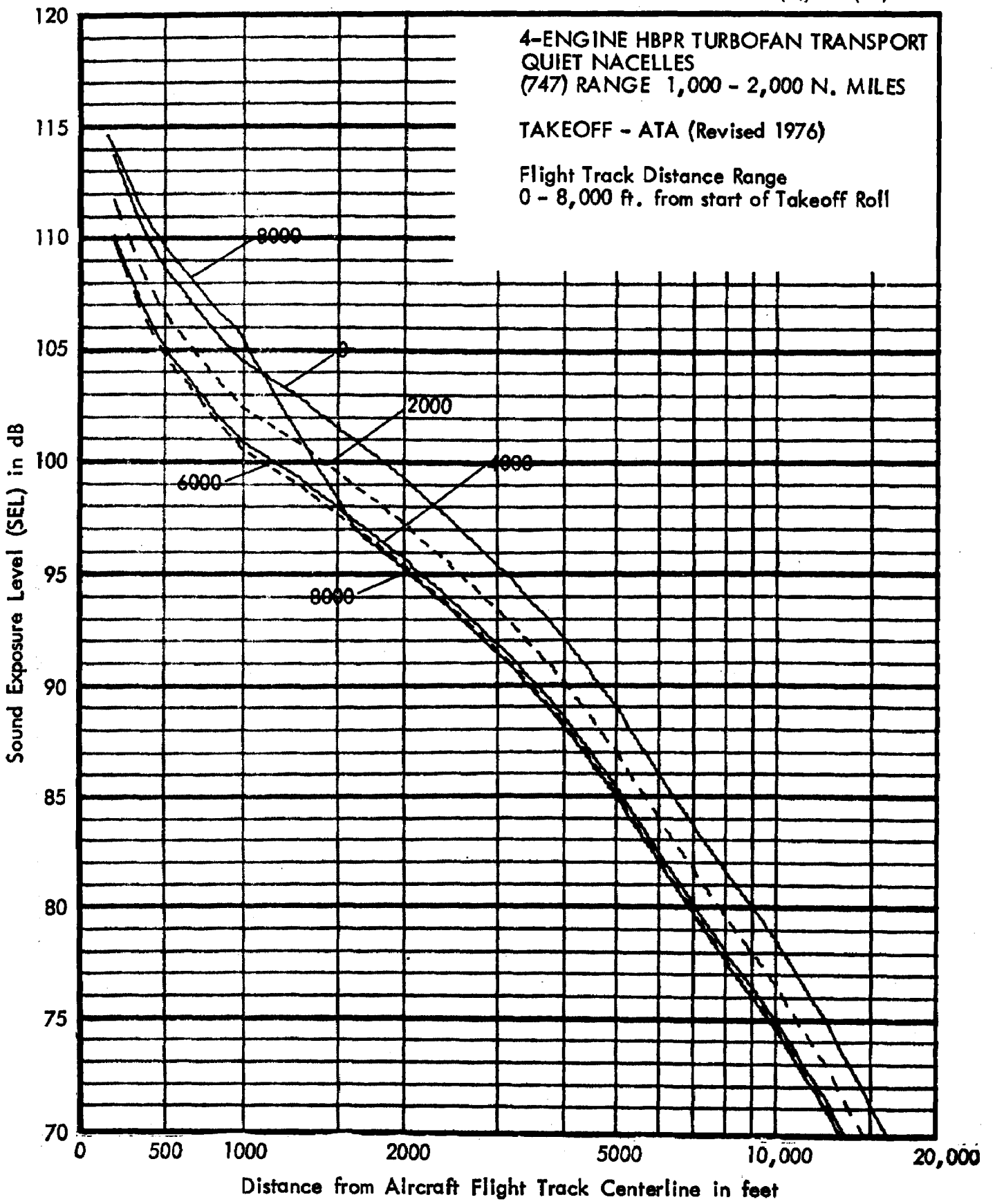

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 35,000 ft.
Flight Track Distance Range
10,000 - 40,000 ft. from start of Takeoff Roll
10,000
2,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
40,000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

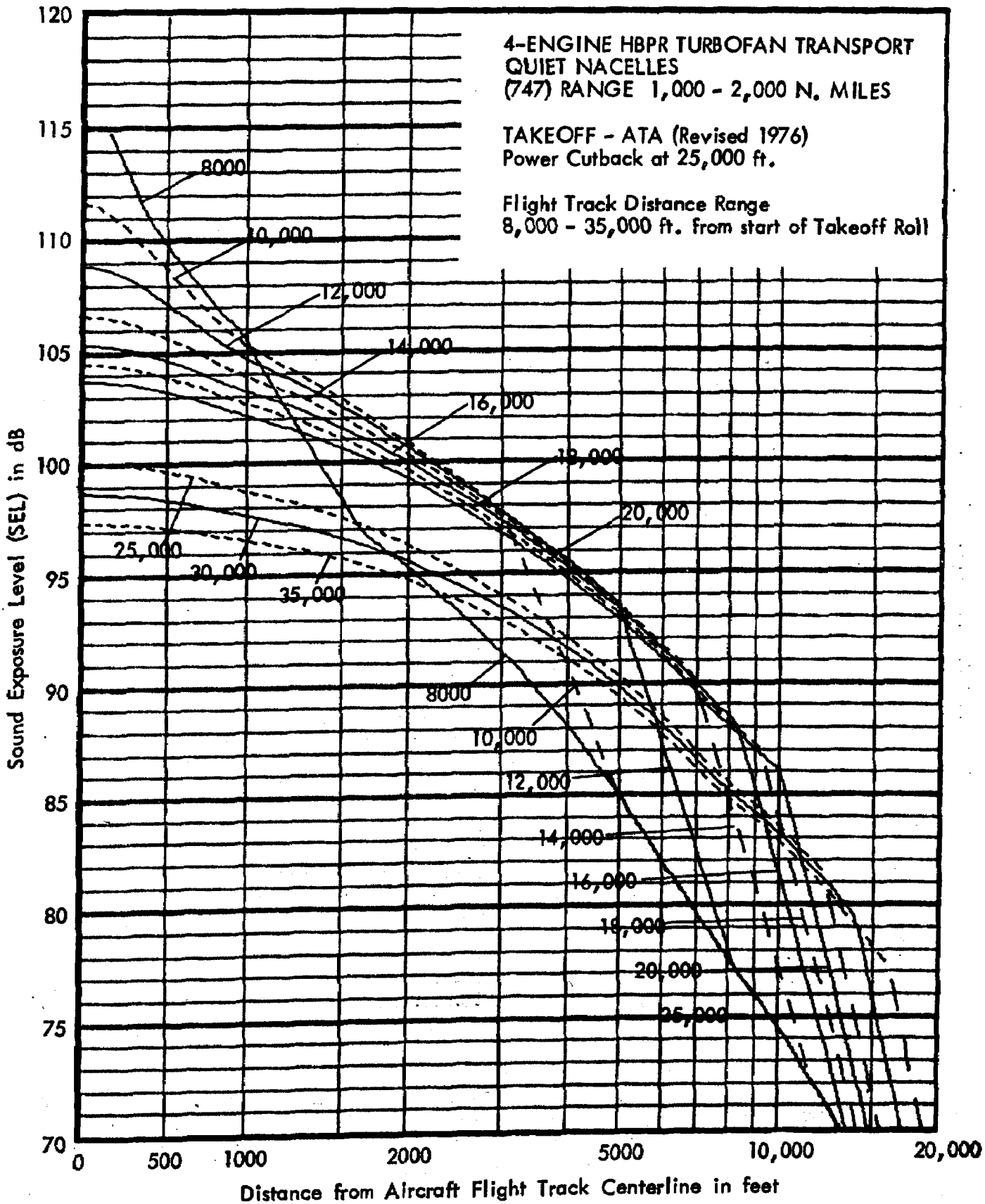

4-ENGINE HBPR TURBOFAN TRANSPORT
(747) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
40,000 - 140,000 ft. from start of Takeoff Roll
40,000
45,000
50,000
55,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
130,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

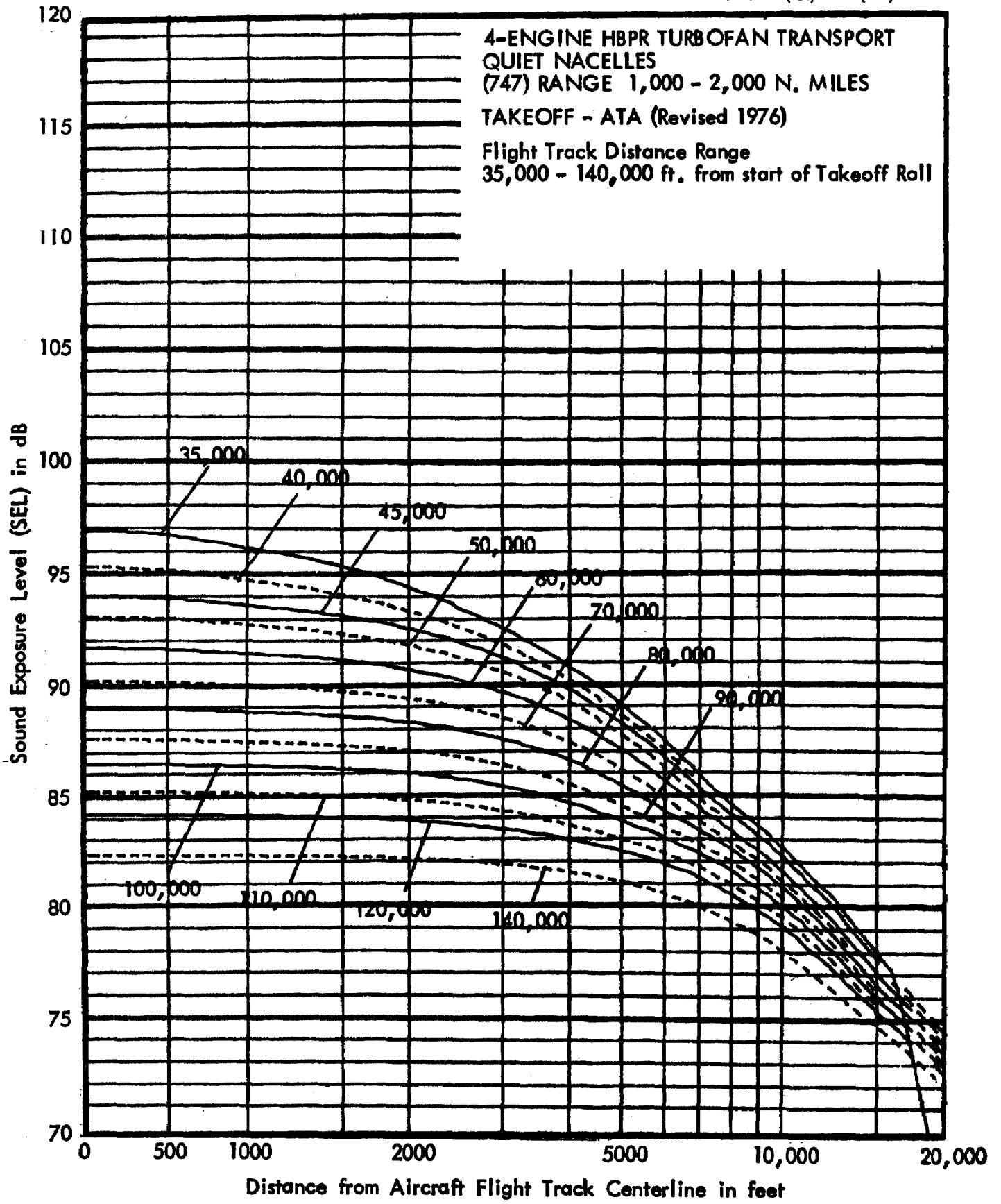

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE 0 - 1000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
0
2000
4000
6000
8000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

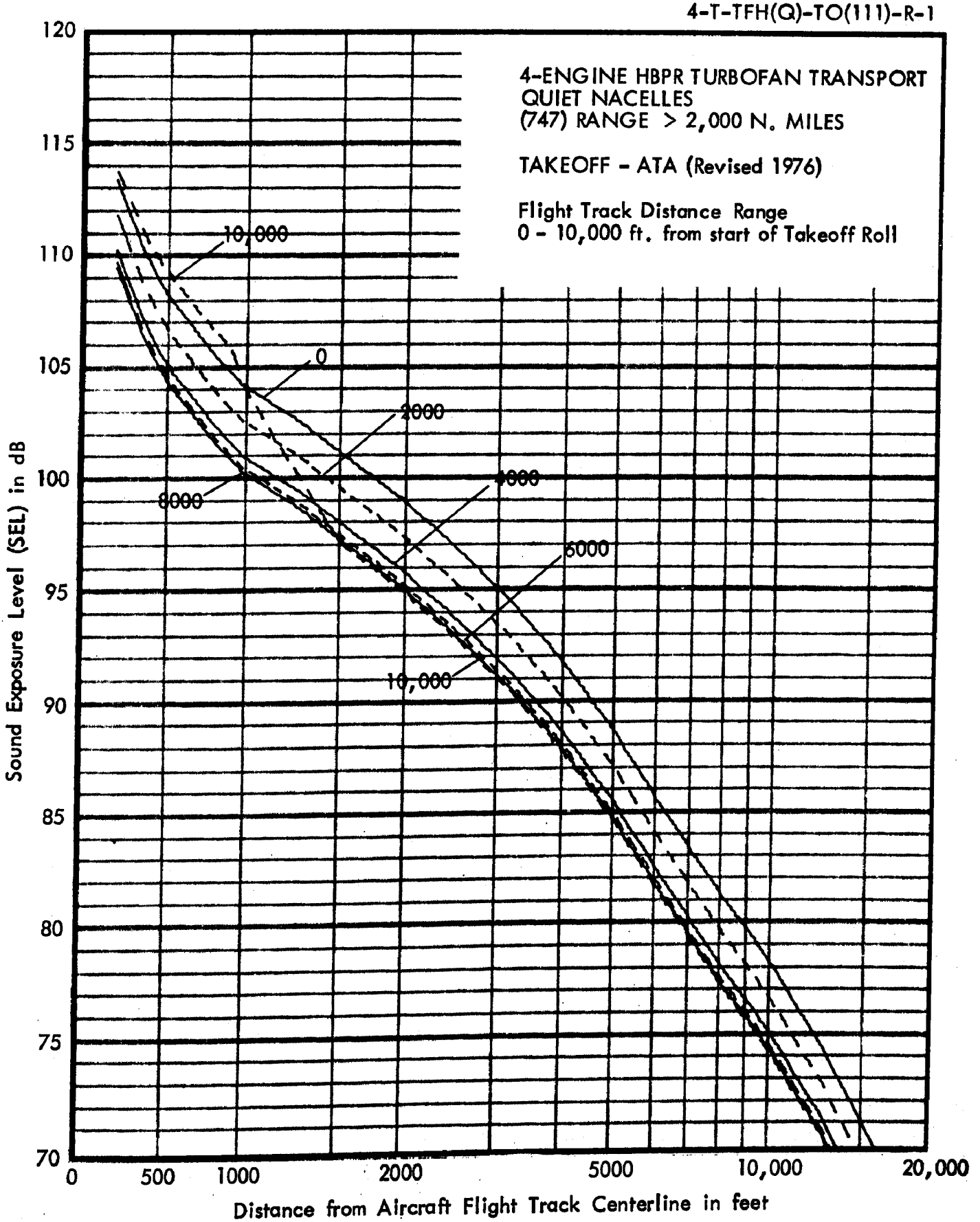

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 20,000 ft.
Flight Track Distance Range
8,000 - 30,000 ft. From Start of Takeoff Roll
8000
10,000
15,000
20,000
25,000
30,000
8000
10,000
15,000
20,000
25,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

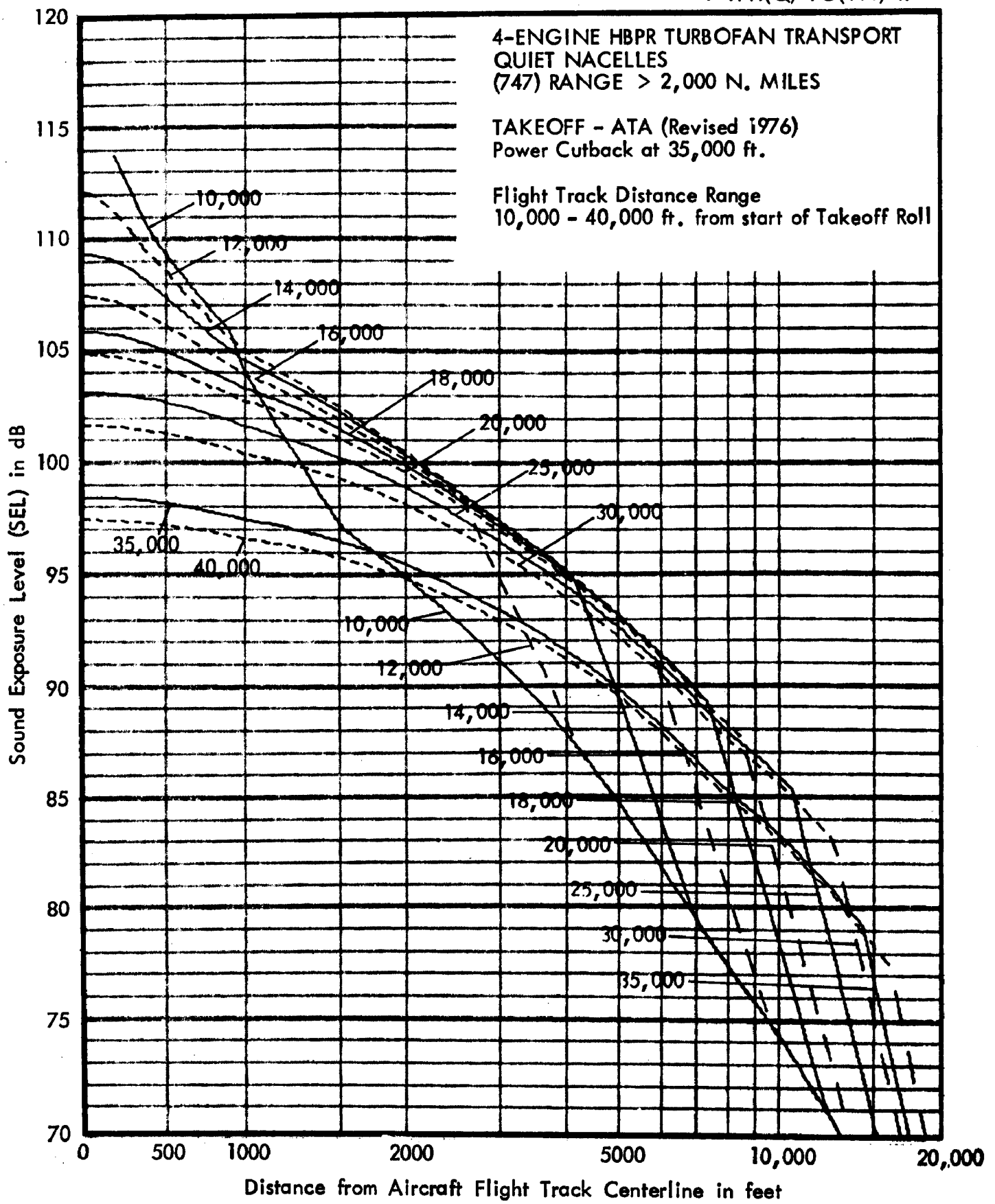

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
30,000 - 140,000 ft. from start of Takeoff Roll
30,000
35,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

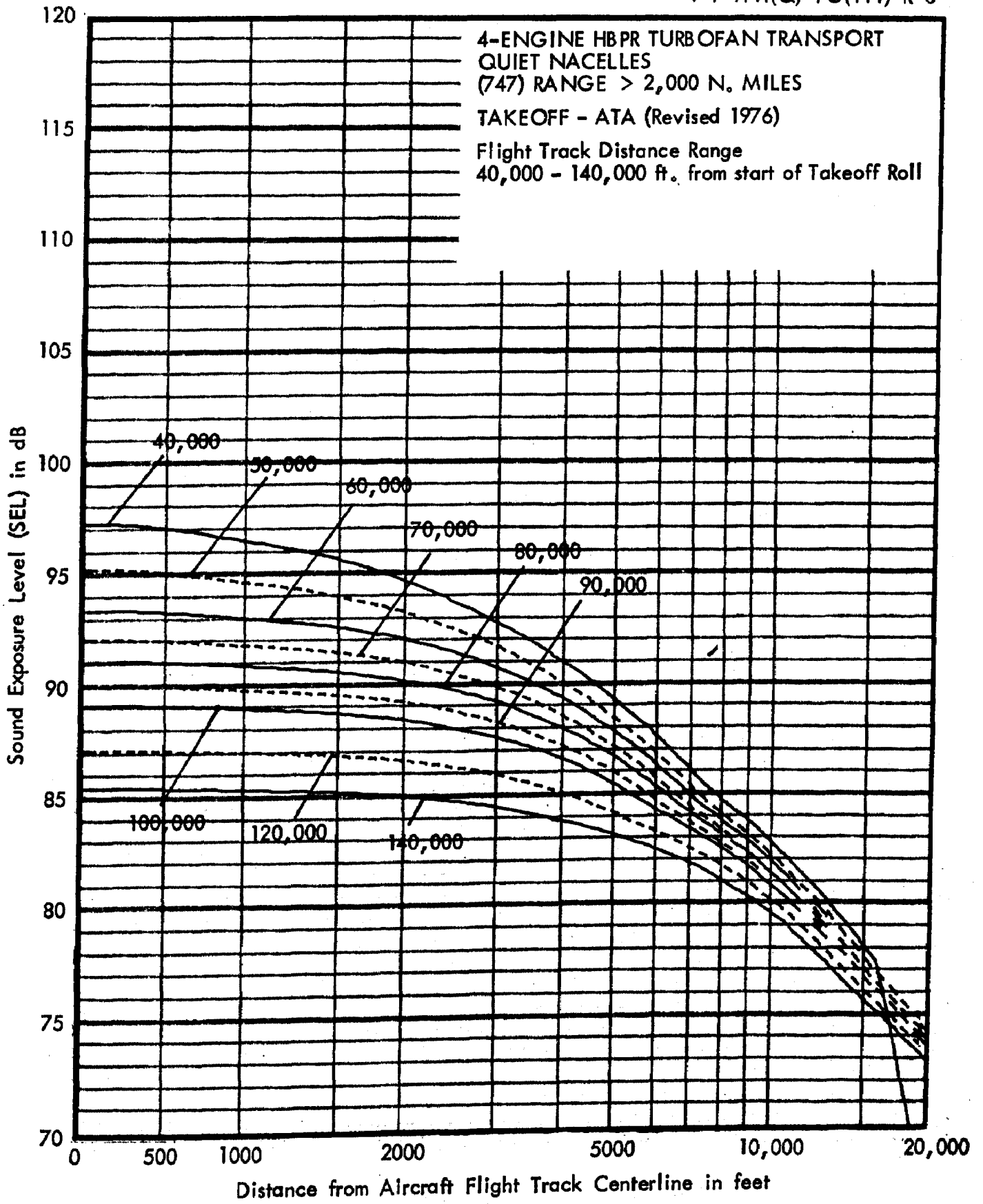

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
0
2000
4000
6000
8000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

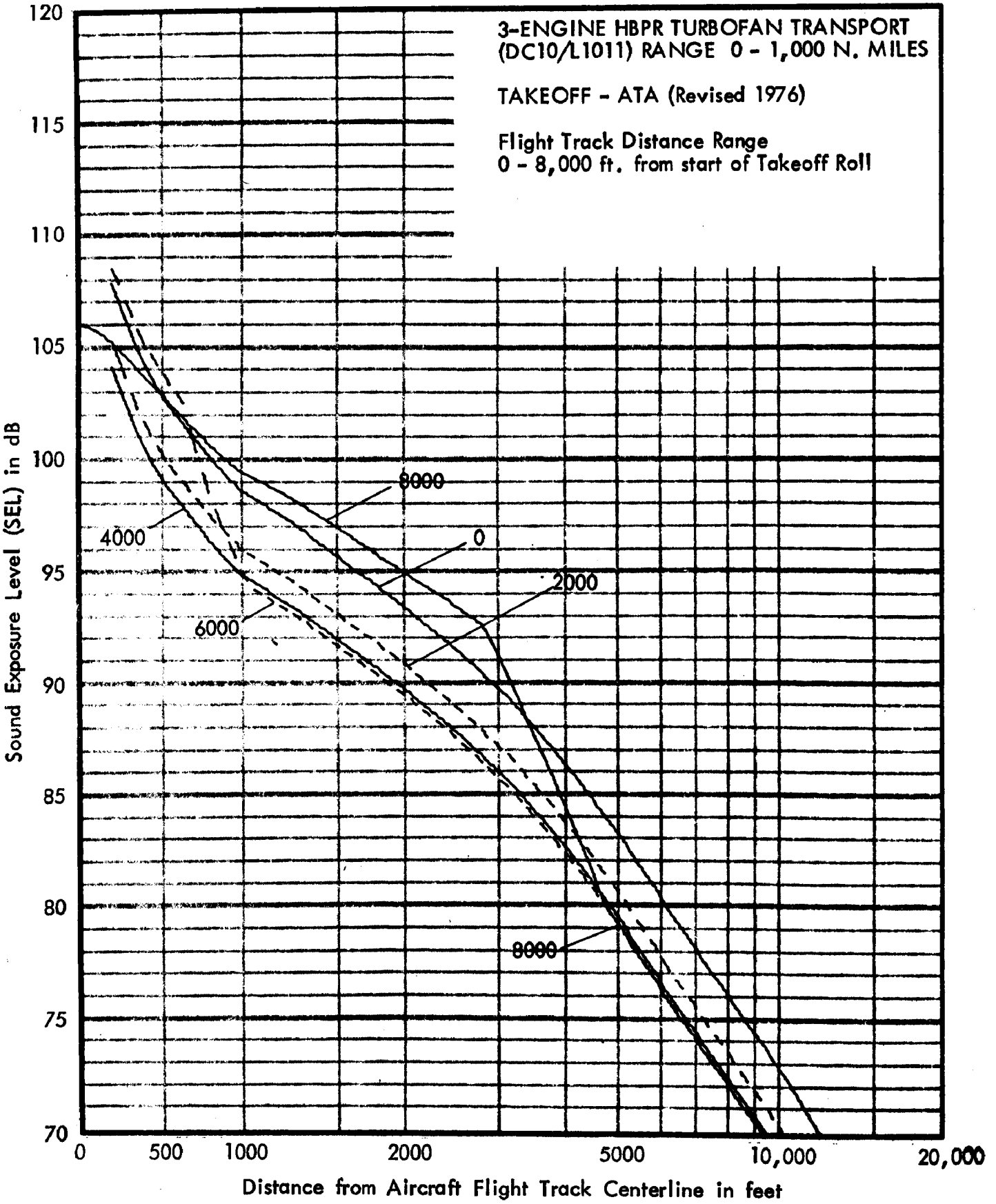

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 25,000 ft.
Flight Track Distance Range
8,000 - 35,000 ft. from start of Takeoff Roll
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

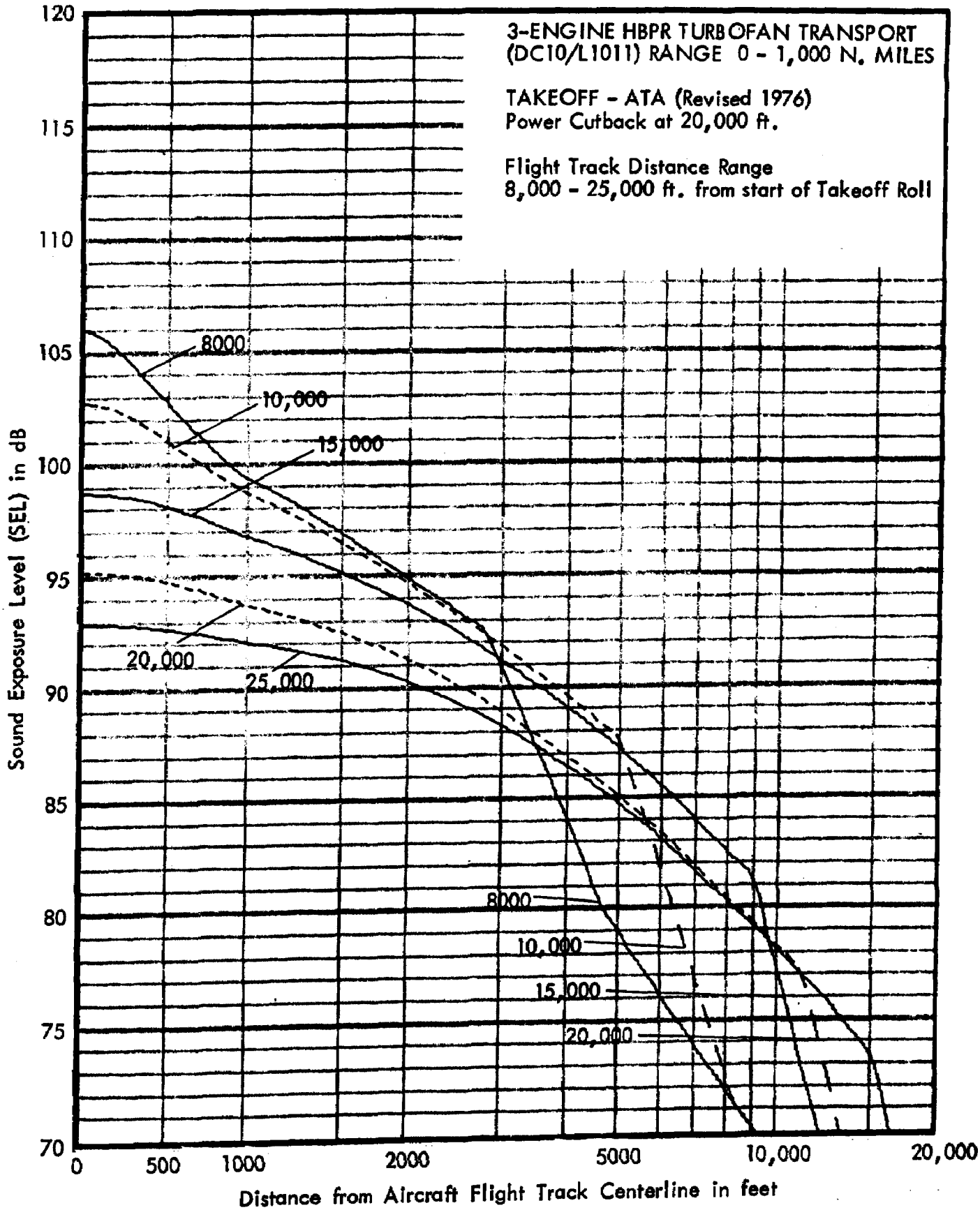

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
35,000 - 140,000 ft. from start of Takeoff Roll
35,000
40,000
45,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

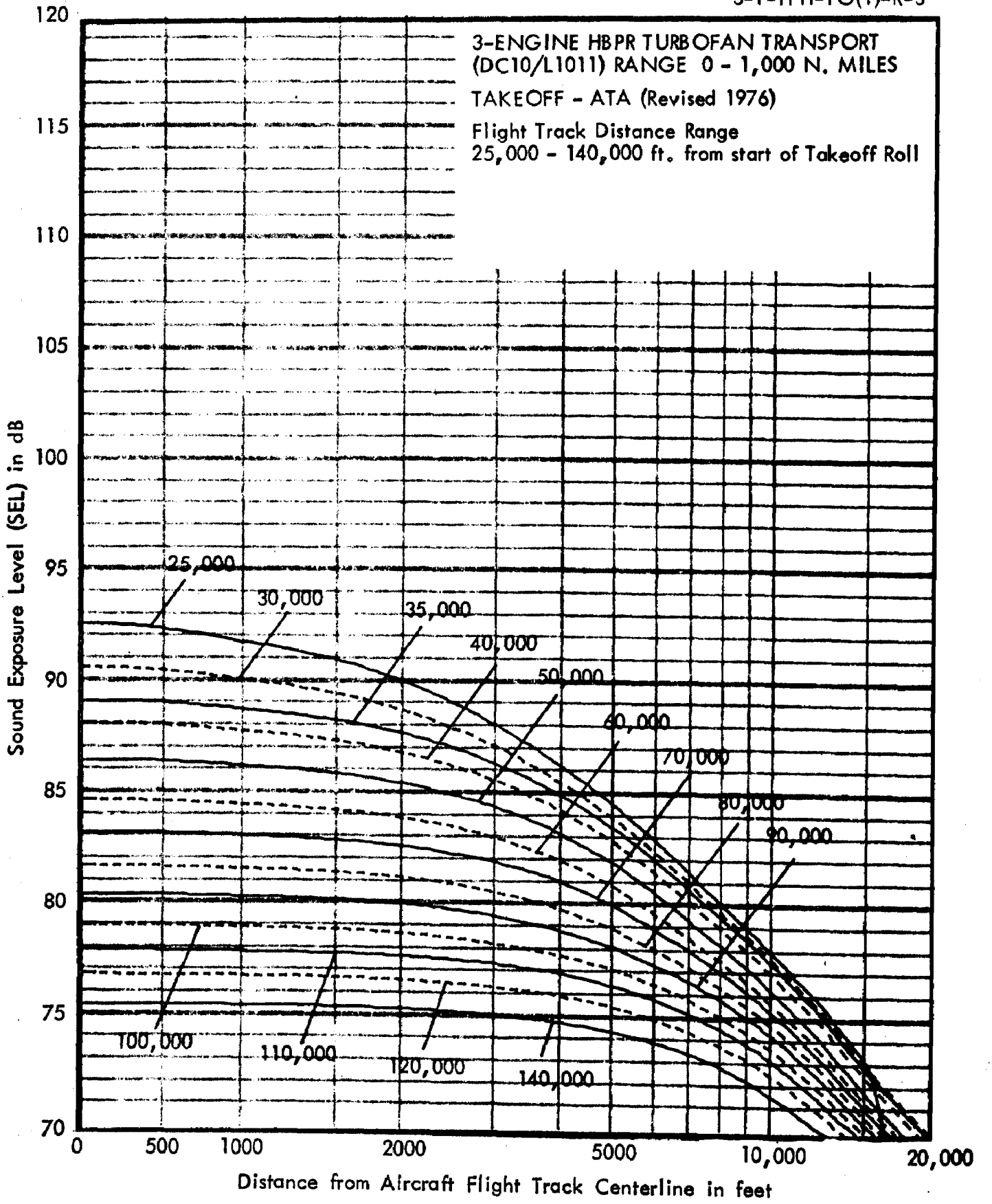

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 10,000 ft. from start of Takeoff Roll
10,000
0
2000
4000
6000
8000
10,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

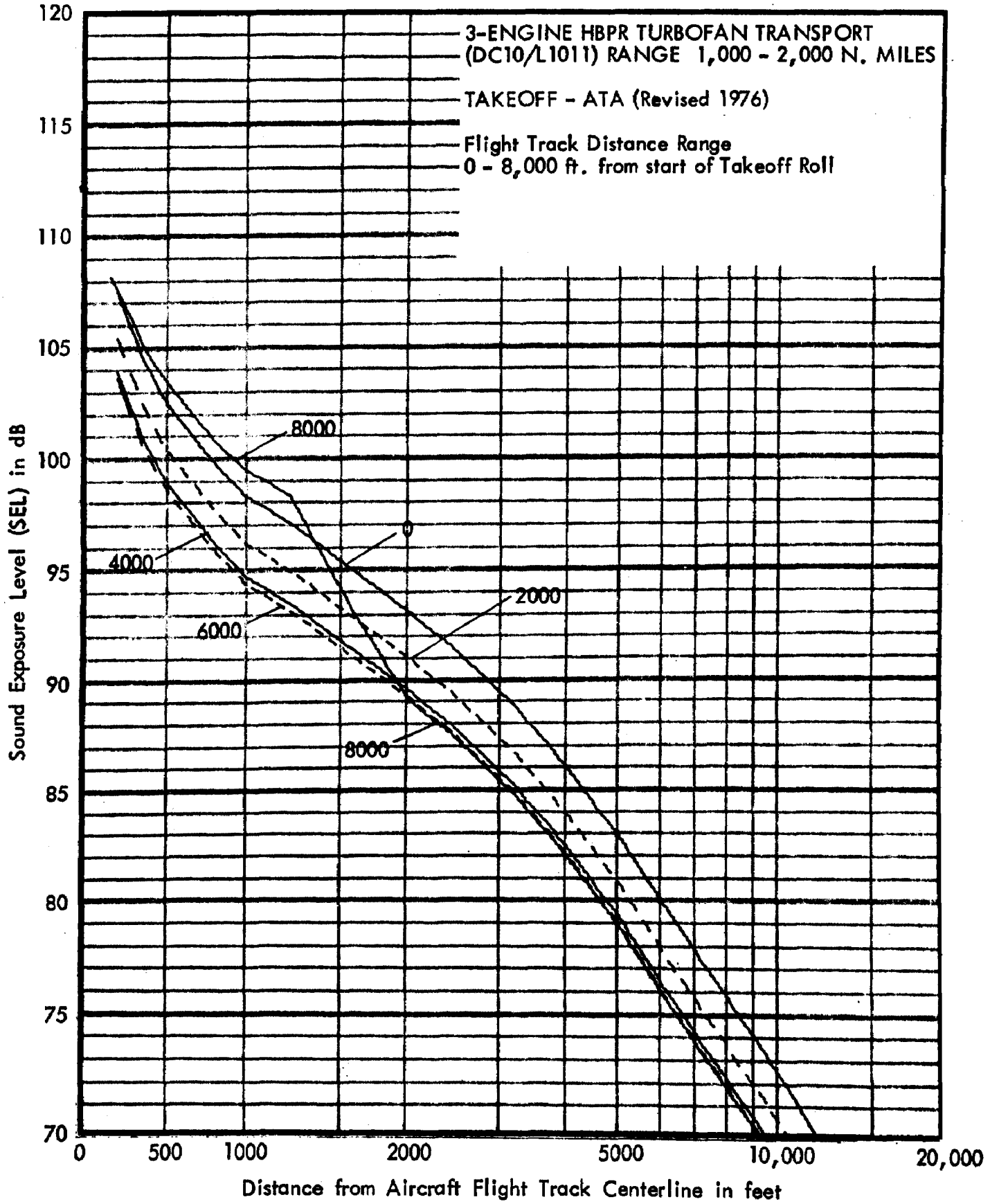

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 35,000 ft.
Flight Track Distance Range
10,000 - 40,000 ft. from start of Takeoff Roll
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
40,000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

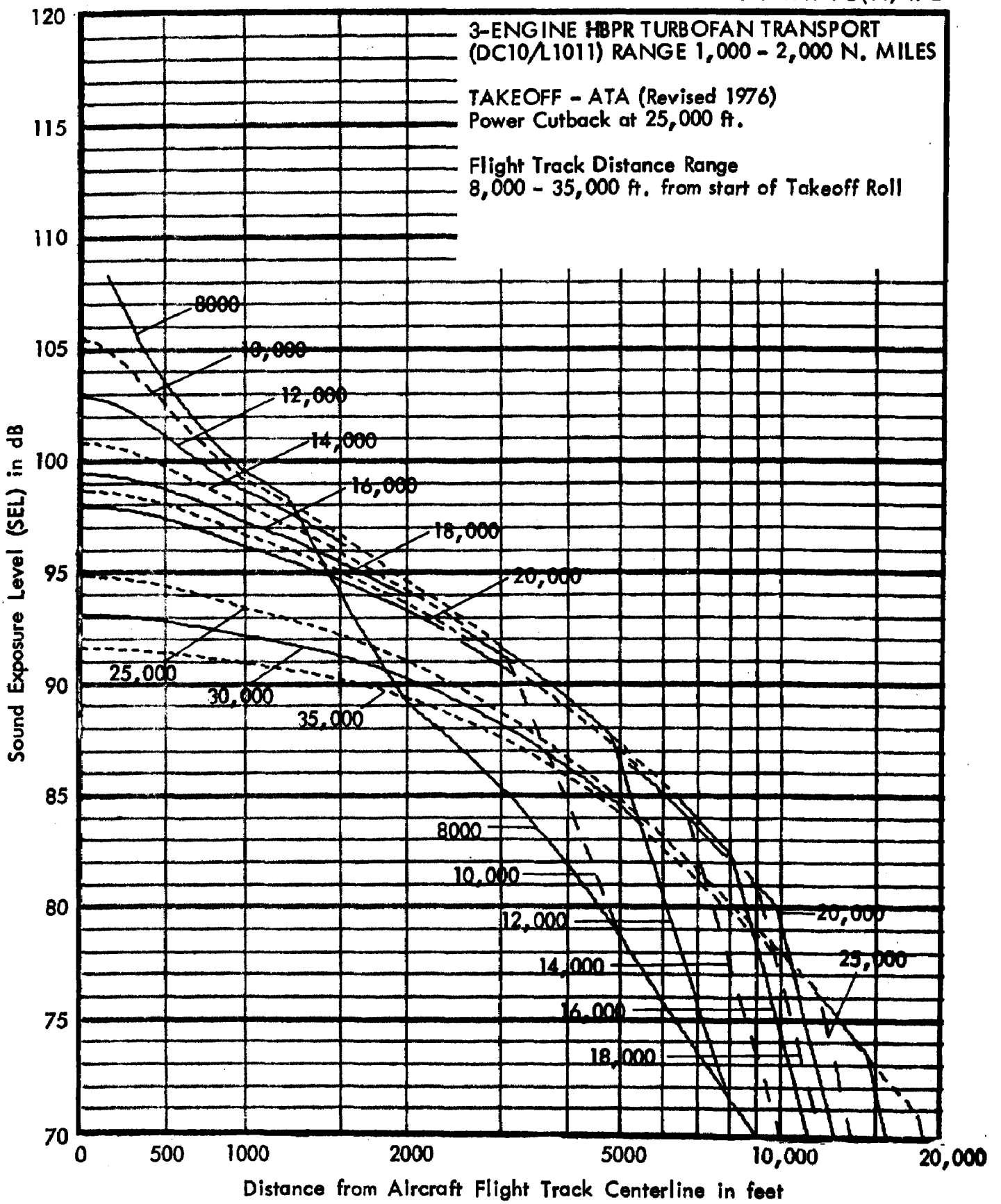

4-ENGINE HBPR TURBOFAN TRANSPORT
QUIET NACELLES
(747) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
40,000 - 140,000 ft. from start of Takeoff Roll
40,000
50,000
60,000
70,000
80,000
90,000
100,000
120,000
140,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

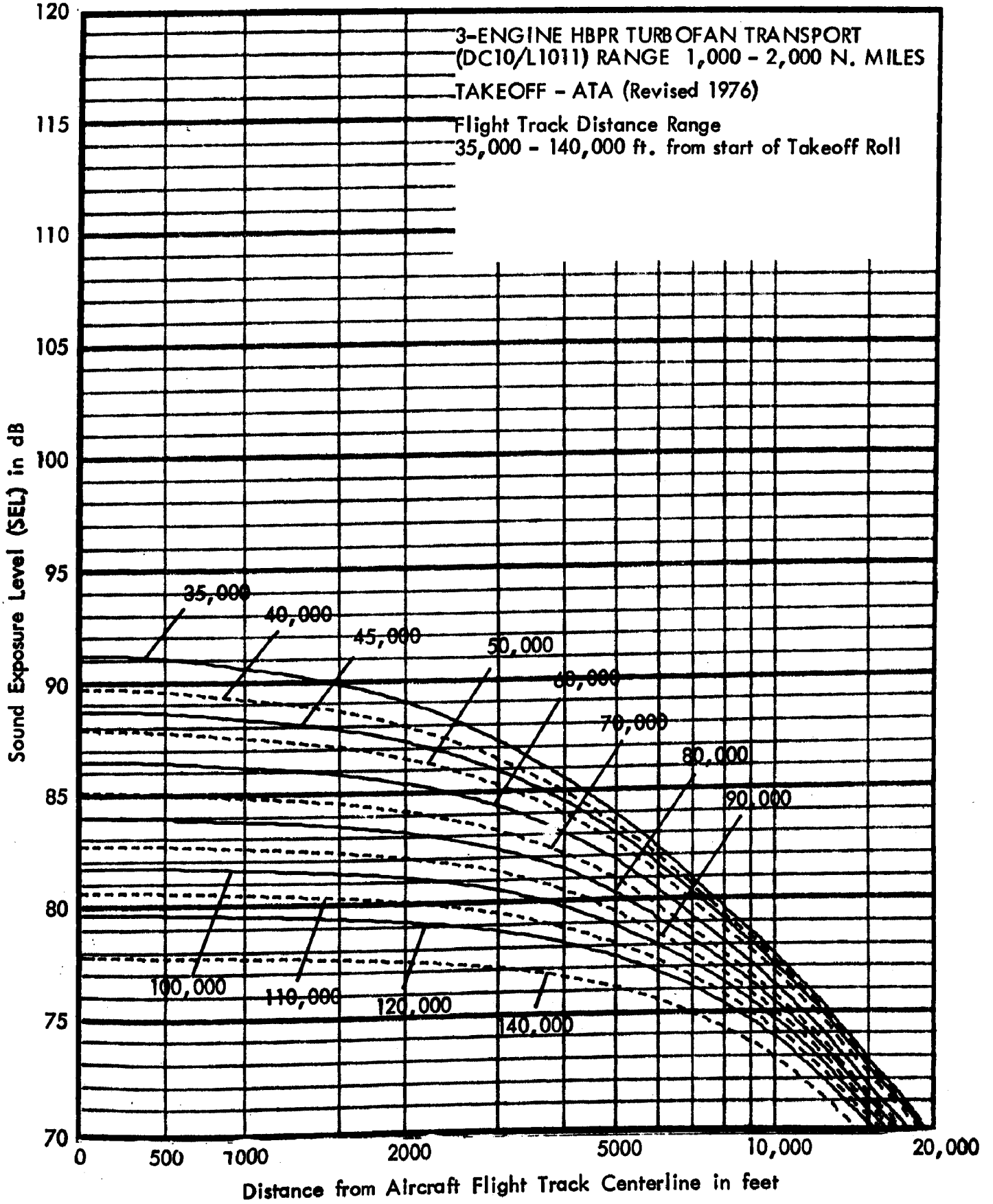

3-ENGINE HBPR TURBOFAN TRANSPORT
(DC10/L1011) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
8000
4000
0
2000
6000
8000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

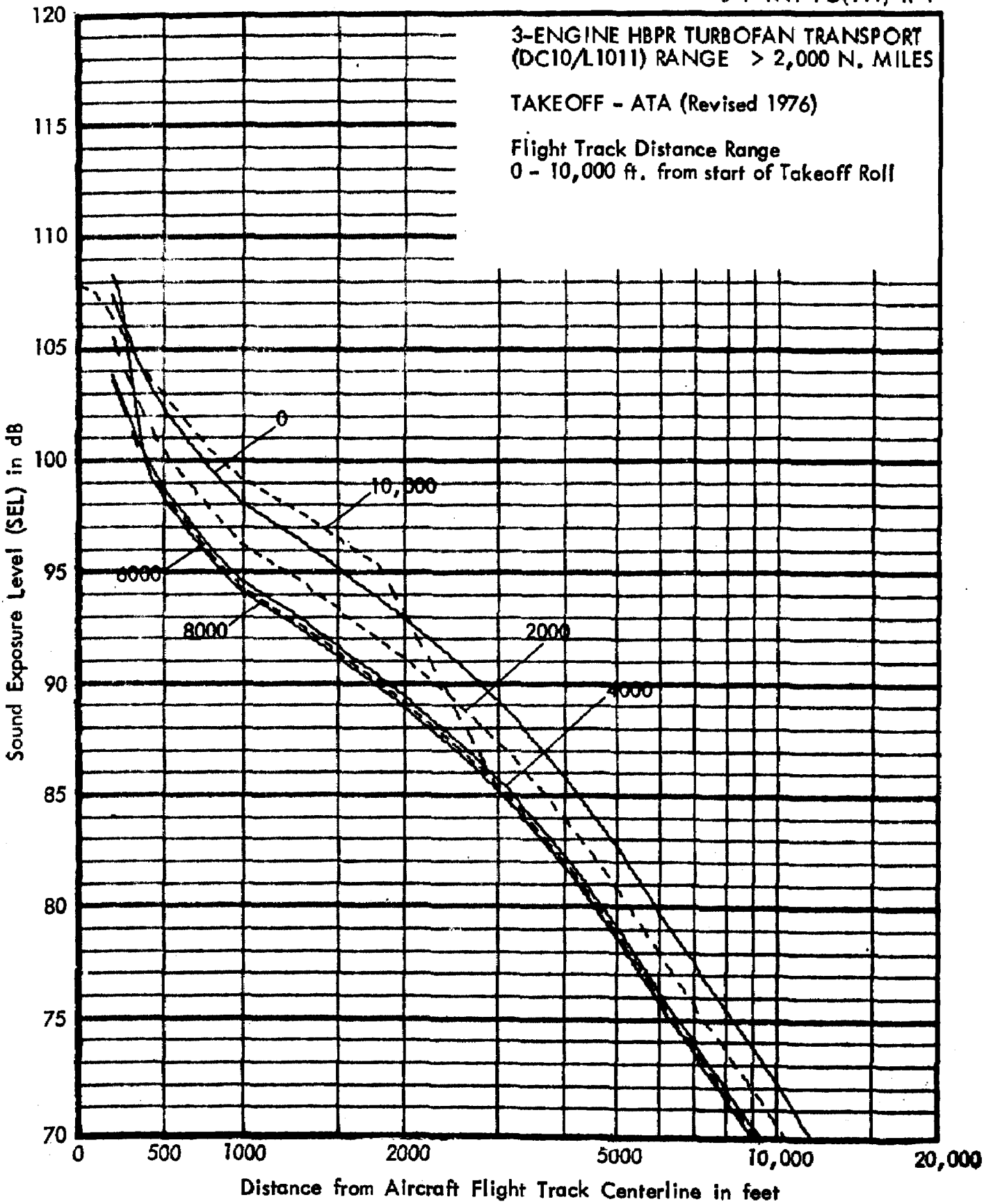

3-ENGINE HBPR TURBOFAN TRANSPORT
(DC10/L1011) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 20,000 ft.
Flight Track Distance Range
8,000 - 25,000 ft. from start of Takeoff Roll
8000
10,000
15,000
20,000
25,000
8000
10,000
15,000
20,000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

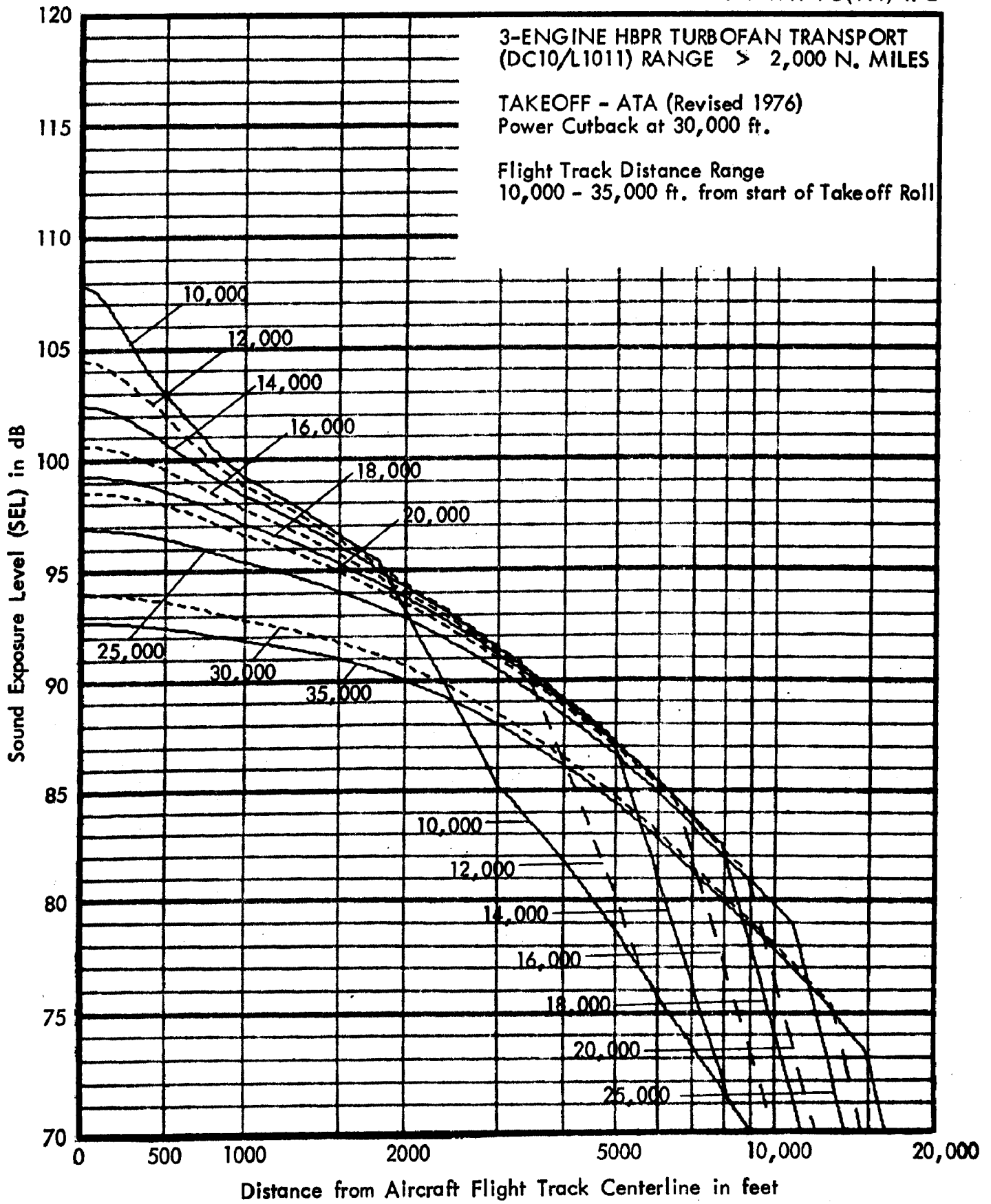

3-ENGINE HBPR TURBOFAN TRANSPORT
(DC10/L1011) RANGE 0 - 1,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
25,000 - 140,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
25,000
30,000
35,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
140,000
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet

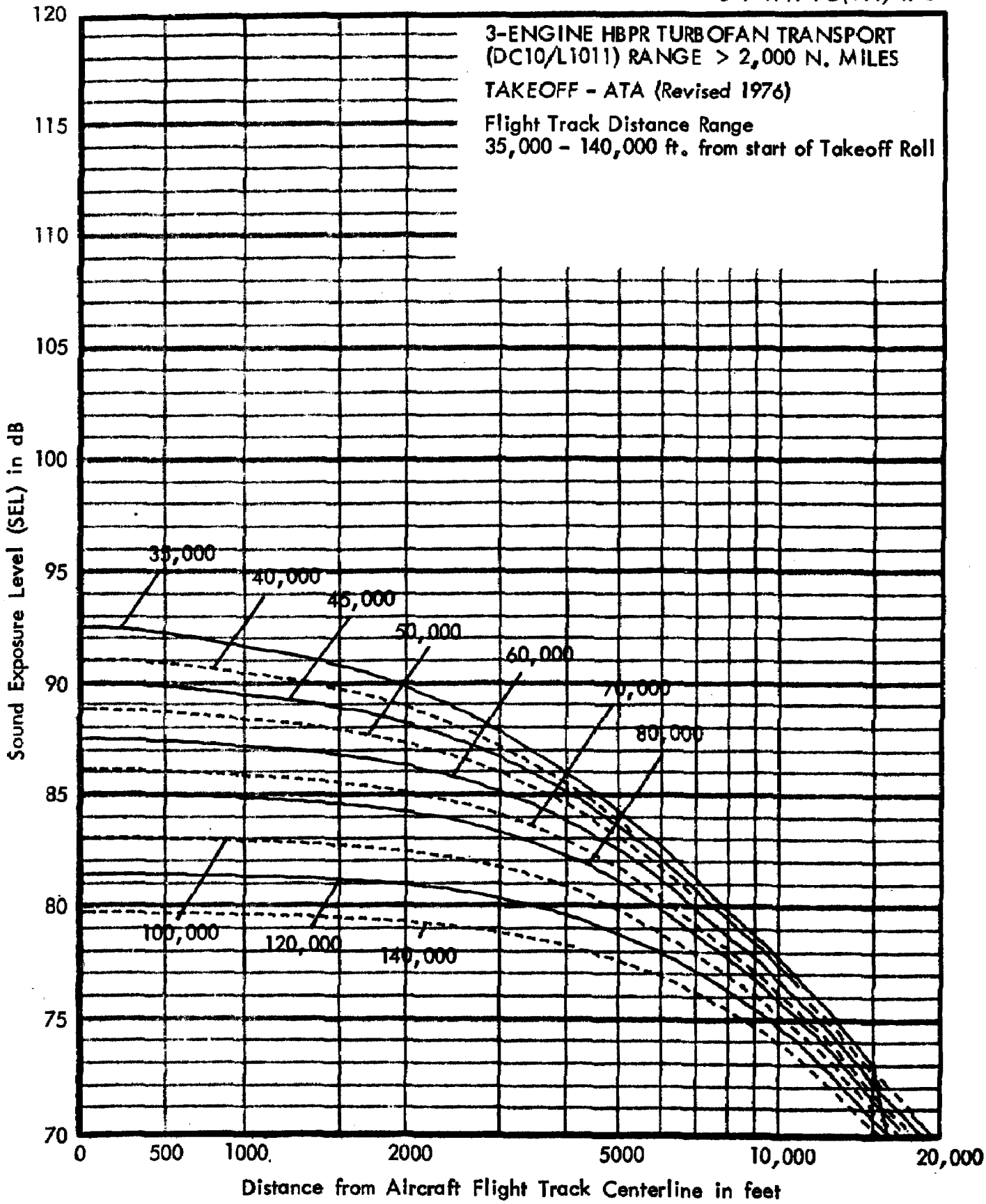

3-ENGINE HBPR TURBOFAN TRANSPORT
(DC10/L1011) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 8,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet
8000
0
4000
2000
6000
8000


3-ENGINE HBPR TURBOFAN TRANSPORT
(DC10/L1011) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 25,000 ft.
Flight Track Distance Range
8,000 - 35,000 ft. from start of Takeoff Roll
Sound Exposure Level (SEL) in dB
Distance from Aircraft Flight Track Centerline in feet
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
8000
10,000
12,000
14,000
16,000
18,000
20,000
25,000


3-ENGINE HBPR TURBOFAN TRANSPORT
(DC10/L1011) RANGE 1,000 - 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
35,000 - 140,000 ft. from start of Takeoff Roll
35,000
40,000
45,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
140,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet


3-ENGINE HBPR TURBOFAN TRANSPORT
(DC10/L1011) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Flight Track Distance Range
0 - 10,000 ft. from start of Takeoff Roll
0
10,000
6000
8000
2000
4000
Sound Exposure Level (SEL) in dB
120
115
110
105
100
95
90
85
80
75
70
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet


3-ENGINE HBPR TURBOFAN TRANSPORT
(DC10/L1011) RANGE > 2,000 N. MILES
TAKEOFF - ATA (Revised 1976)
Power Cutback at 30,000 ft.
Flight Track Distance Range
10,000 - 35,000 ft. from start of Takeoff Roll
10,000
12,000
14,000
16,000
18,000
20,000
25,000
30,000
35,000
10,000
12,000
14,000
16,000
18,000
20,000
25,000
120
115
110
105
100
95
90
85
80
75
70
Sound Exposure Level (SEL) in dB
0
500
1000
2000
5000
10,000
20,000
Distance from Aircraft Flight Track Centerline in feet



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