CAGE Code 81205

787 Airplane Characteristics for Airport Planning

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Revision Date	**February 2008**
Changes in This Revision	All
Revision Letter	**NEW**
Revision Date	**April 2006**
Changes in This Revision	All

Table of Contents

1.0 SCOPE AND INTRODUCTION

1.1 SCOPE

This document provides, in a standardized format, airplane characteristics data for general airport planning. Since operational practices vary among airlines, specific data should be coordinated with the using airlines prior to facility design. Boeing Commercial Airplanes should be contacted for any additional information required.

Content of the document reflects the results of a coordinated effort by representatives from the following organizations:

- Aerospace Industries Association
- Airports Council International - North America
- Air Transport Association of America
- International Air Transport Association

The airport planner may also want to consider the information presented in the "Commercial Aircraft Design Characteristics - Trends and Growth Projections," for long range planning needs and can be accessed via the following website:

http://www.boeing.com/airports

The document is updated periodically and represents the coordinated efforts of the following organizations regarding future aircraft growth trends.

- International Coordinating Council of Aerospace Industries Associations
- Airports Council International - North American and World Organizations
- Air Transport Association of America
- International Air Transport Association

1.2 INTRODUCTION

This document conforms to NAS 3601. It provides characteristics of the Boeing 787 Dreamliner family of airplanes for airport planners and operators, airlines, architectural and engineering consultant organizations, and other interested industry agencies. Airplane changes and available options may alter model characteristics. The data presented herein reflects the 787 family. Data used is generic in scope and not customer-specific.

For additional information contact:

Boeing Commercial Airplanes
2201 Seal Beach Blvd. M/C: 110-SB02
Seal Beach, CA 90740-1515
U.S.A.

Attention: Manager, Airport Compatibility Engineering

Phone: 562-797-1172

Email: AirportCompatibility@boeing.com

1.3 A BRIEF DESCRIPTION OF THE 787 FAMILY OF AIRPLANES

The 787 Dreamliner is an efficient family of twin-engine airplanes with exceptional environmental performance and new passenger-pleasing features. An international team of aerospace companies builds the 787, led by Boeing at its Everett facility near Seattle, WA and in North Charleston, SC.

787 Family

The 787 family is designed for medium- to long-range flights. In a typical dual-class configuration, the 787-8 can carry 242 passengers, the 787-9 can carry 290 passengers, and the 787-10 will carry 330 passengers.

787 Engines

The 787 features new engines from General Electric and Rolls-Royce that represent nearly a two-generation jump in technology.

Cargo Handling

The lower lobe cargo compartments can accommodate a variety of containers and pallets now in use.

Ground Servicing

The 787 features a more-electric design and does not have a traditional pneumatic system. The traditional pneumatic starters on the engines are replaced with a pair of gearbox-mounted main-engine starter/generators. Cabin air conditioning and wing anti-ice systems are also electrically powered. The remaining pneumatic system is for engine nacelle anti-ice. The airplane has ground service connections compatible with existing ground service equipment, and no special equipment is necessary. In case of an inoperable APU, engine starts may be accomplished via the airplane's external ground electrical connections.

1.4 CONVERSION FACTORS

The data in this manual is provided in both English and Metric units. Unless otherwise stated, the conversions listed below are used throughout this manual.

MULTIPLY	BY	TO OBTAIN
Pounds	0.45359237	Kilograms
U.S. Gallons	3.78541180	Liters
Inches	2.54000000	Centimeters
Feet	0.30480000	Meters

When totals or summations are required the English values are summed separately from the Metric values. Differences may occur when comparing the English total with metric totals due to rounding.

All metric values are converted from English values. When using the conversion factors in this manual, all resultants will be rounded except when the value is a weight limitation. For minimum or maximum weight limitations the resultant metric values will be rounded up or truncated, whichever is more conservative.

2.0 AIRPLANE DESCRIPTION

2.1 GENERAL CHARACTERISTICS

Maximum Design Taxi Weight (MTW). Maximum weight for ground maneuver as limited by aircraft strength and airworthiness requirements. (It includes weight of taxi and run-up fuel.)

Maximum Design Takeoff Weight (MTOW). Maximum weight for takeoff as limited by aircraft strength and airworthiness requirements. (This is the maximum weight at start of the takeoff run.)

Maximum Design Landing Weight (MLW). Maximum weight for landing as limited by aircraft strength and airworthiness requirements.

Maximum Design Zero Fuel Weight (MZFW). Maximum weight allowed before usable fuel and other specified usable agents must be loaded in defined sections of the aircraft as limited by strength and airworthiness requirements.

Operating Empty Weight (OEW). Weight of structure, powerplant, furnishing systems, unusable fuel and other unusable propulsion agents, and other items of equipment that are considered an integral part of a particular airplane configuration. Also included are certain standard items, personnel, equipment, and supplies necessary for full operations, excluding usable fuel and payload.

Maximum Structural Payload. Maximum design zero fuel weight minus operation empty weight.

Maximum Seating Capacity. The maximum number of passengers specifically certificated or anticipated for certification.

Maximum Cargo Volume. The maximum space available for cargo.

Usable Fuel. Fuel available for aircraft propulsion.

2.1.1 General Characteristics: Model 787-8

CHARACTERISTICS	UNITS	ENGINE MANUFACTURER	
		GENERAL ELECTRIC	ROLLS-ROYCE
MAX DESIGN TAXI WEIGHT	POUNDS	503,500	503,500
	KILOGRAMS	228,383	228,383
MAX DESIGN TAKEOFF WEIGHT	POUNDS	502,500	502,500
	KILOGRAMS	227,930	227,930
MAX DESIGN LANDING WEIGHT	POUNDS	380,000	380,000
	KILOGRAMS	172,365	172,365
MAX DESIGN ZERO FUEL WEIGHT	POUNDS	355,000	355,000
	KILOGRAMS	161,025	161,025
SEATING CAPACITY	ONE CLASS	359 ALL-ECONOMY SEATS; FAA EXIT LIMIT = 381 SEATS	
	MIXED CLASS	242 DUAL-CLASS; 24 BUSINESS CLASS, 218 ECONOMY CLASS (SEE SEC 2.4)	
MAX CARGO - LOWER DECK *[1]	CUBIC FEET	4,826	4,826
	CUBIC METERS	136.7	136.7
USABLE FUEL *[2]	U.S. GALLONS	33,340	33,340
	LITERS	126,206	126,206
	POUNDS	223,378	223,378
	KILOGRAMS	101,343	101,343

NOTES:

*[1] 16 LD-3 CONTAINERS IN FWD COMPARTMENT AT 158 CU FT (4.5 CU M) EACH; 12 LD-3 CONTAINERS IN AFT COMPARTMENT; 402 CU FT (11.4 CU M) IN BULK CARGO COMPARTMENT. SEE SEC 2.6 FOR OTHER LOADING COMBINATIONS.

*[2] FUEL DENSITY = 6.7 LBS/US GAL

2.1.2 General Characteristics: Model 787-9

CHARACTERISTICS	UNITS	ENGINE MANUFACTURER	
		GENERAL ELECTRIC	ROLLS-ROYCE
MAX DESIGN TAXI WEIGHT	POUNDS	561,500	561,500
	KILOGRAMS	254,692	254,692
MAX DESIGN TAKEOFF WEIGHT	POUNDS	560,000	560,000
	KILOGRAMS	254,011	254,011
MAX DESIGN LANDING WEIGHT	POUNDS	425,000	425,000
	KILOGRAMS	192,776	192,776
MAX DESIGN ZERO FUEL WEIGHT	POUNDS	400,000	400,000
	KILOGRAMS	181,436	181,436
SEATING CAPACITY	ONE CLASS	406 ALL-ECONOMY SEATS; FAA EXIT LIMIT = 420 SEATS	
	MIXED CLASS	290 DUAL-CLASS; 28 BUSINESS CLASS, 262 ECONOMY CLASS (SEE SEC 2.4)	
MAX CARGO - LOWER DECK *[1]	CUBIC FEET	6,090	6,090
	CUBIC METERS	172.4	172.4
USABLE FUEL *[2]	U.S. GALLONS	33,399	33,399
	LITERS	126,429	126,429
	POUNDS	223,773	223,773
	KILOGRAMS	101,522	101,522

NOTES:

*[1] 20 LD-3 CONTAINERS IN FWD COMPARTMENT AT 158 CU FT (4.5 CU M) EACH; 16 LD-3 CONTAINERS IN AFT COMPARTMENT; 402 CU FT (11.4 CU M) IN BULK CARGO COMPARTMENT. SEE SEC 2.6 FOR OTHER LOADING COMBINATIONS.

*[2] FUEL DENSITY = 6.7 LBS/US GAL

2.1.3 General Characteristics: Model 787-10

CHARACTERISTICS	UNITS	ENGINE MANUFACTURER	
		GENERAL ELECTRIC	ROLLS-ROYCE
MAX DESIGN TAXI WEIGHT	POUNDS	561,500	561,500
	KILOGRAMS	254,692	254,692
MAX DESIGN TAKEOFF WEIGHT	POUNDS	560,000	560,000
	KILOGRAMS	254,011	254,011
MAX DESIGN LANDING WEIGHT	POUNDS	445,000	445,000
	KILOGRAMS	201,848	201,848
MAX DESIGN ZERO FUEL WEIGHT	POUNDS	425,000	425,000
	KILOGRAMS	192,776	192,776
SEATING CAPACITY	ONE CLASS	440 ALL-ECONOMY SEATS; FAA EXIT LIMIT = 440 SEATS	
	MIXED CLASS	330 DUAL-CLASS; 32 BUSINESS CLASS, 298 ECONOMY CLASS (SEE SEC 2.4)	
MAX CARGO - LOWER DECK *[1]	CUBIC FEET	6,722	6,722
	CUBIC METERS	190.3	190.3
USABLE FUEL *[2]	U.S. GALLONS	33,399	33,399
	LITERS	126,429	126,429
	POUNDS	223,773	223,773
	KILOGRAMS	101,522	101,522

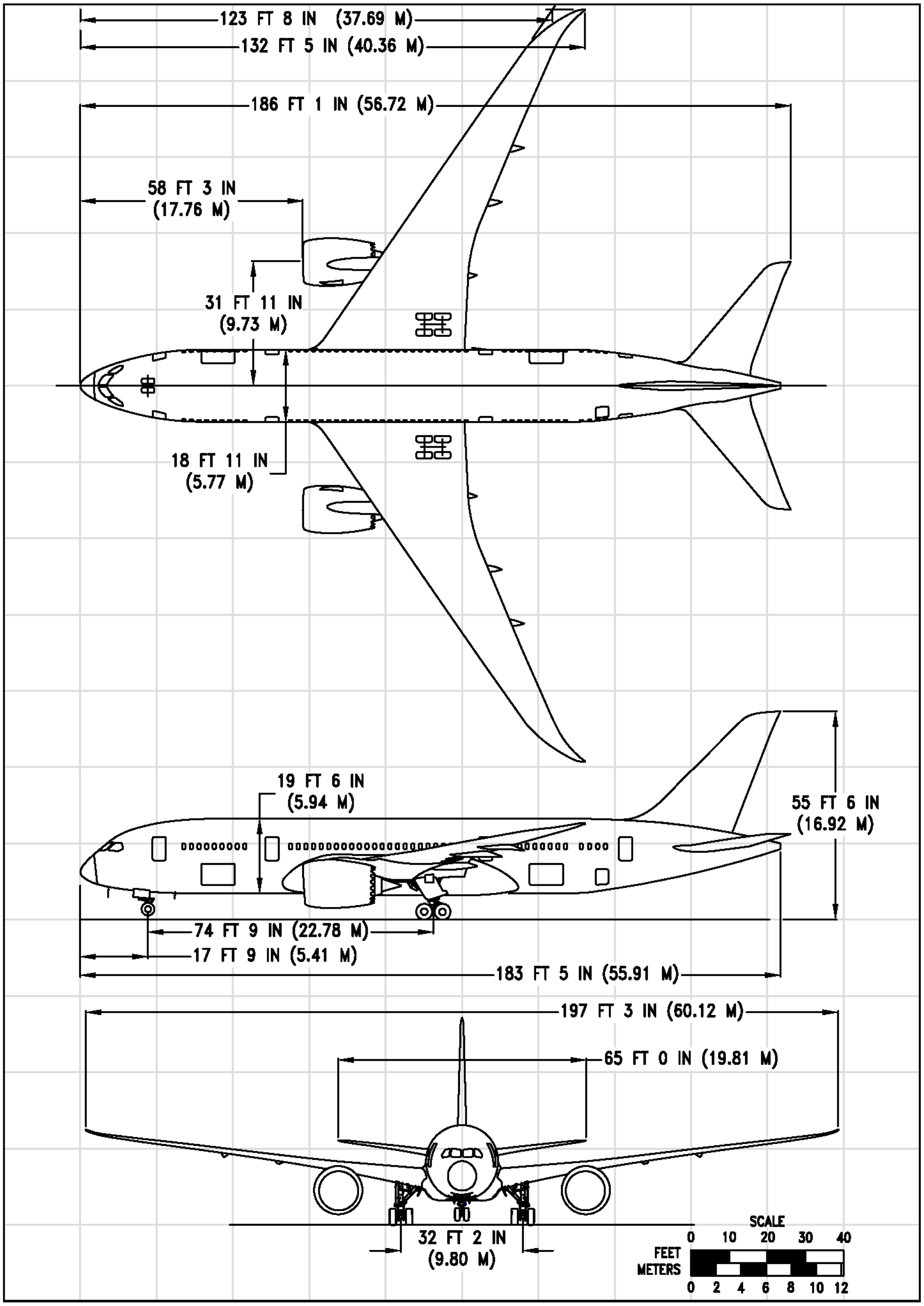
NOTES:

*[1] 22 LD-3 CONTAINERS IN FWD COMPARTMENT AT 158 CU FT (4.5 CU M) EACH; 18 LD-3 CONTAINERS IN AFT COMPARTMENT; 402 CU FT (11.4 CU M) IN BULK CARGO COMPARTMENT. SEE SEC 2.6 FOR OTHER LOADING COMBINATIONS.

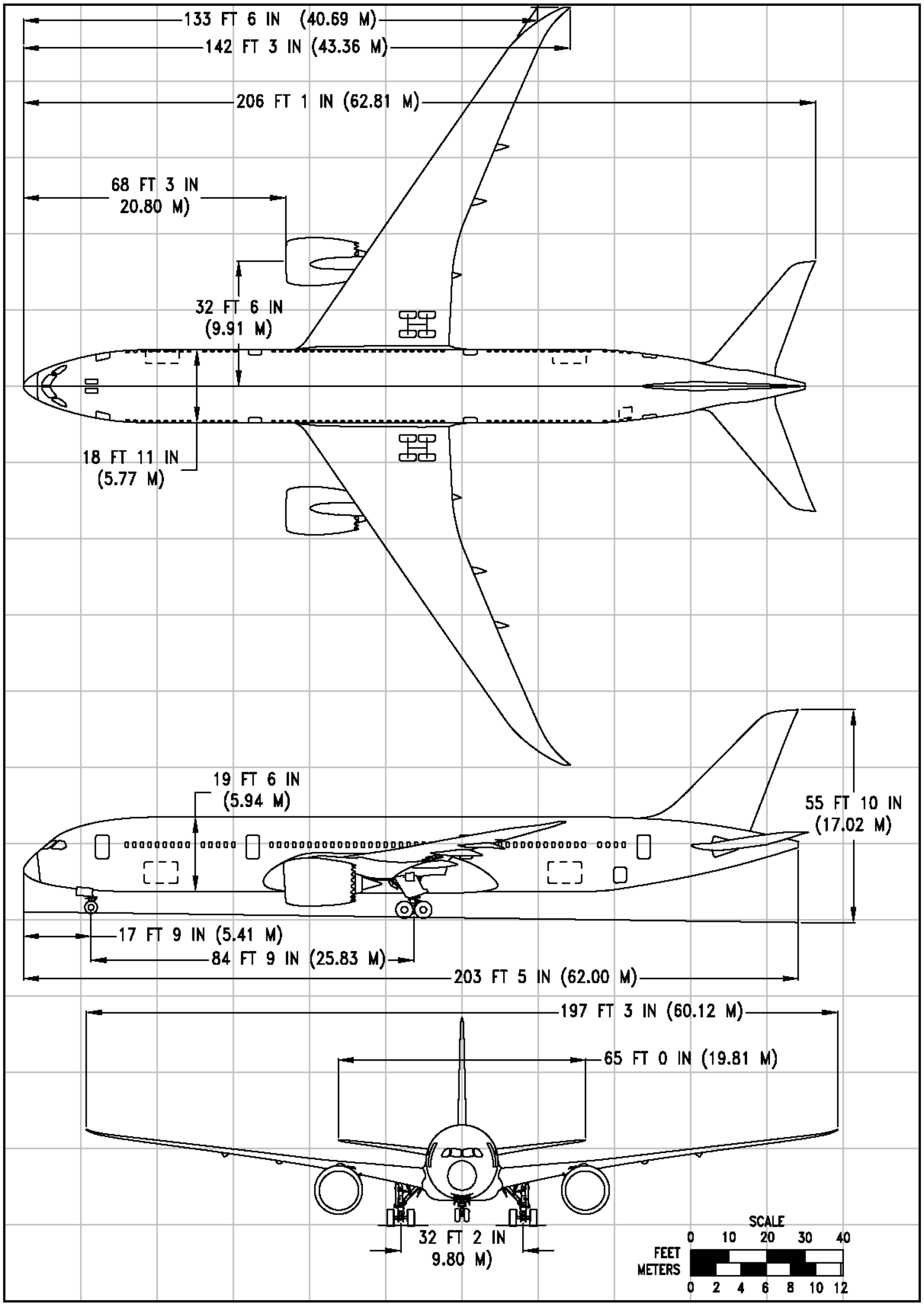
*[2] FUEL DENSITY = 6.7 LBS/US GAL

2.2 GENERAL DIMENSIONS

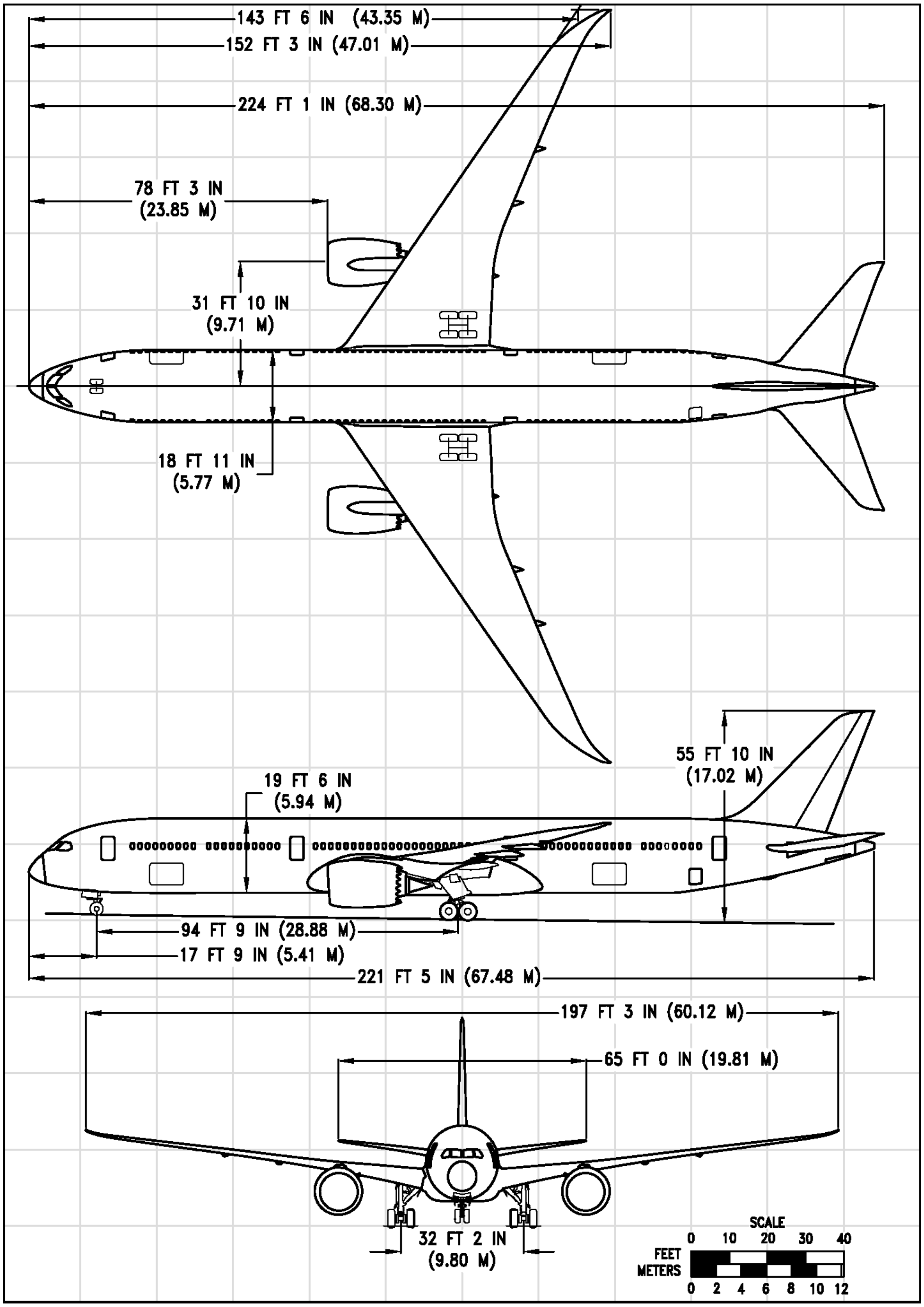
2.2.1 General Dimensions: Model 787-8



2.2.2 General Dimensions: Model 787-9

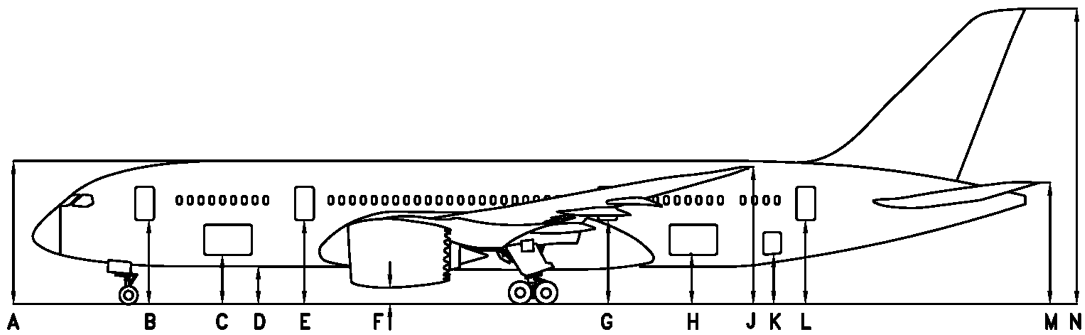


2.2.3 General Dimensions: Model 787-10



2.3 GROUND CLEARANCES

2.3.1 Ground Clearances: Model 787-8

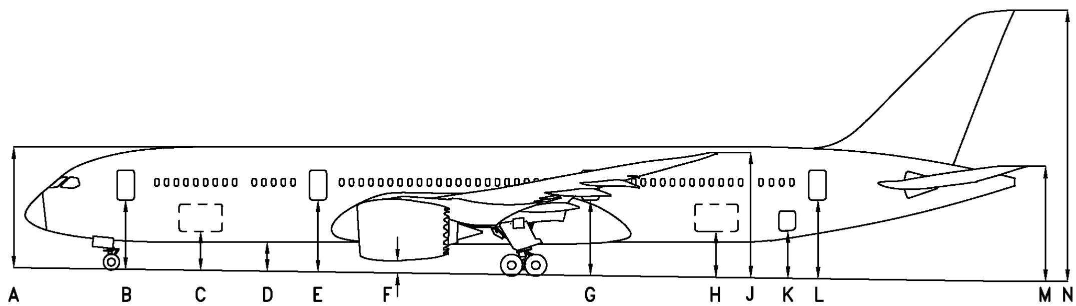


Dimension	MINIMUM		MAXIMUM	
	FT - IN	M	FT - IN	M
A	25 – 2	7.67	26 – 4	8.03
B	13 – 11	4.24	15 – 6	4.72
C	7 – 9	2.36	9 – 0	2.74
D	5 – 6	1.68	6 – 10	2.08
E	14 – 5	4.39	15 – 5	4.70
F (GE ENGINES)	2 – 5	0.74	3 – 6	1.07
F (RR ENGINES)	2 – 4	0.71	3 – 6	1.07
G	15 – 1	4.60	15 – 8	4.78
H	8 – 9	2.67	9 – 6	2.90
J	23 – 10	7.26	25 – 5	7.75
K	8 – 11	2.72	9 – 10	3.00
L	15 – 3	4.65	16 – 2	4.93
M	22 – 3	6.78	23 – 5	7.14
N	54 – 5	16.59	56 – 1	17.09

NOTES:

1. VERTICAL CLEARANCES SHOWN OCCUR DURING MAXIMUM VARIATIONS OF AIRPLANE ATTITUDE. COMBINATIONS OF AIRPLANE LOADING AND UNLOADING ACTIVITIES THAT PRODUCE THE GREATEST POSSIBLE VARIATION IN ATTITUDE WERE USED TO ESTABLISH THE VARIATIONS SHOWN.
2. DURING ROUTINE SERVICING, THE AIRPLANE REMAINS RELATIVELY STABLE, PITCH AND ELEVATION CHANGES OCCURRING SLOWLY.

2.3.2 Ground Clearances: Model 787-9

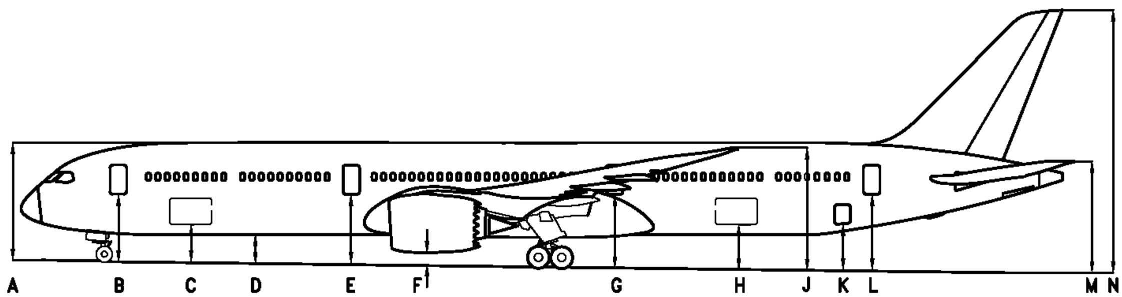


Dimension	MINIMUM		MAXIMUM	
	FT - IN	**M**	**FT - IN**	**M**
A	24 – 4	7.42	25 - 8	7.82
B	13 – 11	4.24	15 – 9	4.80
C	7 – 8	2.34	9 – 3	2.82
D	5 – 9	1.75	6 – 1	1.85
E	14 – 6	4.42	15 – 9	4.80
F (GE ENGINES)	2 – 3	0.69	2 - 6	0.76
F (RR ENGINES)	2 – 0	0.61	2 – 7	0.79
G	15 – 2	4.62	16 – 0	4.88
H	8 – 10	2.69	9 – 11	3.02
J	24 – 0	7.32	25 – 6	7.77
K	9 – 0	2.74	10 - 0	3.05
L	15 – 5	4.70	16 – 8	5.08
M	22 – 7	6.88	23 – 5	7.14
N	55 – 2	16.81	56 – 1	17.09

NOTES:

1. VERTICAL CLEARANCES SHOWN OCCUR DURING MAXIMUM VARIATIONS OF AIRPLANE ATTITUDE. COMBINATIONS OF AIRPLANE LOADING AND UNLOADING ACTIVITIES THAT PRODUCE THE GREATEST POSSIBLE VARIATION IN ATTITUDE WERE USED TO ESTABLISH THE VARIATIONS SHOWN.
2. DURING ROUTINE SERVICING, THE AIRPLANE REMAINS RELATIVELY STABLE, PITCH AND ELEVATION CHANGES OCCURRING SLOWLY.

2.3.3 Ground Clearances: Model 787-10



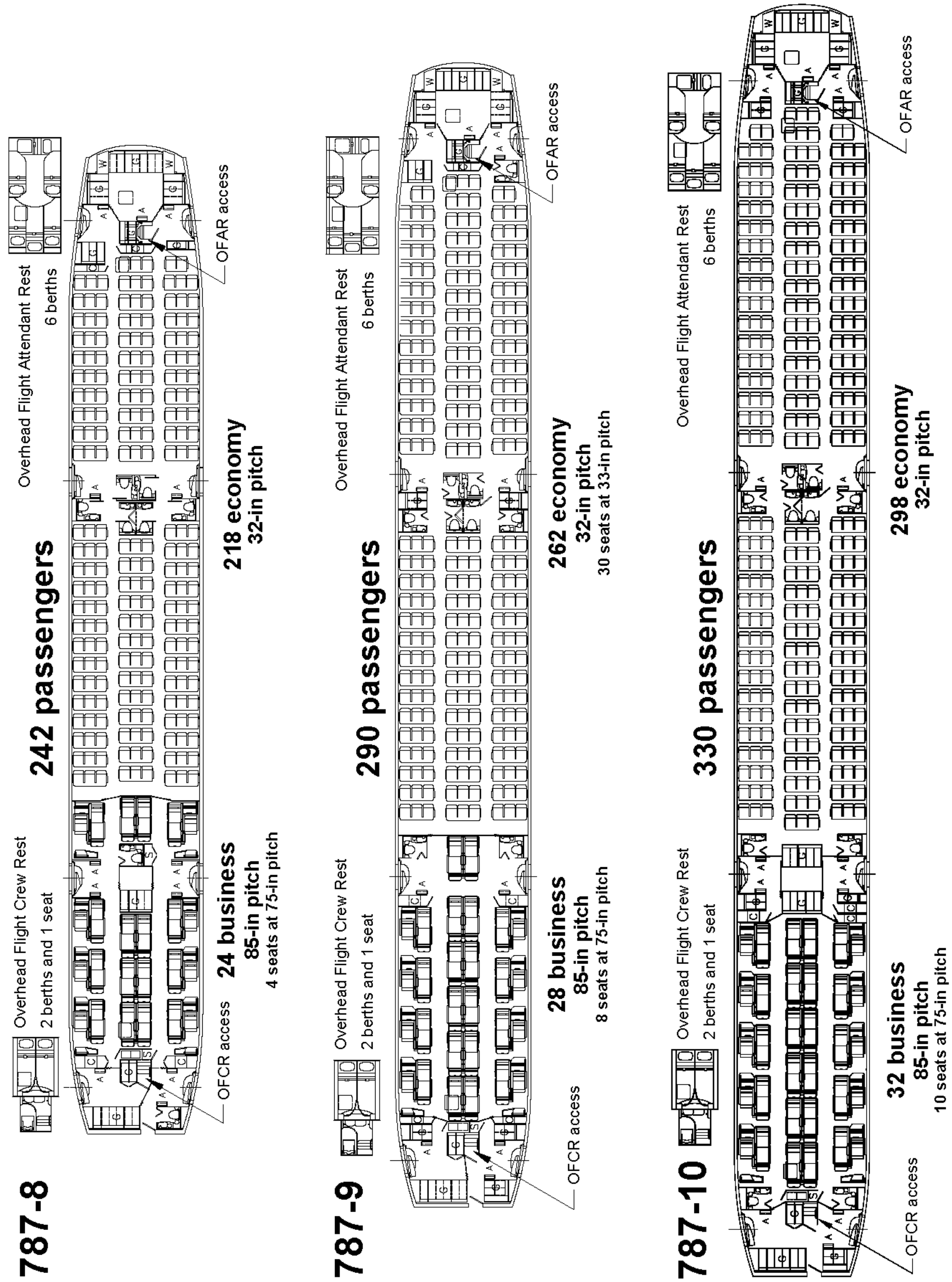
Dimension	MINIMUM		MAXIMUM	
	FT - IN	M	FT - IN	M
A	26-0	7.92	26-9	8.15
B	14-0	4.27	15-5	4.70
C	7-9	2.36	9-0	2.74
D	6-6	1.98	7-3	2.21
E	14-8	4.47	15-7	4.75
F (GE ENGINES)	2-5	0.74	3-3	0.99
F (RR ENGINES)	2-5	0.74	3-2	0.97
G	15-4	4.67	16-0	4.88
H	9-2	2.79	9-9	2.97
J	25-4	7.72	25-11	7.90
K	9-6	2.90	10-1	3.07
L	15-10	4.83	16-5	5.00
M	23-3	7.09	23-8	7.21
N	55-5	16.89	55-10	17.02

NOTES:

1. VERTICAL CLEARANCES SHOWN OCCUR DURING MAXIMUM VARIATIONS OF AIRPLANE ATTITUDE. COMBINATIONS OF AIRPLANE LOADING AND UNLOADING ACTIVITIES THAT PRODUCE THE GREATEST POSSIBLE VARIATION IN ATTITUDE WERE USED TO ESTABLISH THE VARIATIONS SHOWN.
2. DURING ROUTINE SERVICING, THE AIRPLANE REMAINS RELATIVELY STABLE, PITCH AND ELEVATION CHANGES OCCURRING SLOWLY.

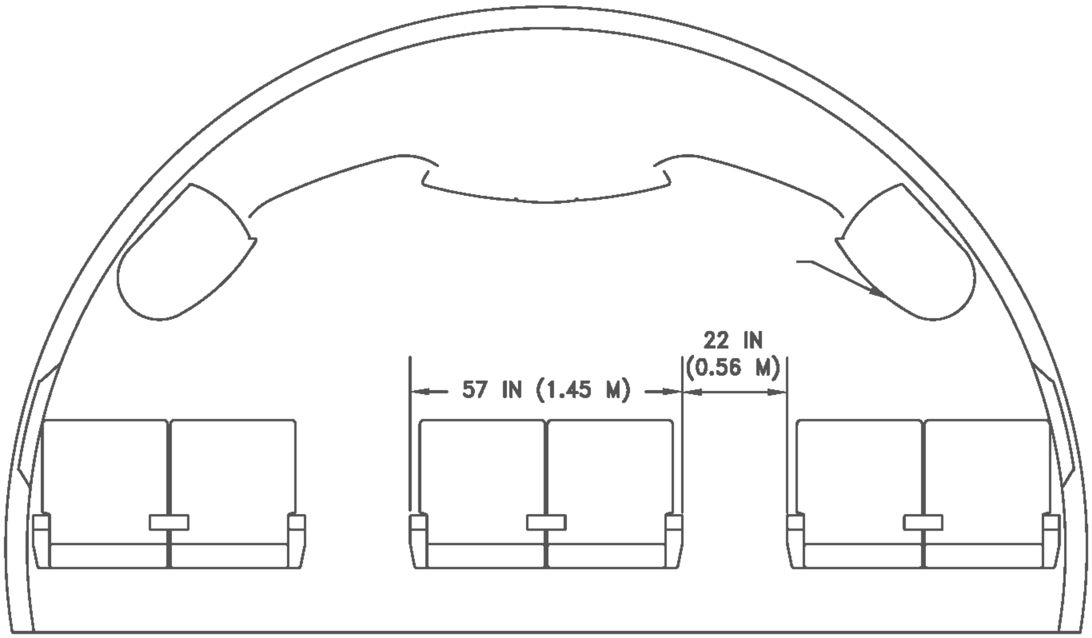
2.4 INTERIOR ARRANGEMENTS

2.4.1 Interior Arrangements - Typical: Model 787-8, 787-9, 787-10

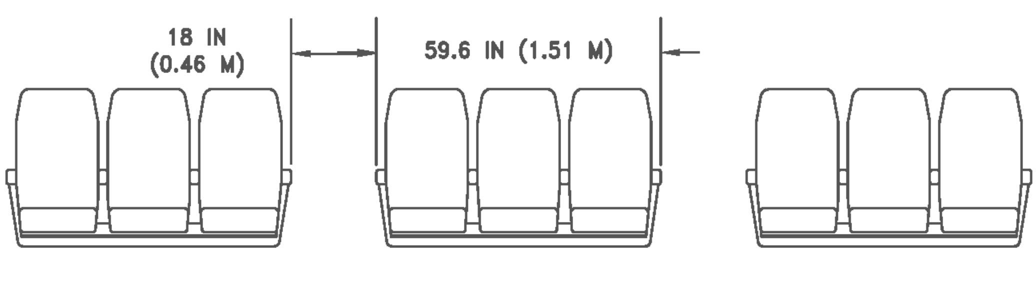


2.5 CABIN CROSS SECTIONS

2.5.1 Cabin Cross-Sections: Model 787-8, 787-9, 787-10



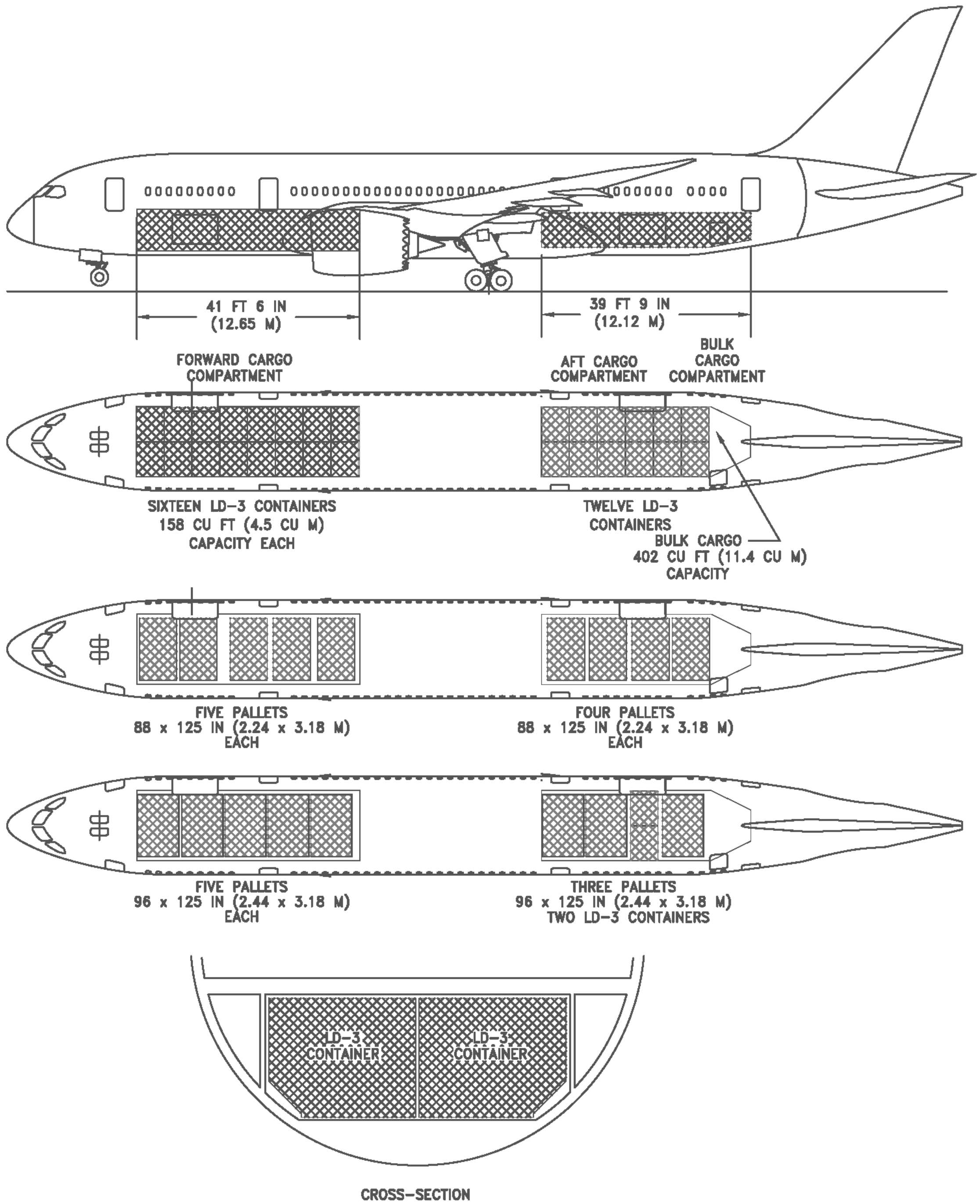
FIRST CLASS/BUSINESS CLASS SEATS



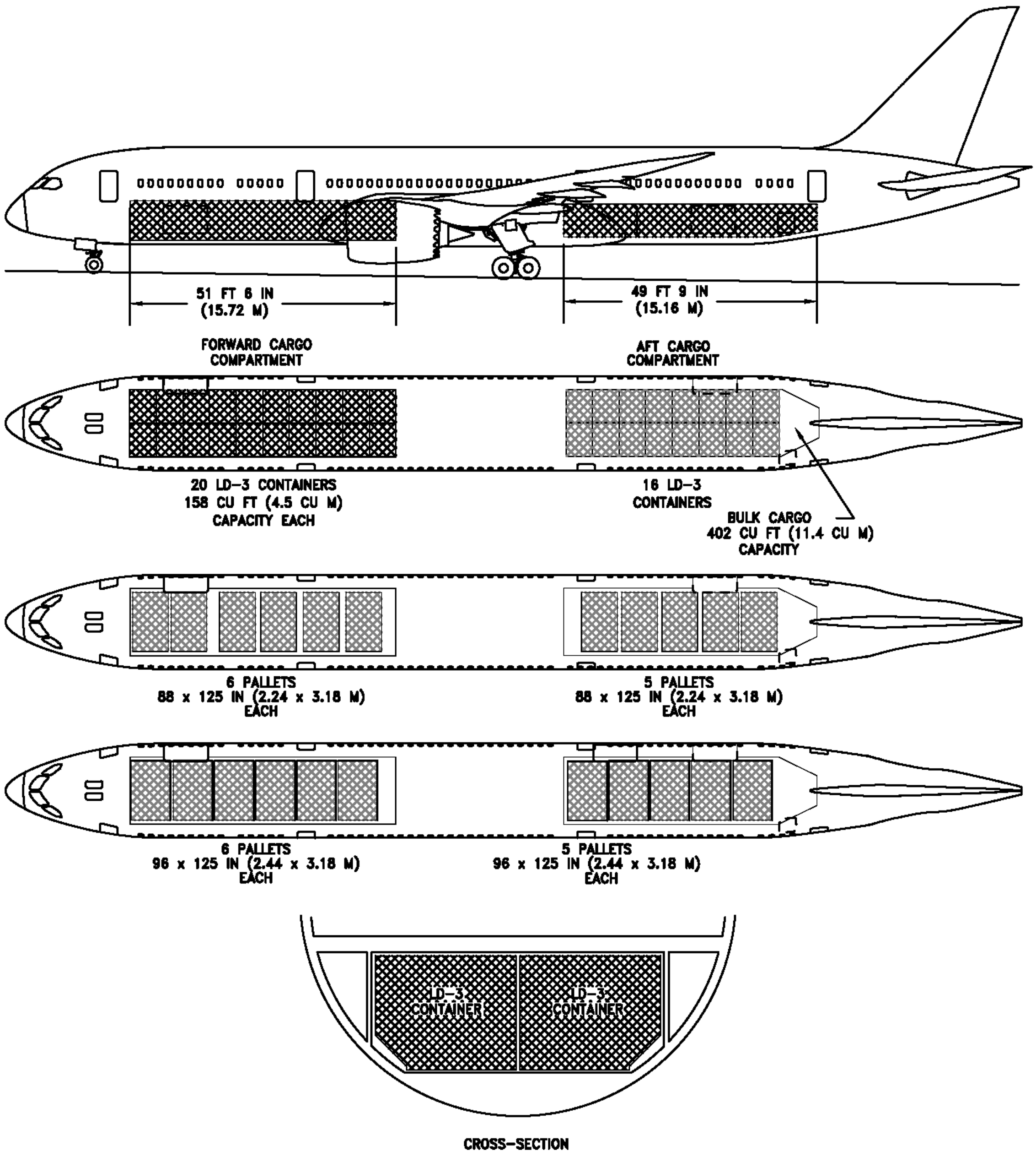
9–ABREAST ECONOMY SEATS

2.6 LOWER CARGO COMPARTMENTS

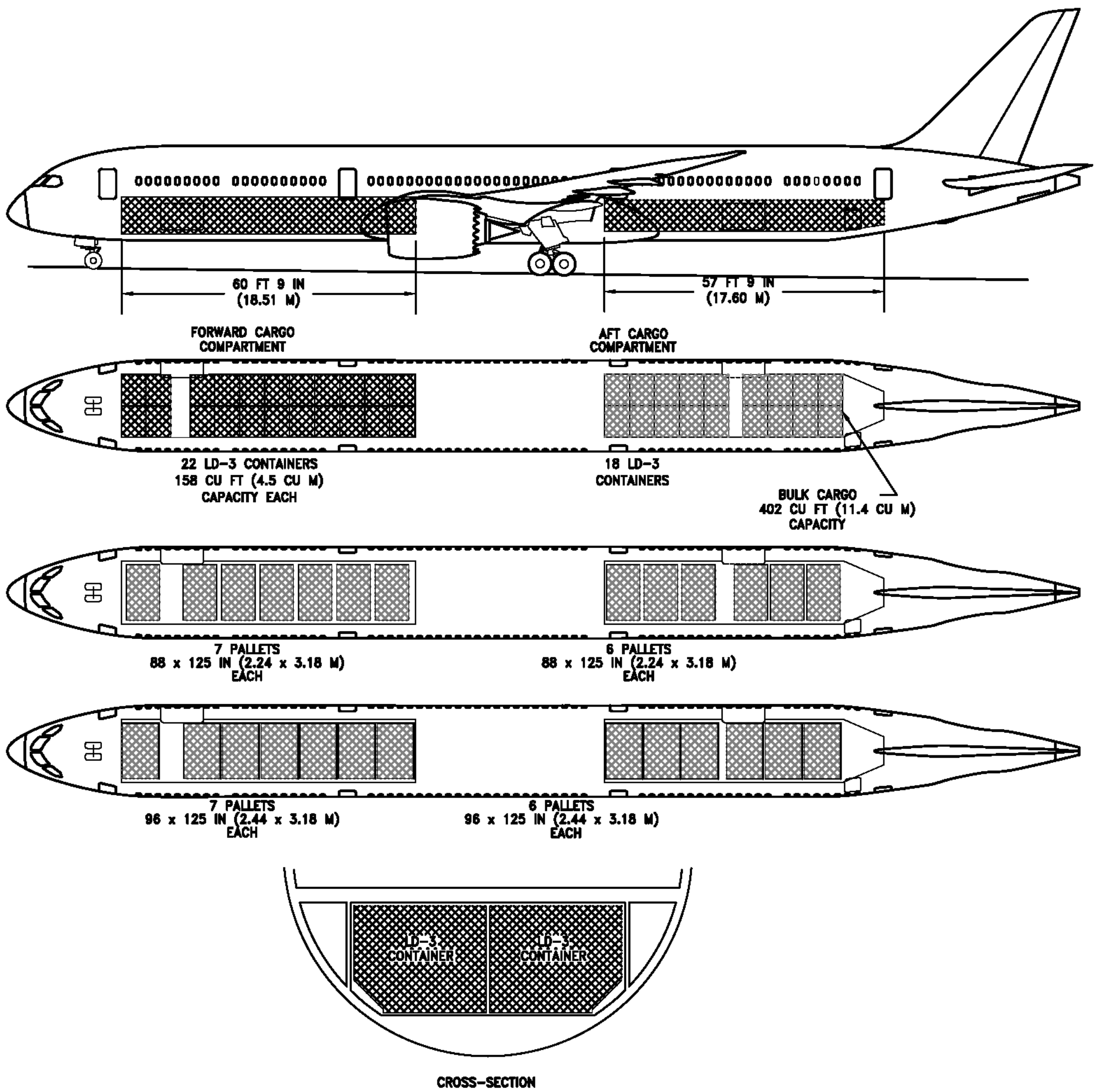
2.6.1 Lower Cargo Compartments: Model 787-8, Containers and Bulk Cargo



2.6.2 Lower Cargo Compartments: Model 787-9, Containers and Bulk Cargo

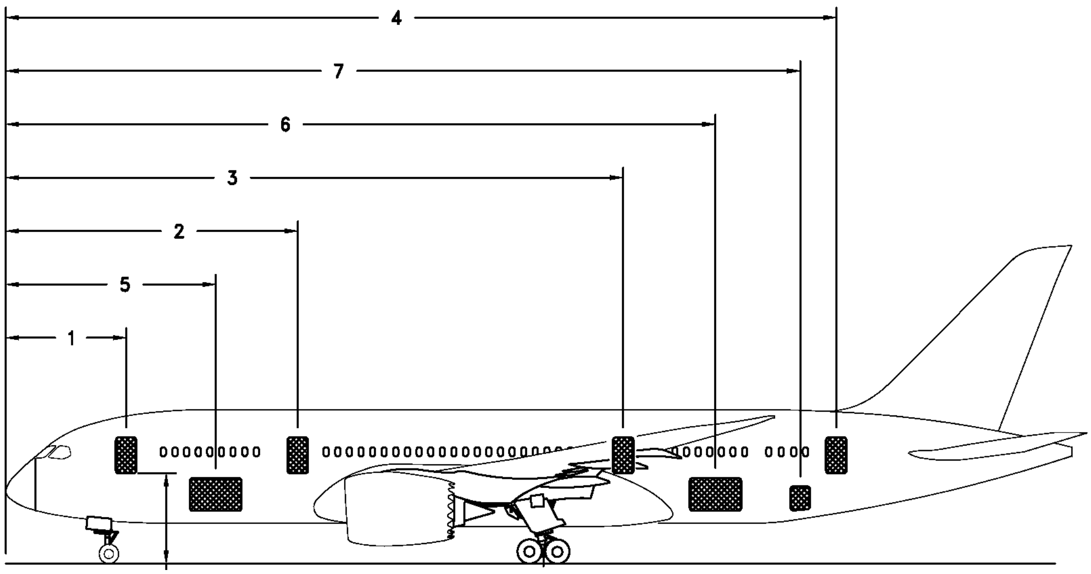


2.6.3 Lower Cargo Compartments: Model 787-10, Containers and Bulk Cargo



2.7 DOOR CLEARANCES

2.7.1 Door Locations: Model 787-8, 787-9, 787-10, Passenger and Cargo Doors



SEE NOTE *[2]

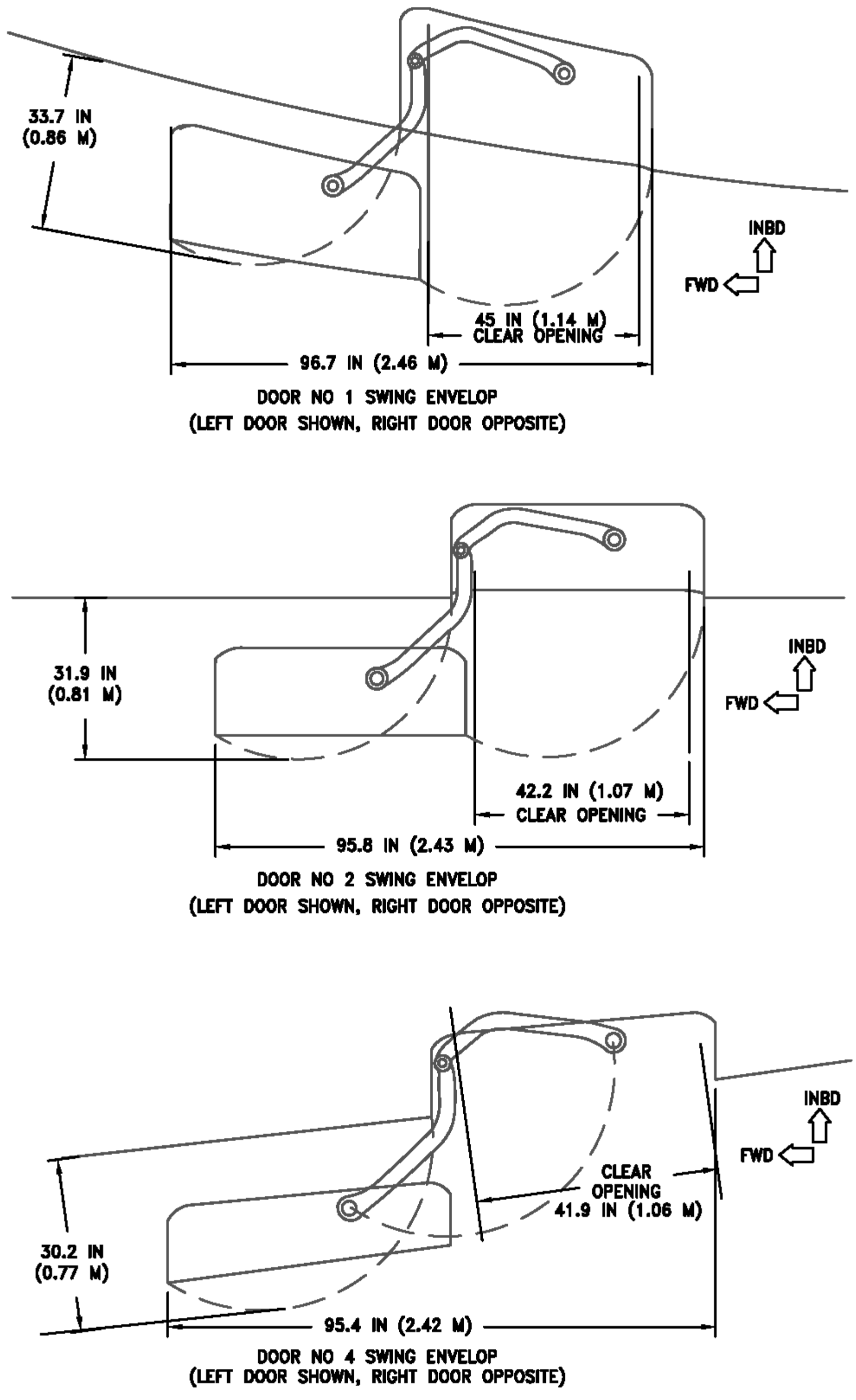
	Door Name	Door Location	787-8 FT-IN/M	787-9 FT-IN/M	787-10 FT-IN/M
1	MAIN ENTRY/SERVICE DOOR NO 1 (2)	LEFT AND RIGHT	20-8 / 6.30	20-8 / 6.30	20-8 / 6.30
2	MAIN ENTRY/SERVICE DOOR NO 2 (2)	LEFT AND RIGHT	50-3 / 15.32	60-3 / 18.36	70-3 / 21.41
3	EMERGENCY EXIT DOOR NO 3	LEFT AND RIGHT	106-3 / 32.39	116-3 / 35.43	126-3 / 38.48
4	MAIN ENTRY/SERVICE DOOR NO 4 (2)	LEFT AND RIGHT	142-11 / 43.56	162-11 / 49.66	180-11 / 55.14
5	FORWARD CARGO DOOR	RIGHT	36-1 / 11.00	36-1 / 11.00	36-1 / 11.00
6	AFT CARGO DOOR	RIGHT	122-1 / 37.21	142-1 / 43.31	152-1 / 46.36
7	BULK CARGO DOOR	LEFT	136-8 / 41.66	156-8 / 47.75	174-8 / 53.24

NOTES:

*[1] ENTRY DOORS LEFTSIDE, SERVICE DOORS RIGHTSIDE

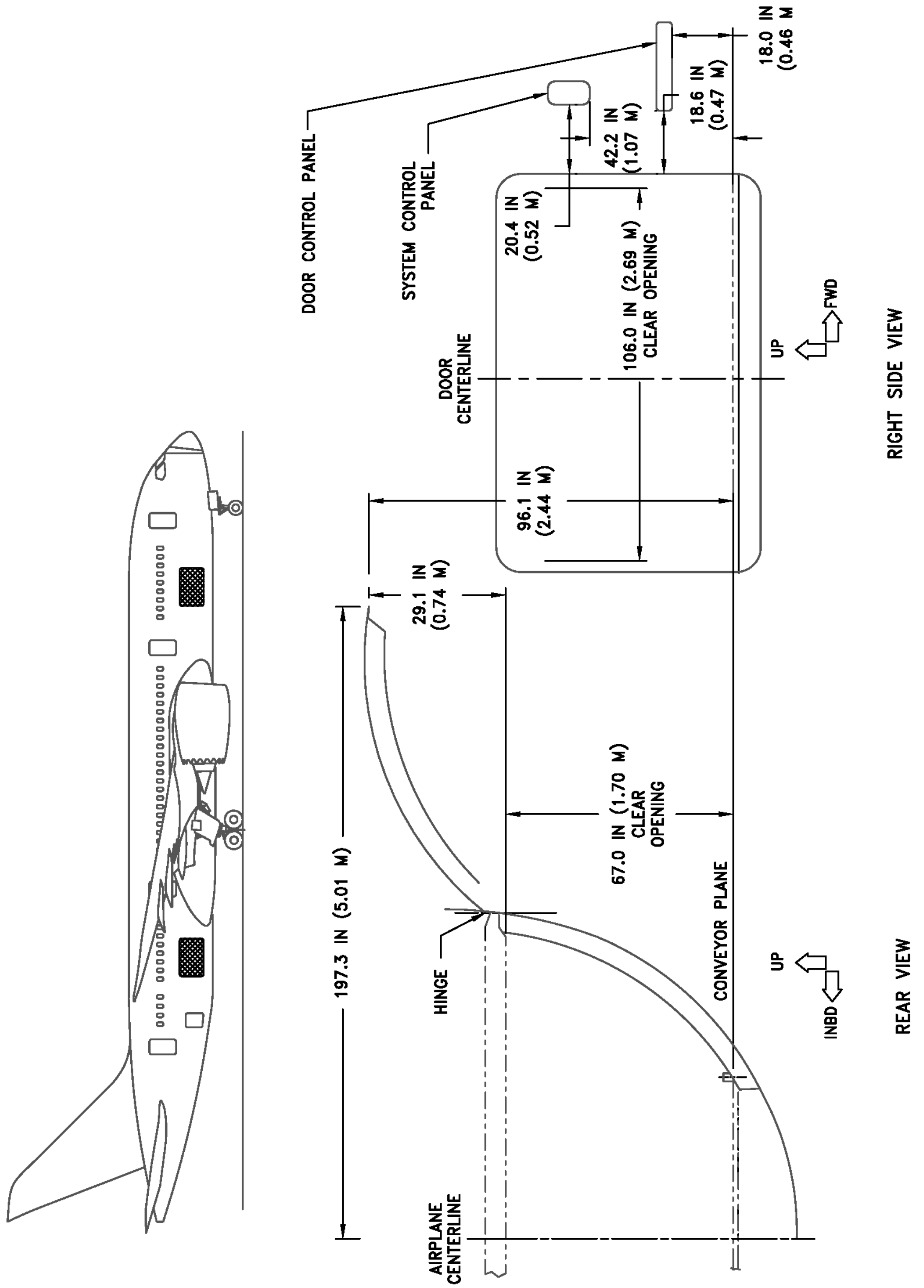
*[2] SEE SECTION 2.3 FOR DOOR SILL HEIGHTS

2.7.2 Door Clearances: Model 787-8, 787-9, 787-10, Main Deck Entry and Service Doors

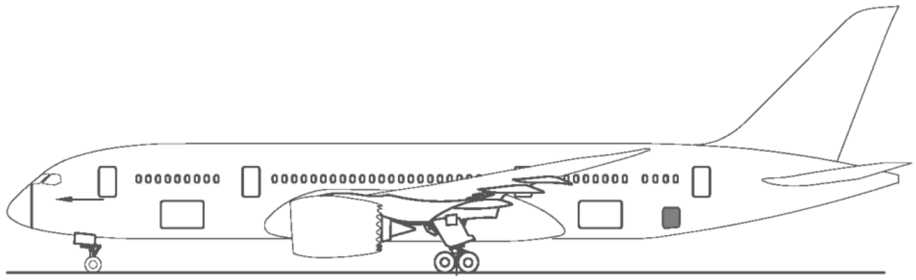


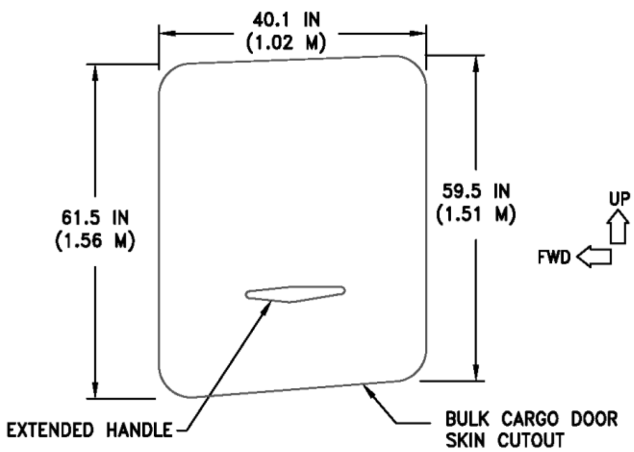
ALL DOORS

2.7.3 Door Clearances: Model 787-8, 787-9, 787-10, Lower Deck Cargo Door (Forward & Aft)

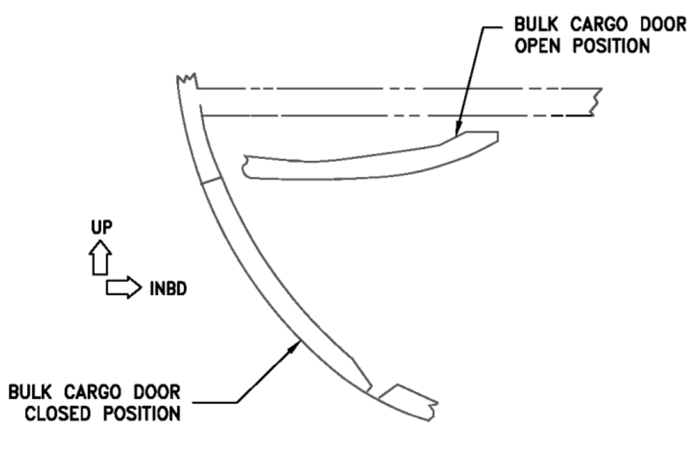


2.7.4 Door Clearances: Model 787-8, 787-9, 787-10, Bulk Cargo Door





LEFT SIDE VIEW



VIEW LOOKING FORWARD

3.0 AIRPLANE PERFORMANCE

3.1 GENERAL INFORMATION

The graphs in Section 3.2 provide information on payload-range capability of the 787 airplane. To use these graphs, if the trip range and zero fuel weight (OEW + payload) are known, the approximate takeoff weight can be found, limited by maximum zero fuel weight, maximum design takeoff weight, or fuel capacity.

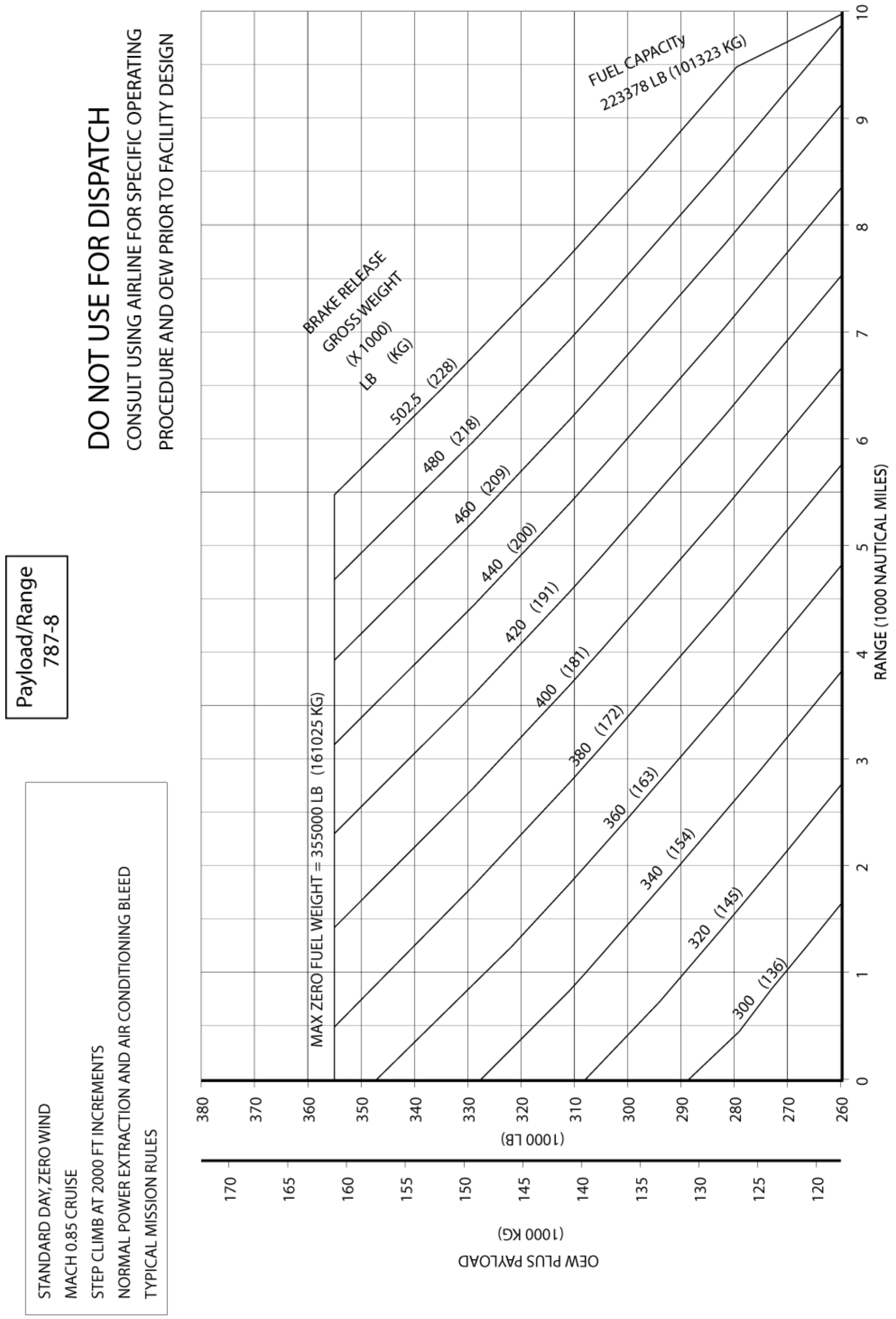
The graphs in Section 3.3 provide information on FAA/EASA takeoff runway length requirements with typical engines at different pressure altitudes. Maximum takeoff weights shown on the graphs are the heaviest for the particular airplane models with the corresponding engines. Standard day temperatures for pressure altitudes shown on the FAA/EASA takeoff graphs are given below:

PRESSURE ALTITUDE		STANDARD DAY TEMP	
FEET	METERS	°F	°C
0	0	59.0	15.0
2,000	610	51.9	11.0
4,000	1,219	44.7	7.1
6,000	1,829	37.6	3.1
8,000	2,438	30.5	-0.8
10,000	3,048	23.3	-4.8
12,000	3,658	16.2	-8.8
14,000	4,267	9.1	-12.7

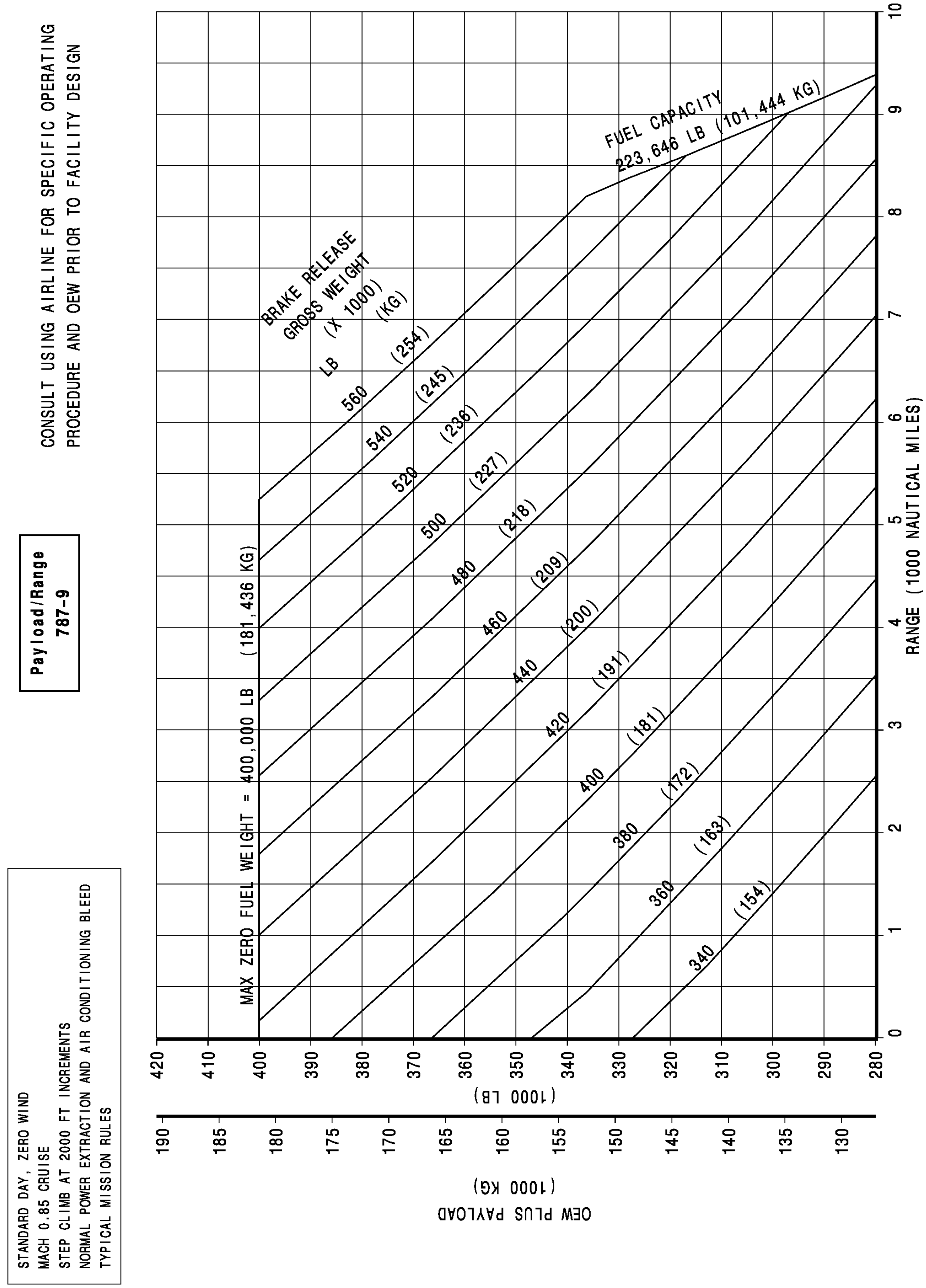
The graphs in Section 3.4 provide information on landing runway length requirements for different airplane weights and airport altitudes. The maximum landing weights shown are the heaviest for the particular airplane model.

3.2 PAYLOAD/RANGE FOR LONG RANGE CRUISE

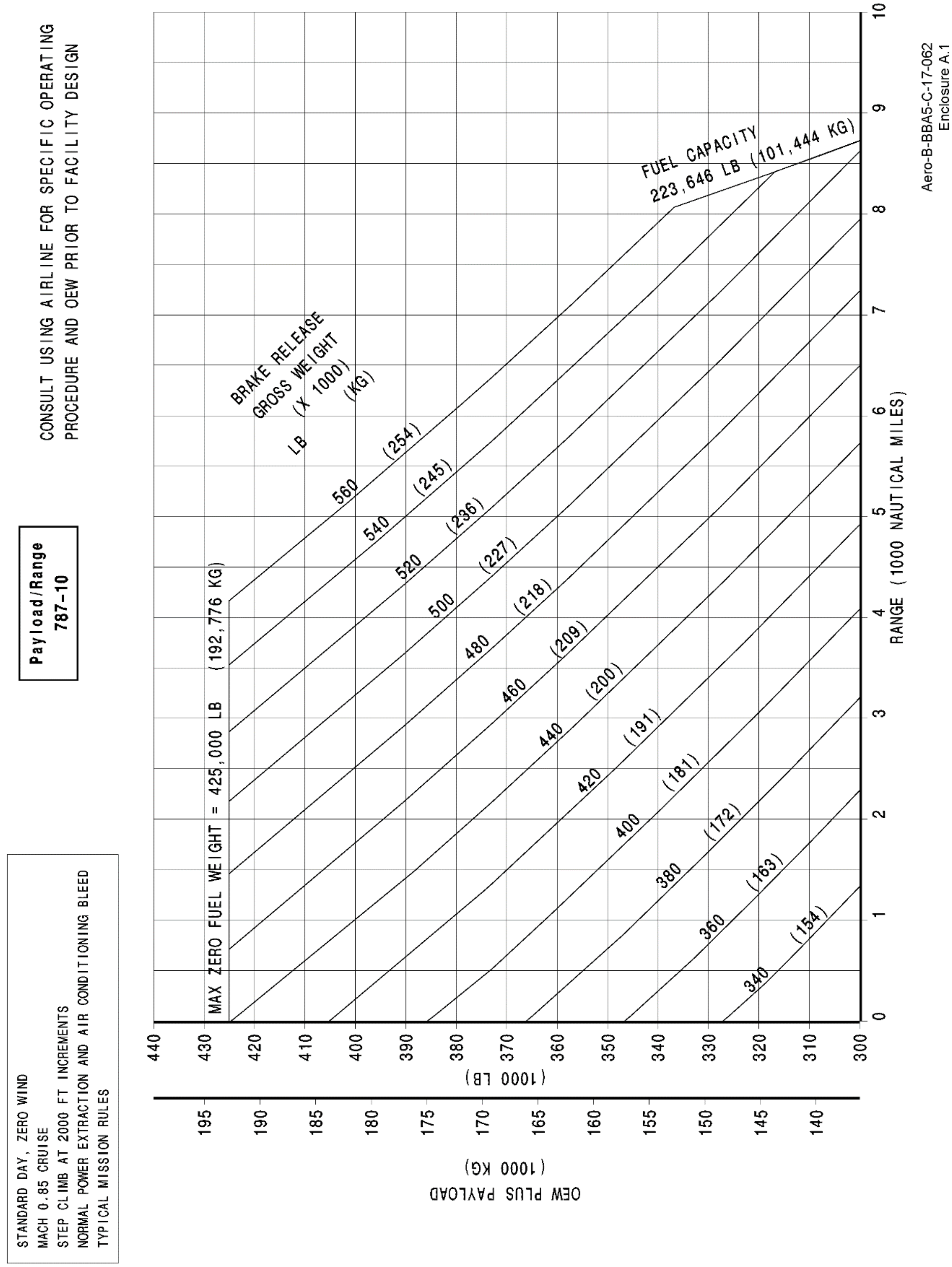
3.2.1 Payload/Range for Long-Range Cruise: Model 787-8 (Typical Engines)



3.2.2 Payload/Range for Long-Range Cruise: Model 787-9 (Typical Engines)

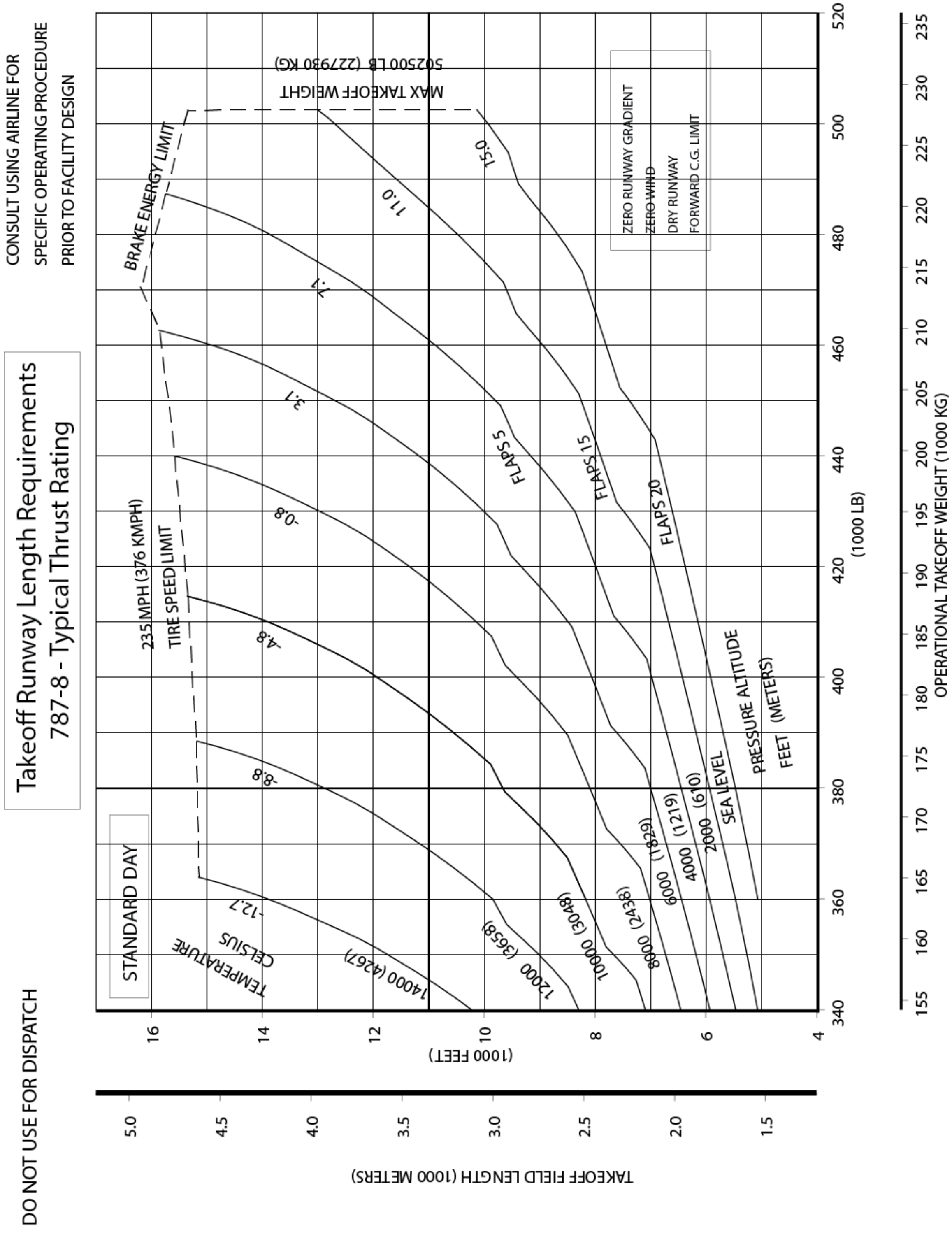


3.2.3 Payload/Range for Long-Range Cruise: Model 787-10 (Typical Engines)

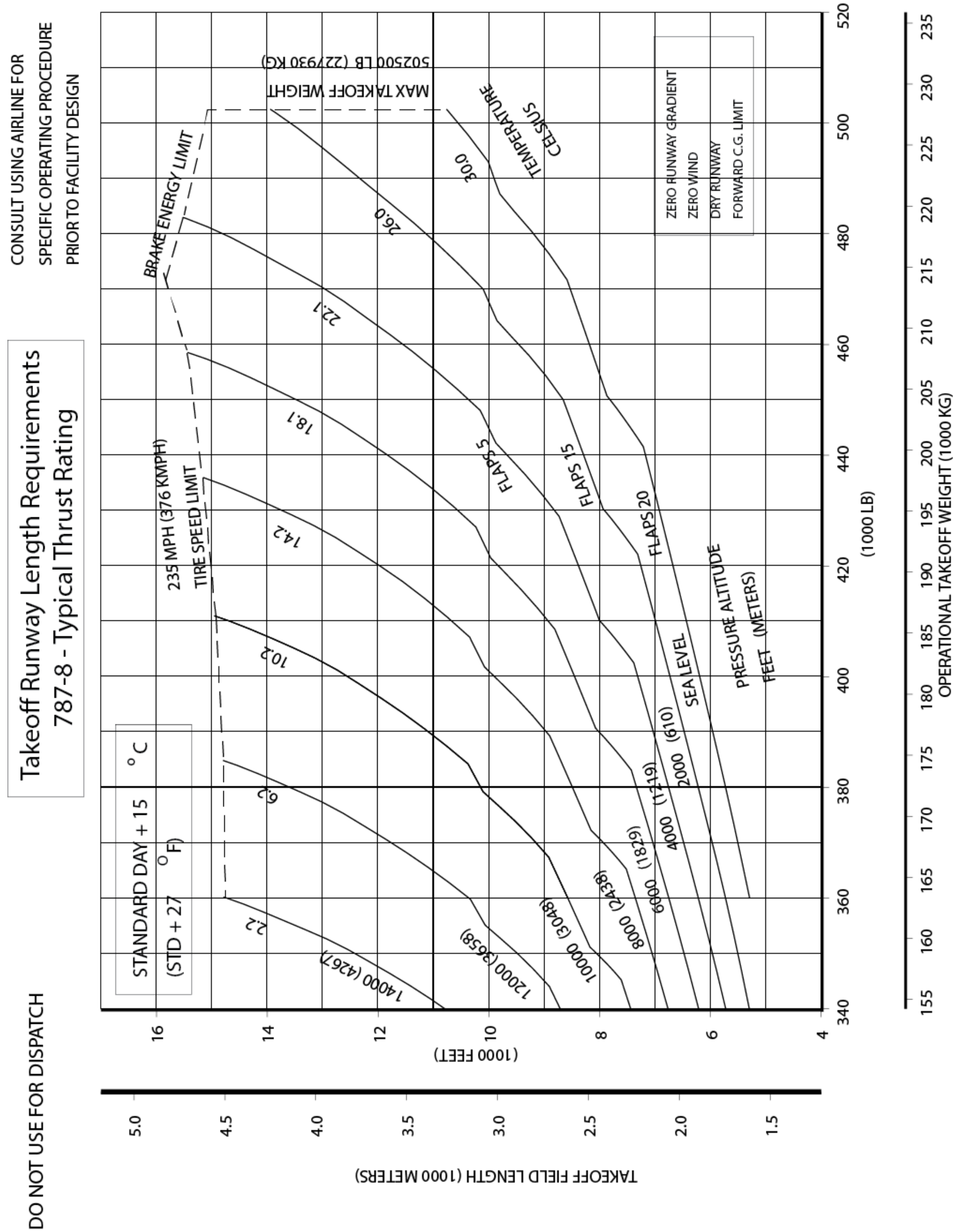


3.3 FAA/EASA TAKEOFF RUNWAY LENGTH REQUIREMENTS

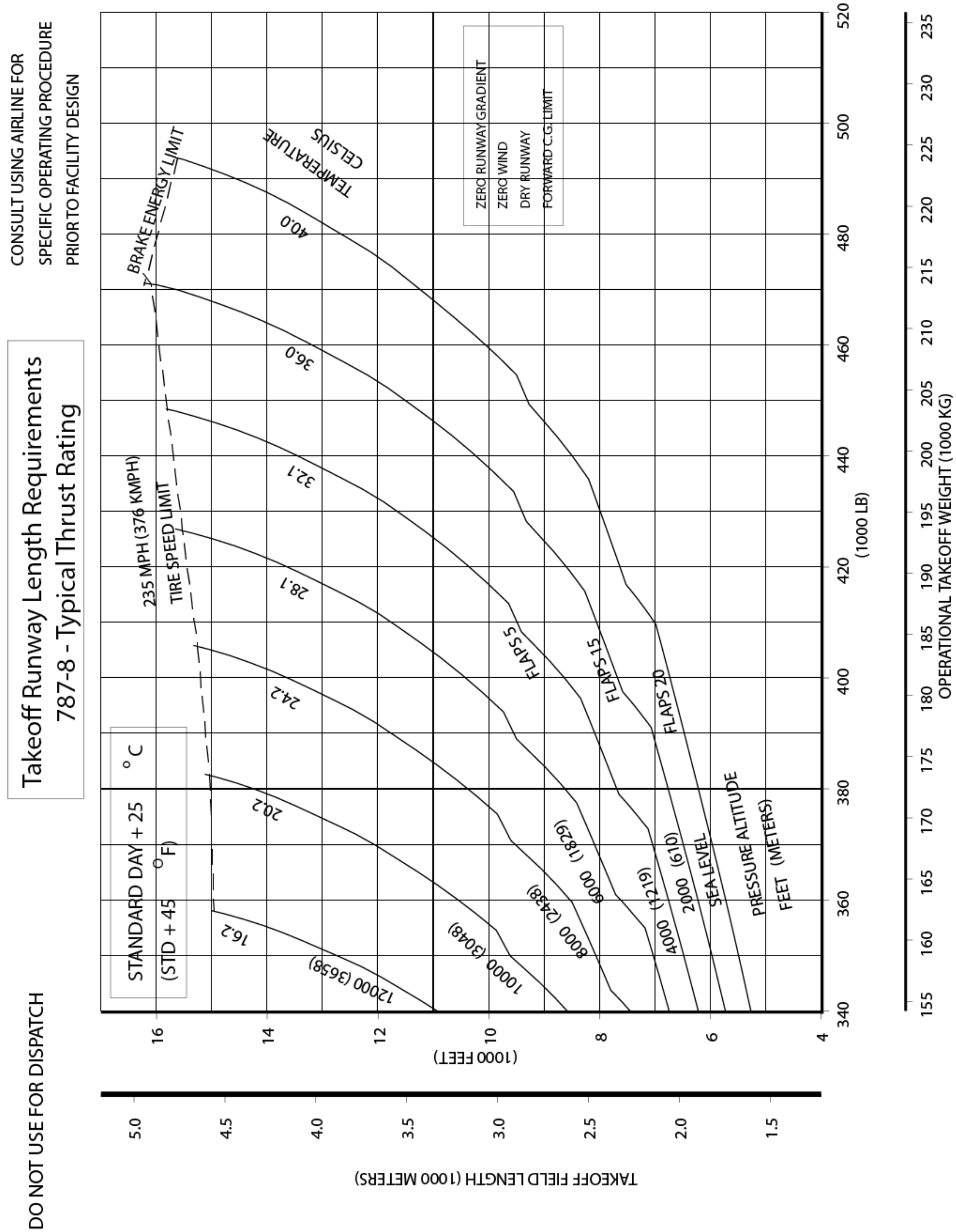
3.3.1 FAA/EASA Takeoff Runway Length Requirements - Standard Day, Dry Runway: Model 787-8 (Typical Engines)



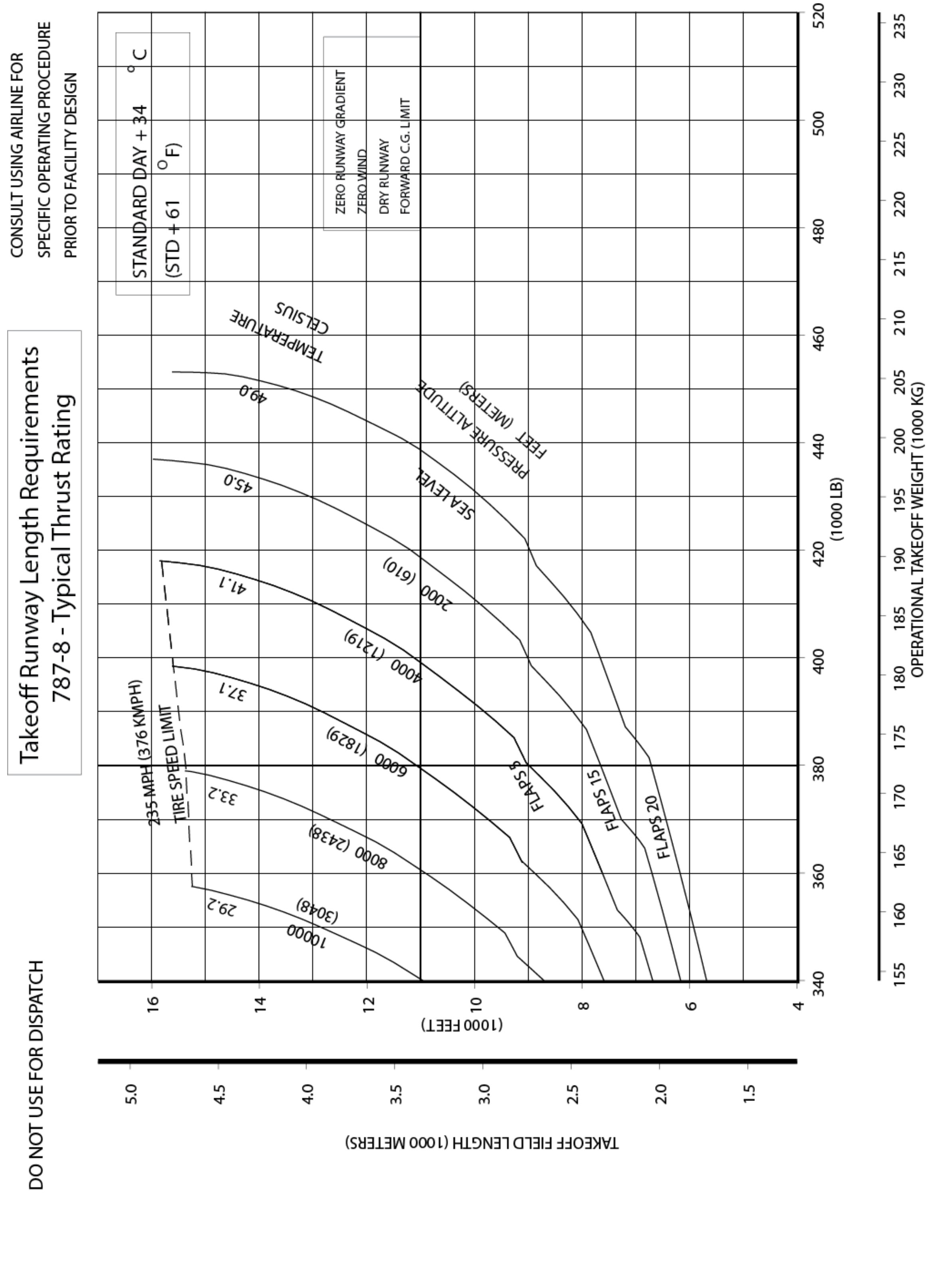
3.3.2 FAA/EASA TakeOff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 787-8 (Typical Engines)



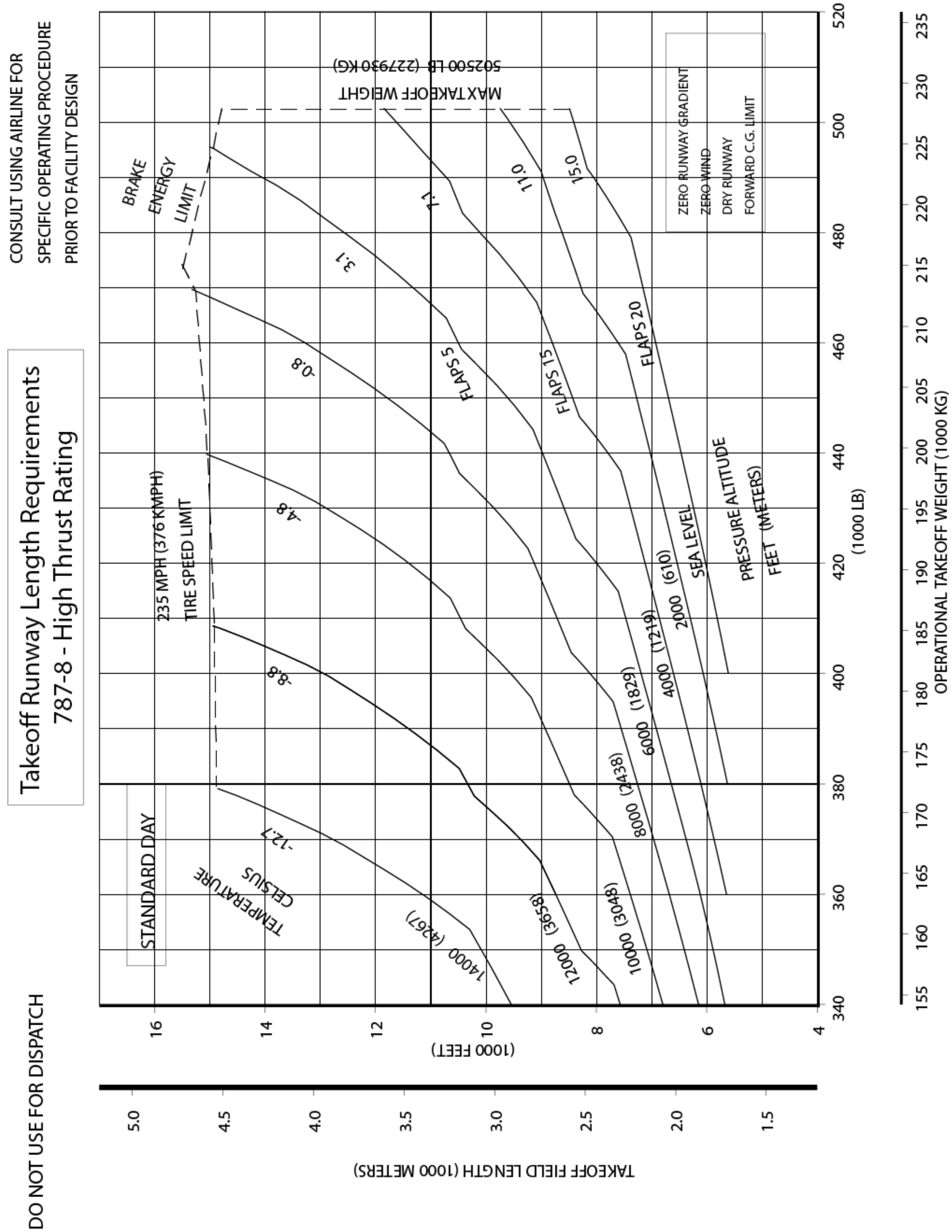
3.3.3 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 45°F (STD + 25°C), Dry Runway: Model 787-8 (Typical Engines)



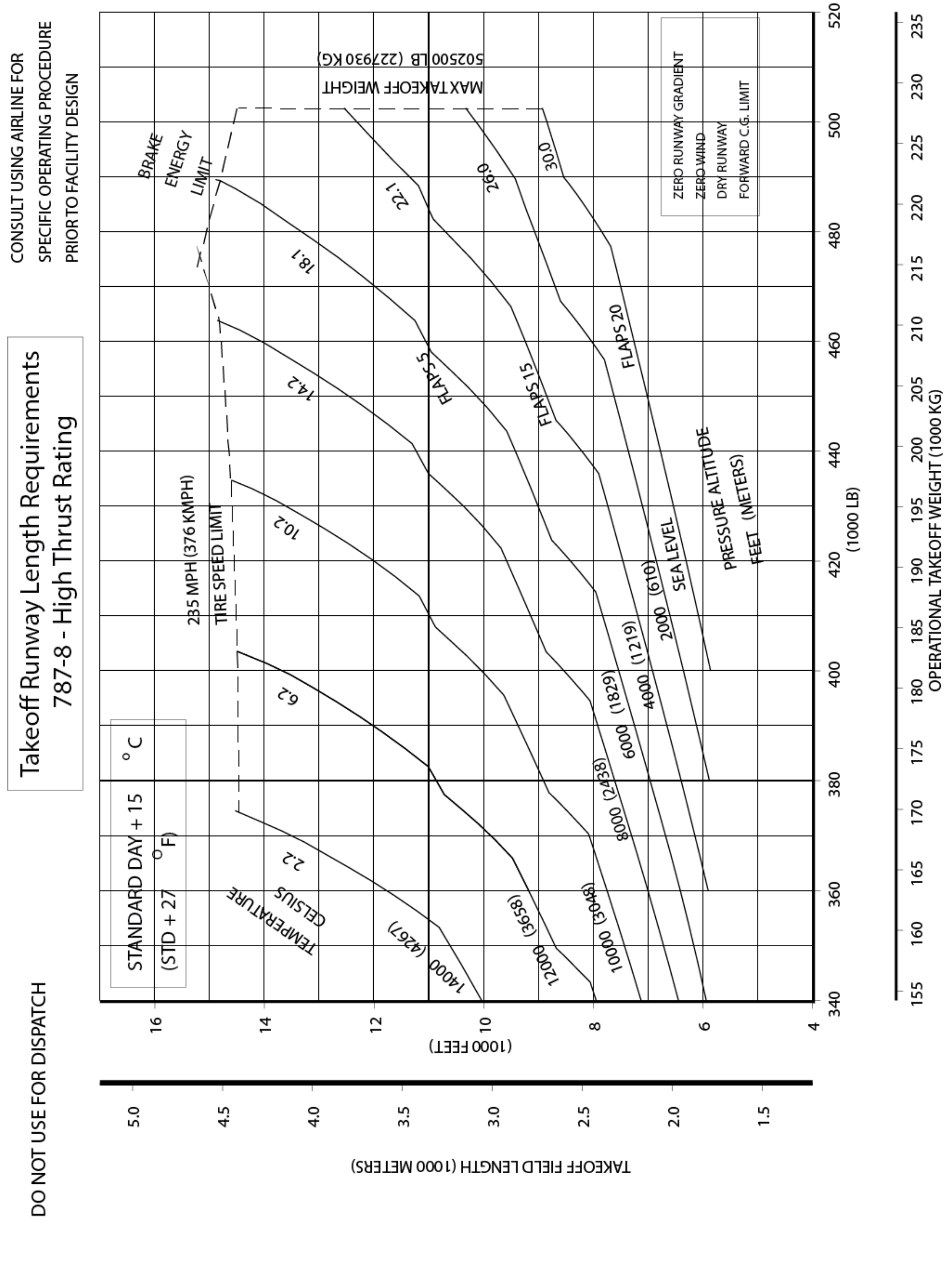
3.3.4 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 61°F (STD + 34°C, Dry Runway): Model 787-8 (Typical Engines)



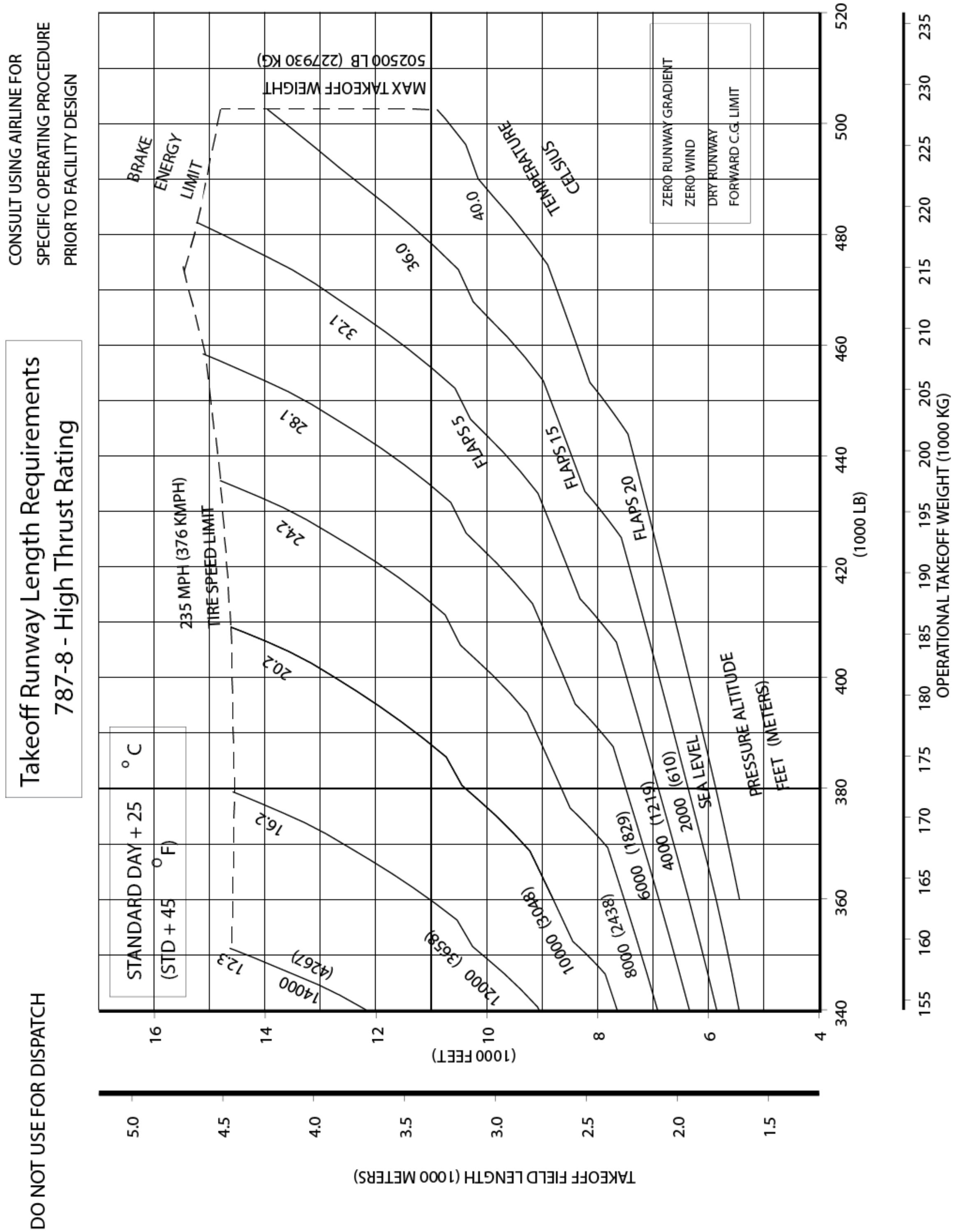
3.3.5 FAA/EASA Takeoff Runway Length Requirements - Standard Day, Dry Runway: Model 787-8 (Hi-Thrust Engines)



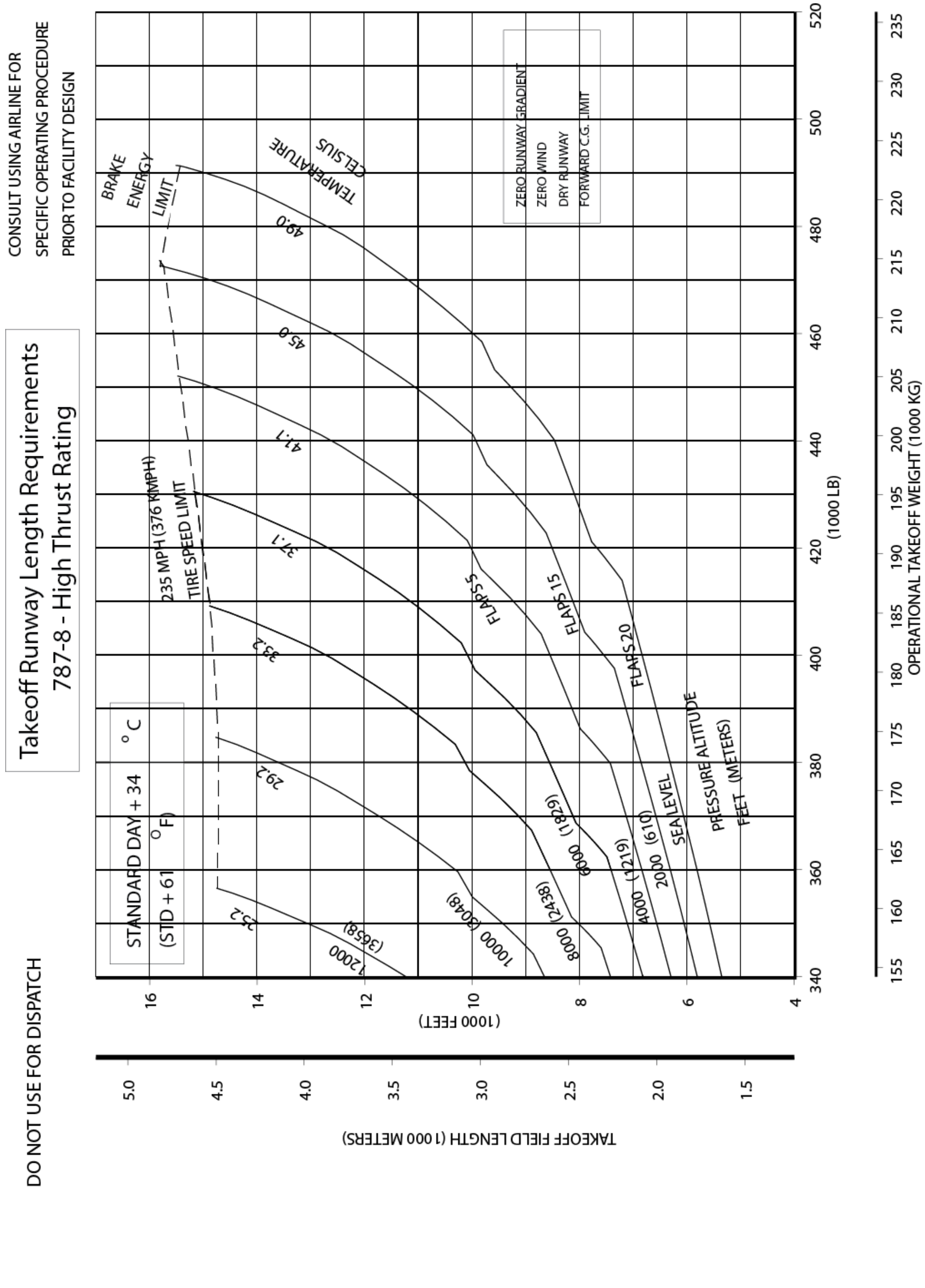
3.3.6 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 787-8 (Hi-Thrust Engines)



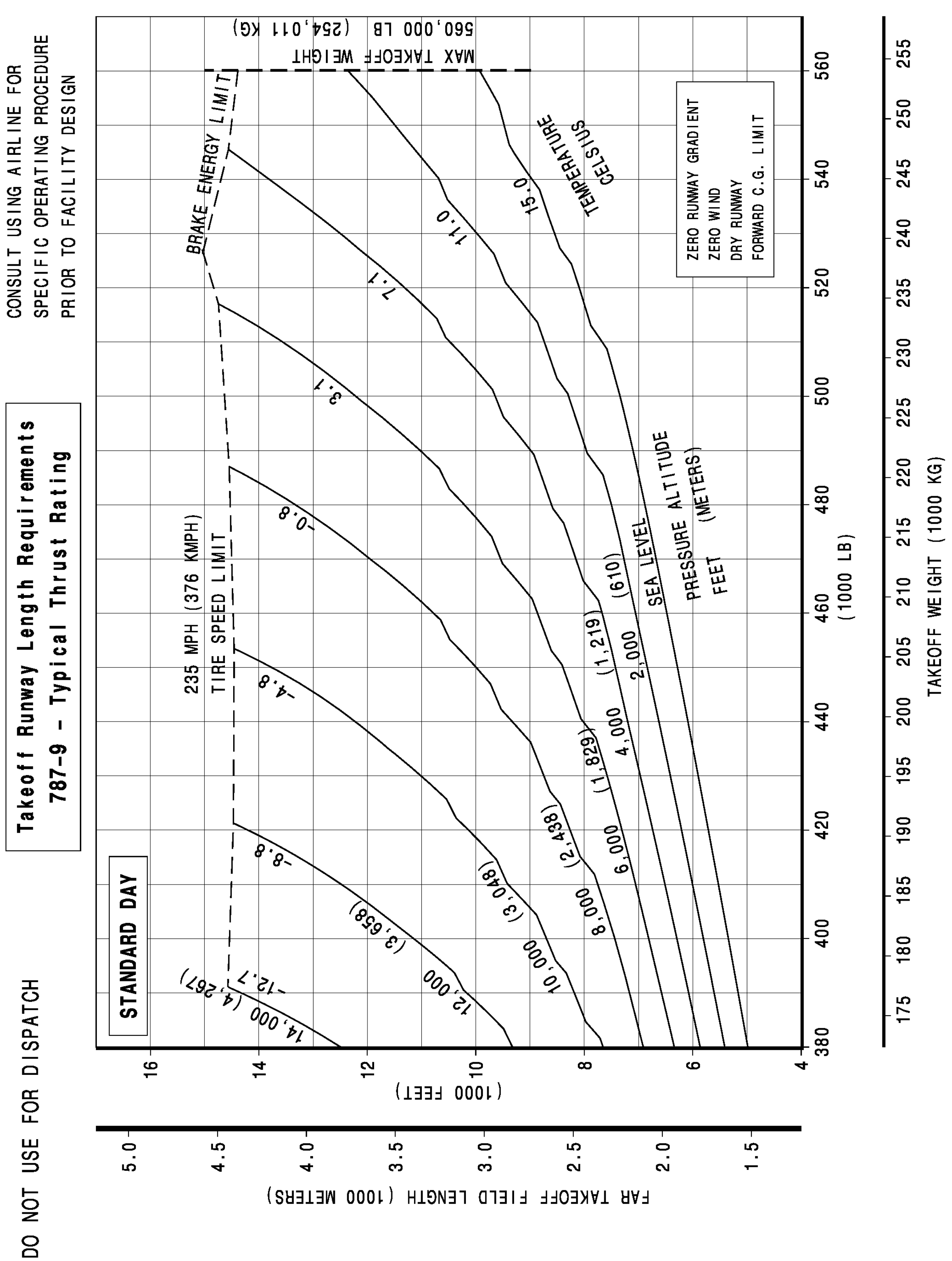
3.3.7 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 45°F (STD + 25°C), Dry Runway: Model 787-8 (Hi-Thrust Engines)



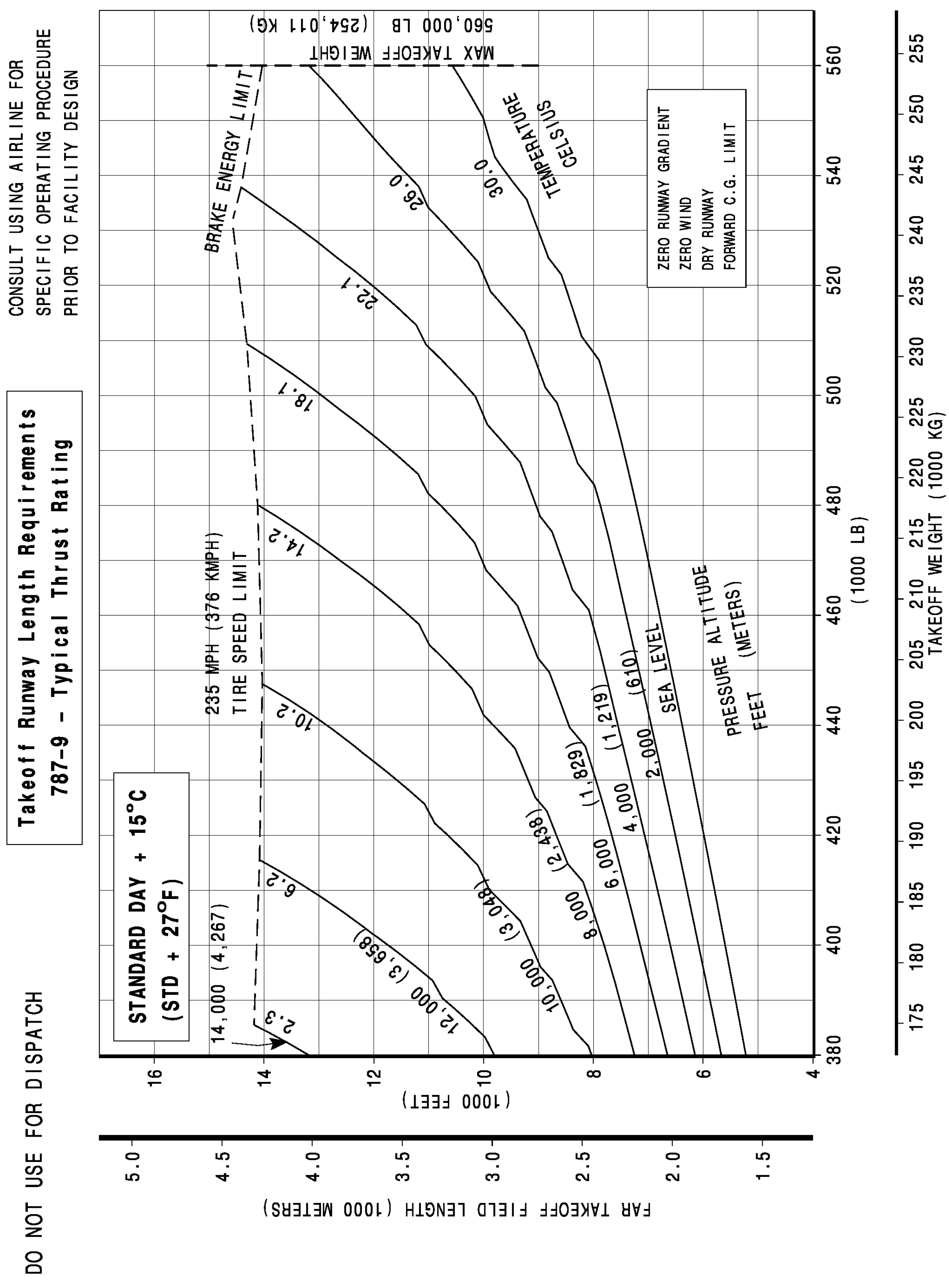
3.3.8 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 61°F (STD + 34°C), Dry Runway: Model 787-8 (Hi-Thrust Engines)



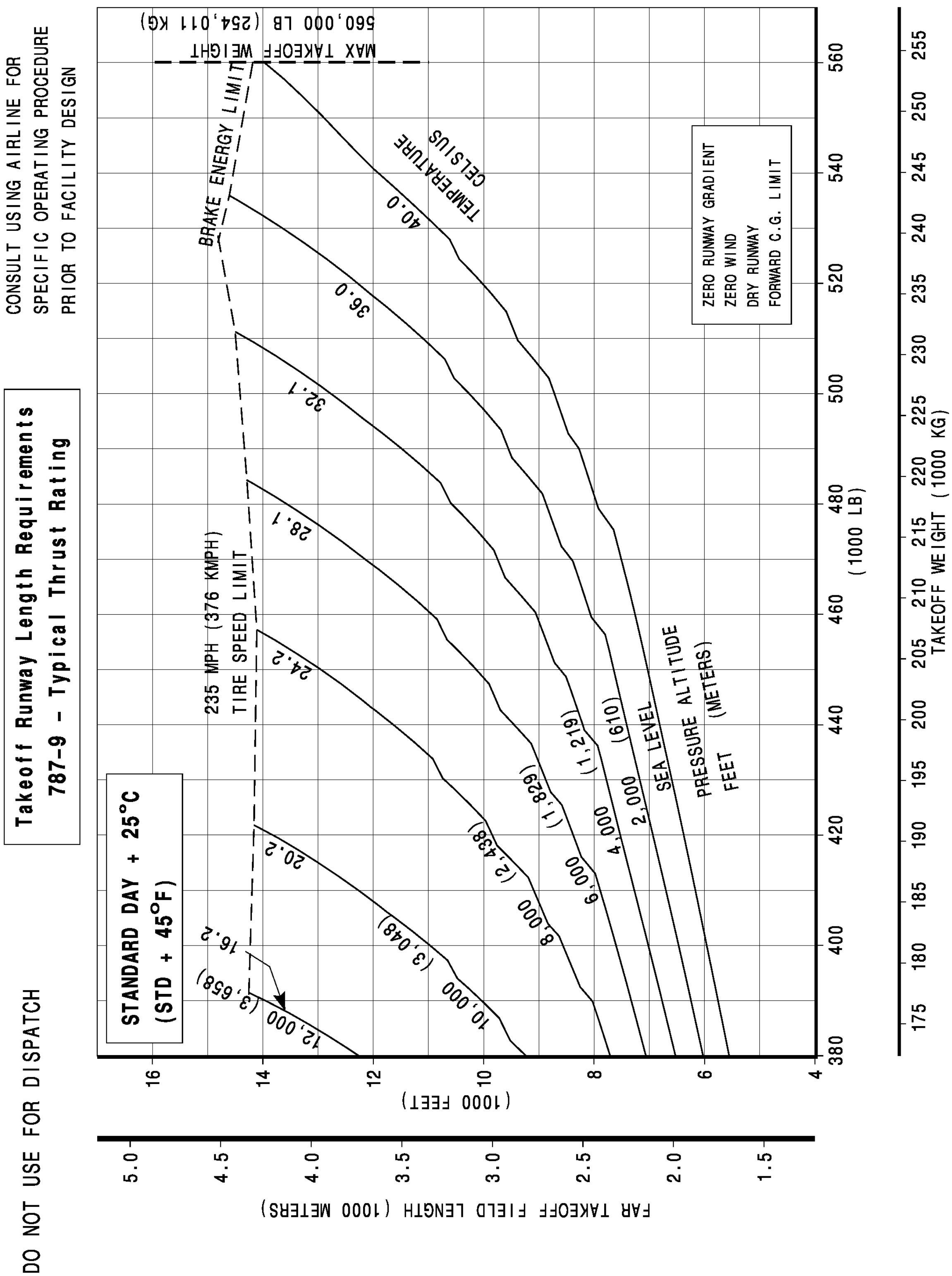
3.3.9 FAA/EASA Takeoff Runway Length Requirements - Standard Day, Dry Runway: Model 787-9 (Typical Engines)



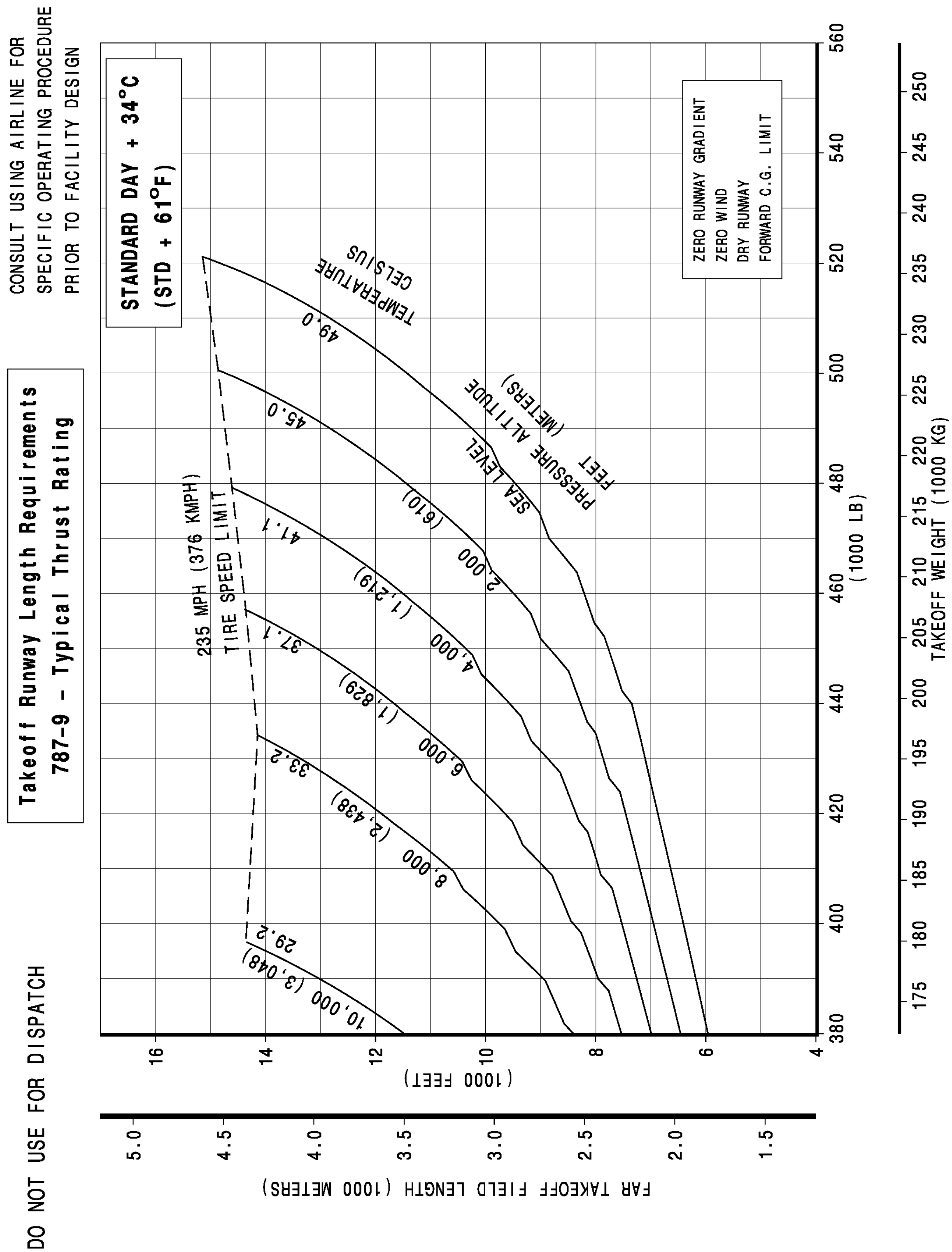
3.3.10 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 787-9 (Typical Engines)



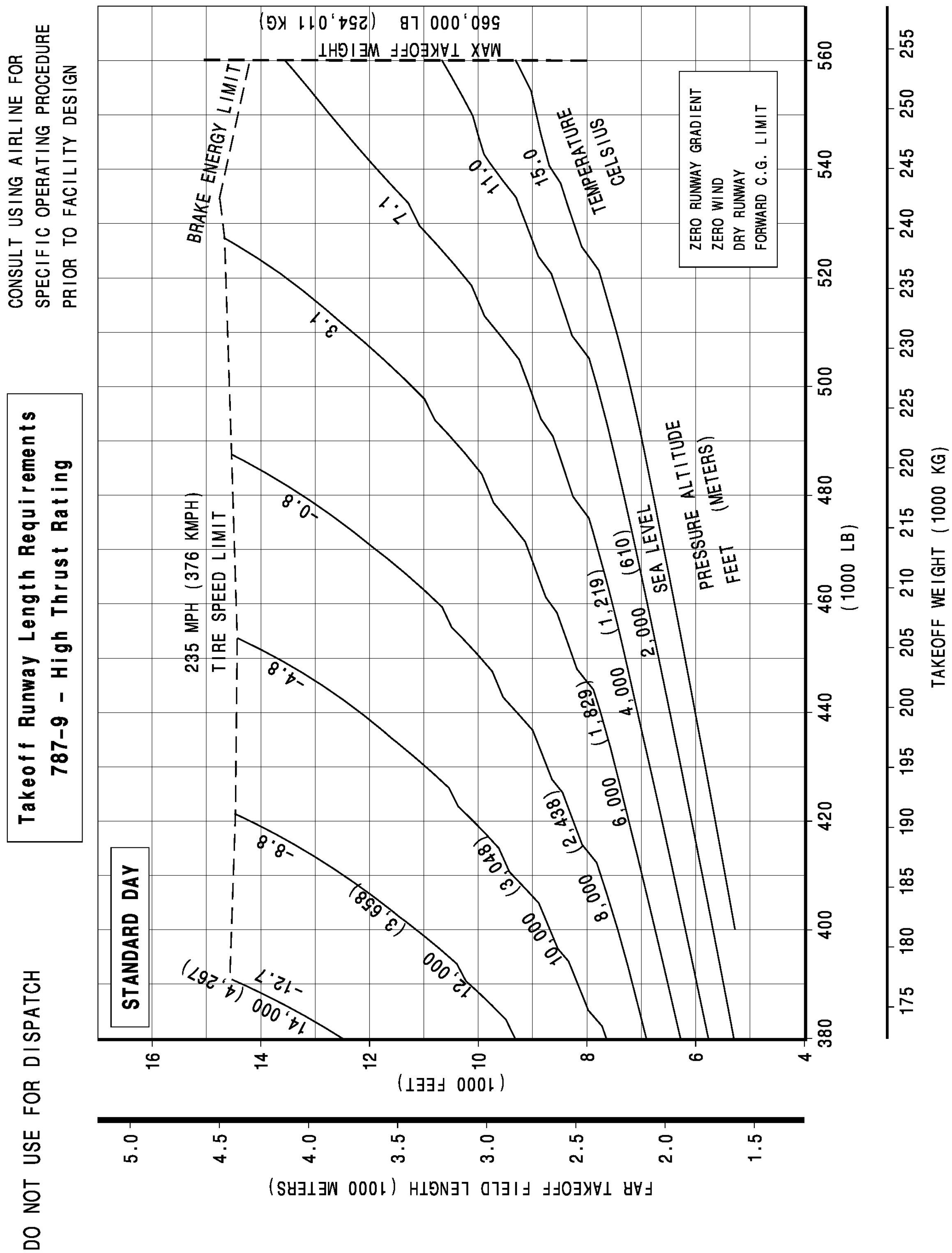
3.3.11 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 45°F (STD + 25°C), Dry Runway: Model 787-9 (Typical Engines)



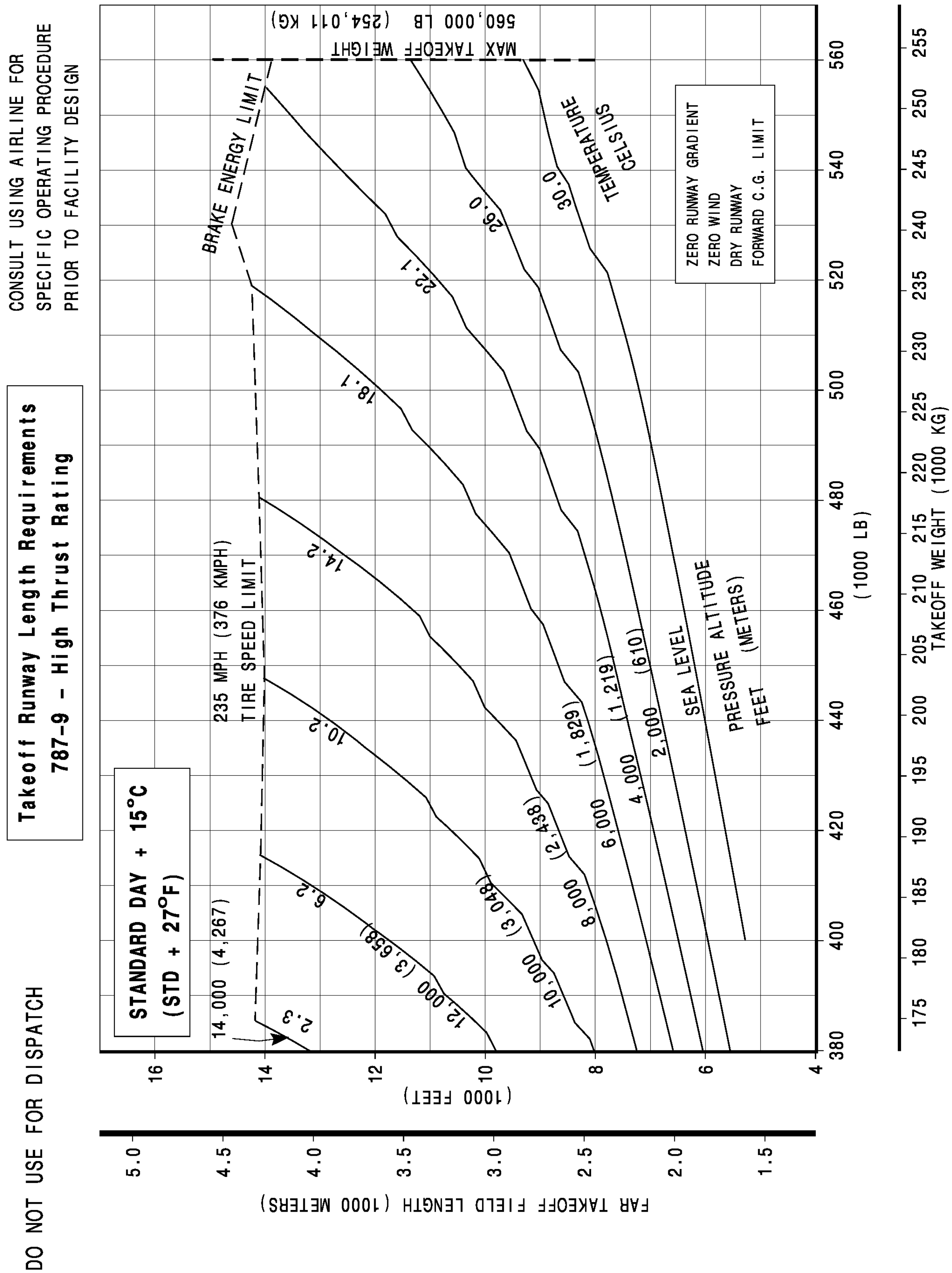
3.3.12 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 61°F (STD + 34°C), Dry Runway: Model 787-9 (Typical Engines)



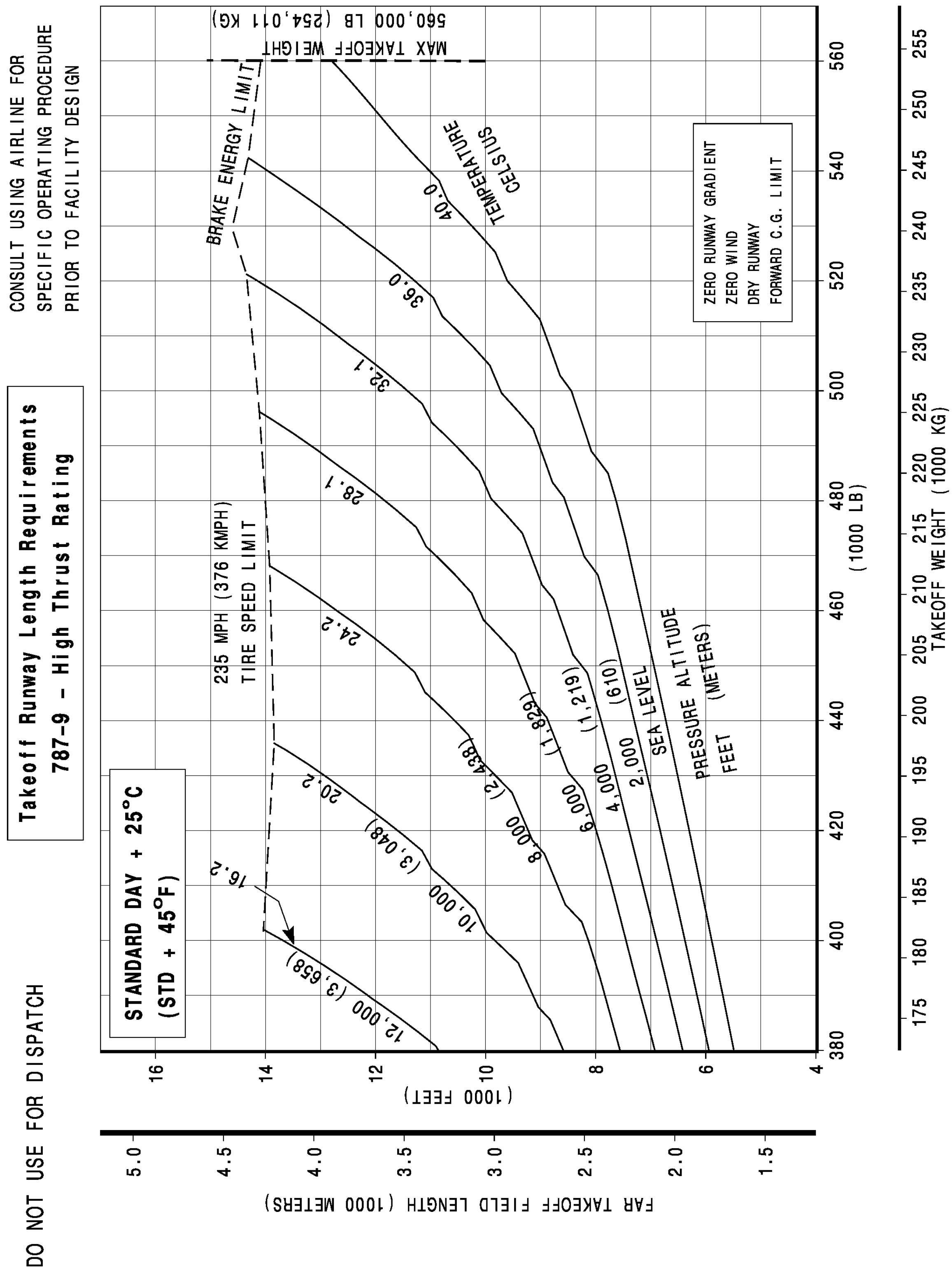
3.3.13 FAA/EASA Takeoff Runway Length Requirements - Standard Day, Dry Runway: Model 787-9, (Hi-Thrust Engines)



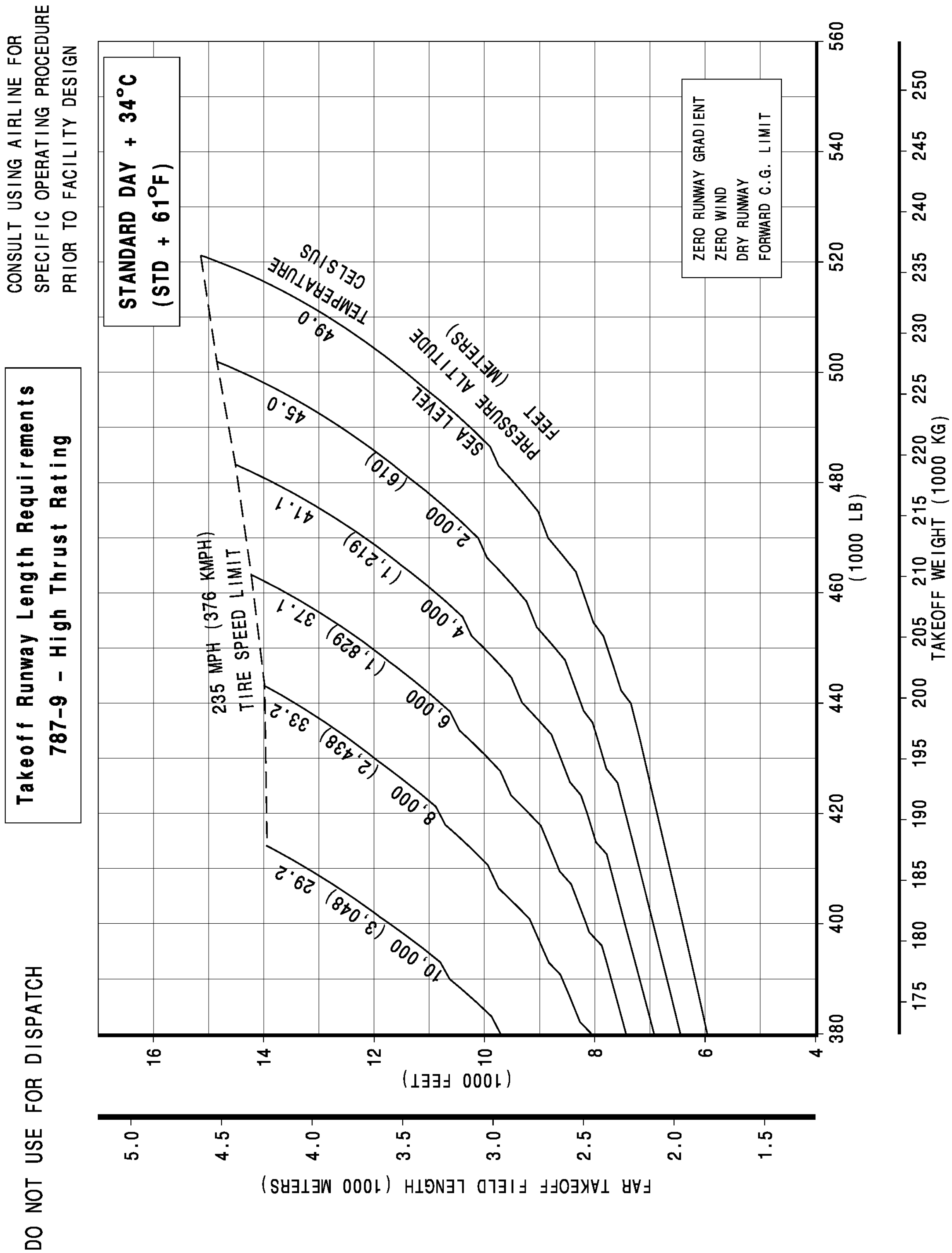
3.3.14 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 787-9, (Hi-Thrust Engines)



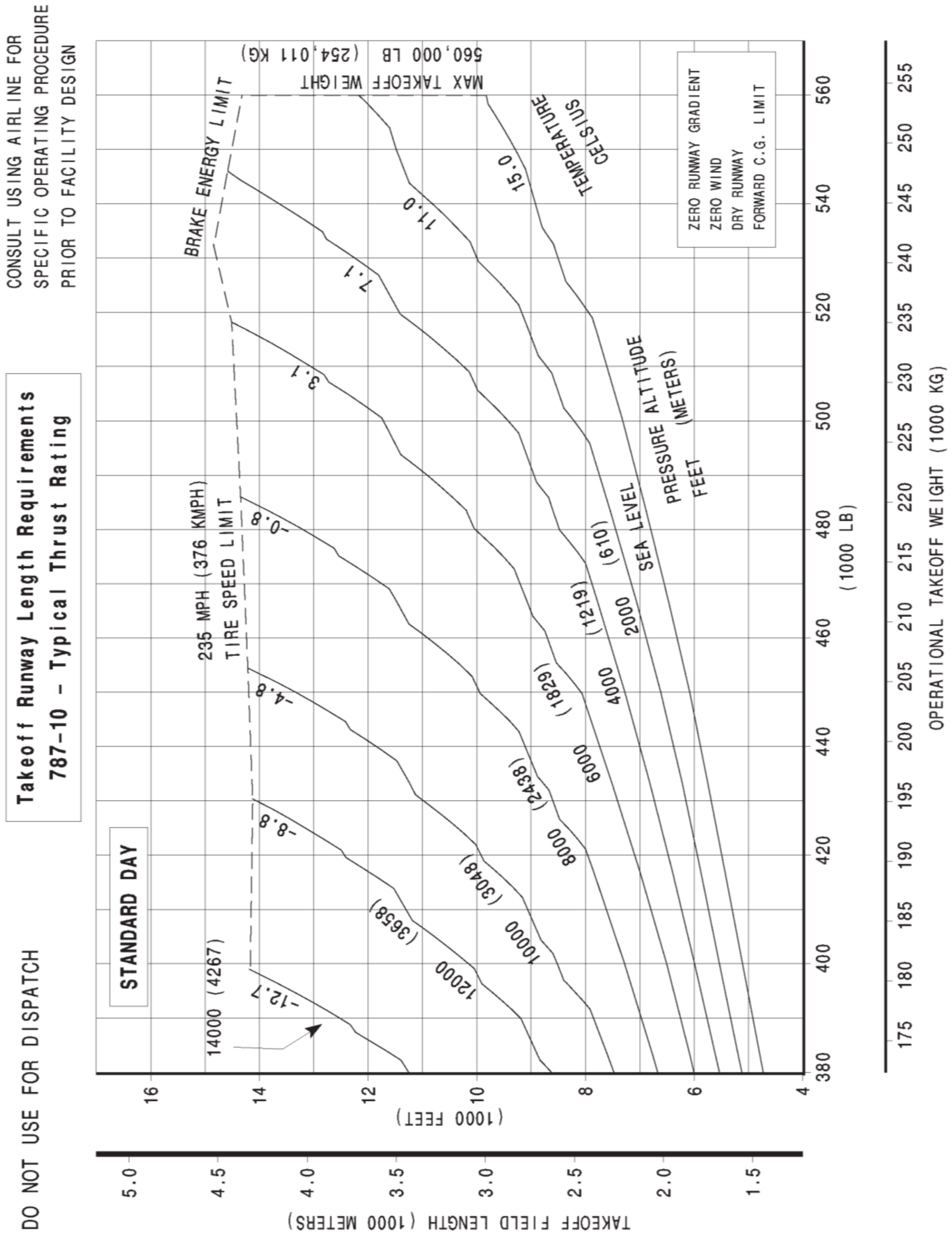
3.3.15 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 45°F (STD + 25°C), Dry Runway: Model 787-9, (Hi-Thrust Engines)



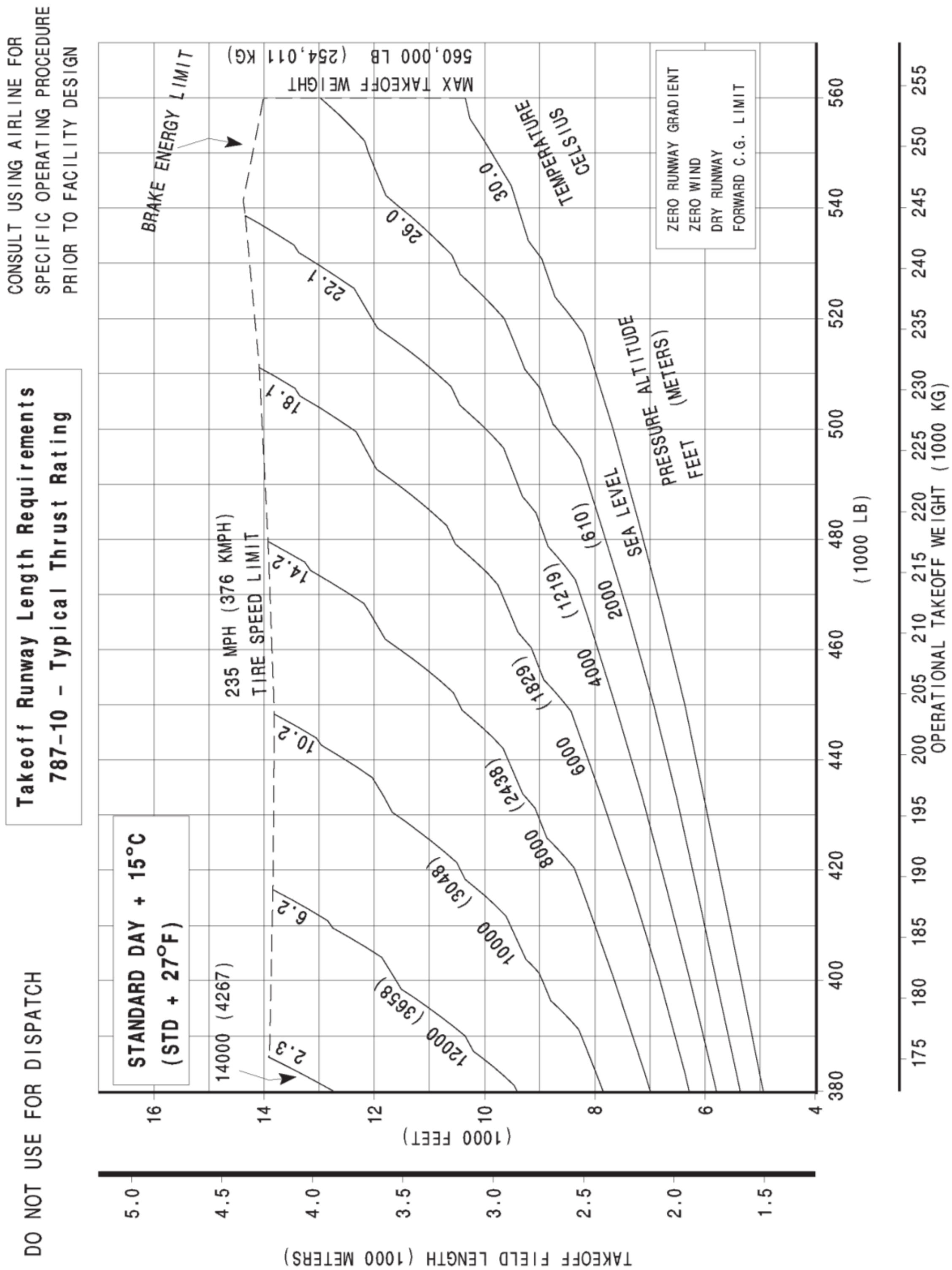
3.3.16 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 61°F (STD + 34°C), Dry Runway: Model 787-9, (Hi-Thrust Engines)



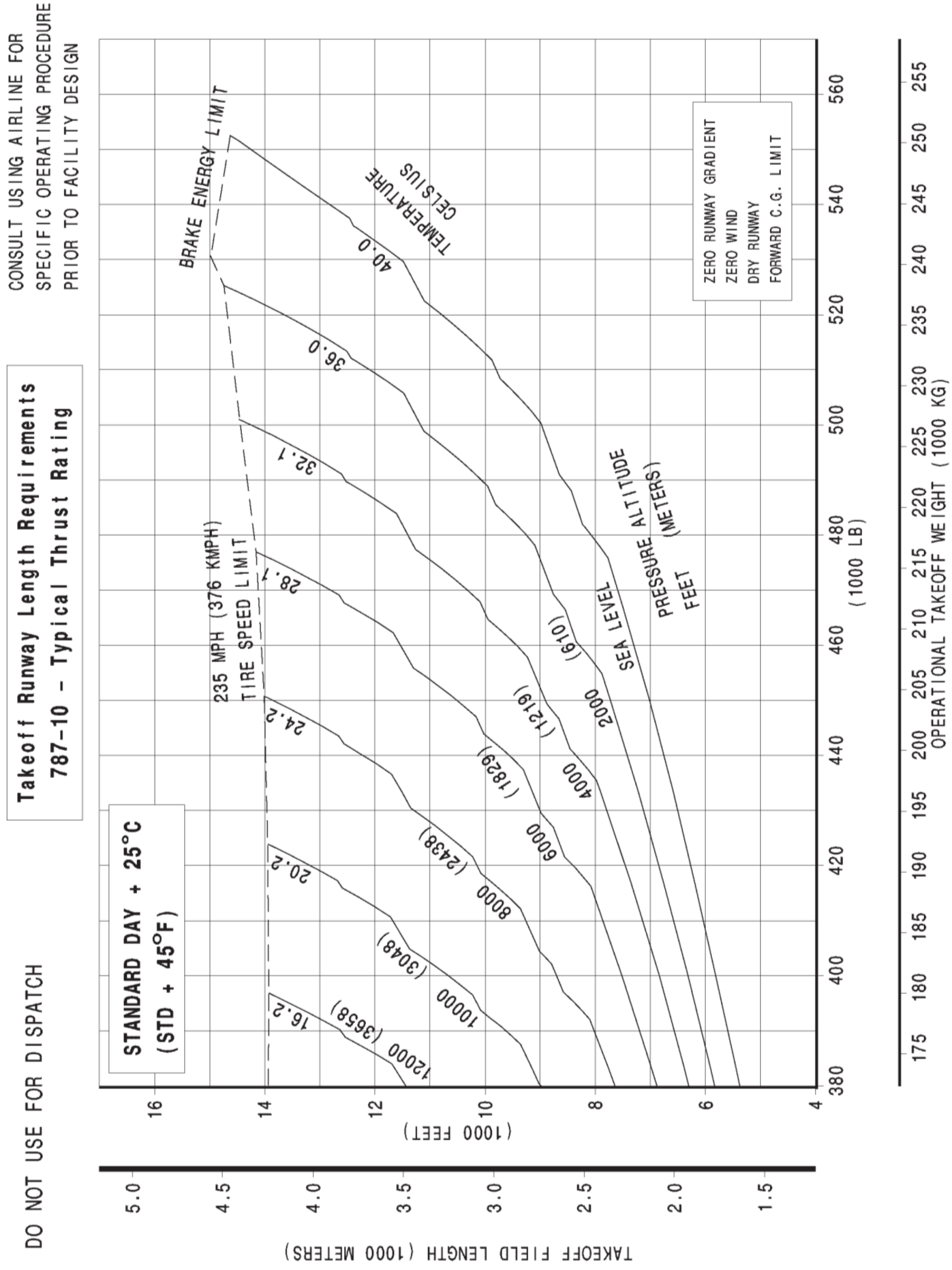
3.3.17 FAA/EASA Takeoff Runway Length Requirements - Standard Day, Dry Runway: Model 787-10 (Typical Engines)



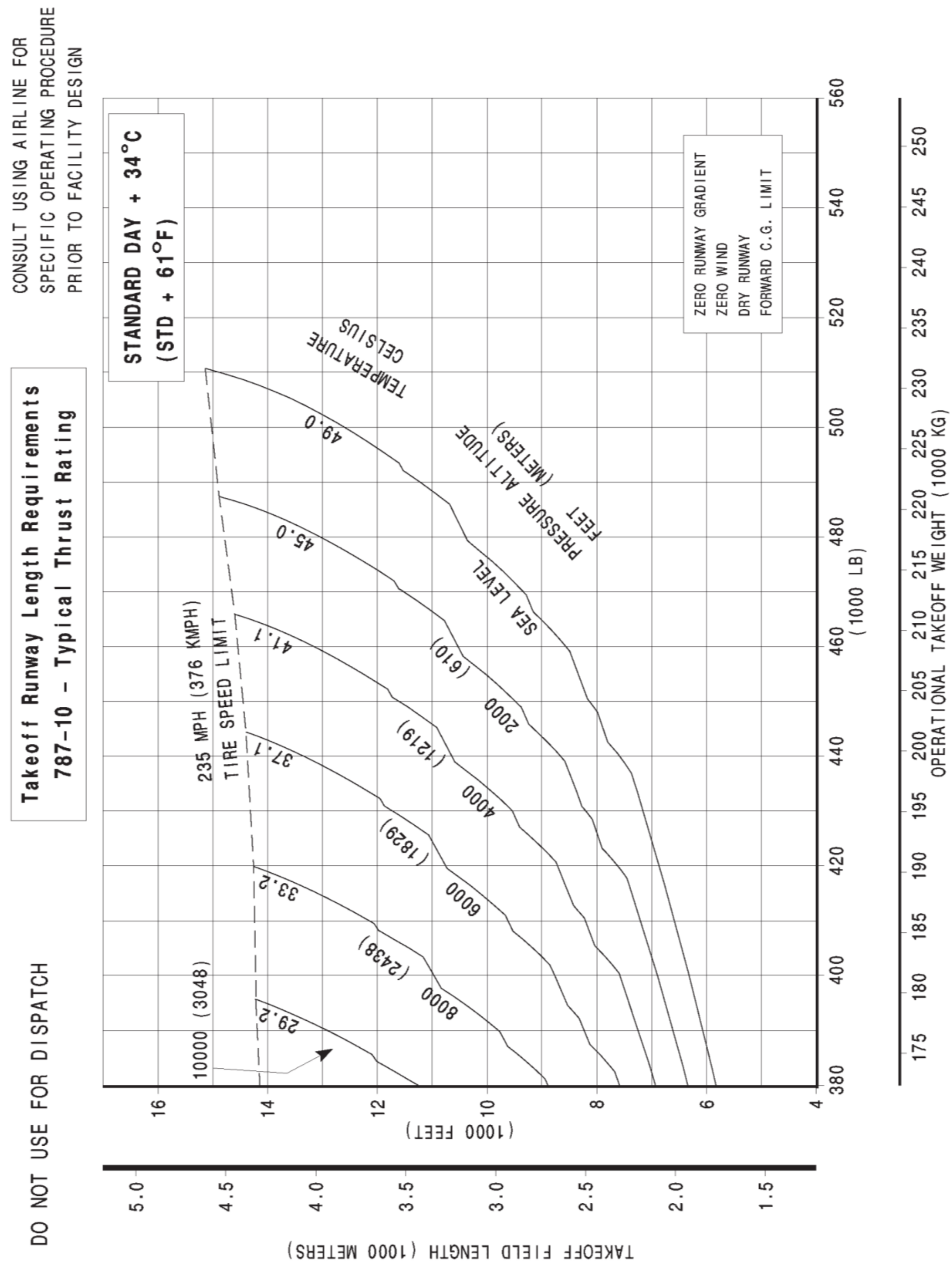
3.3.18 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 787-10 (Typical Engines)



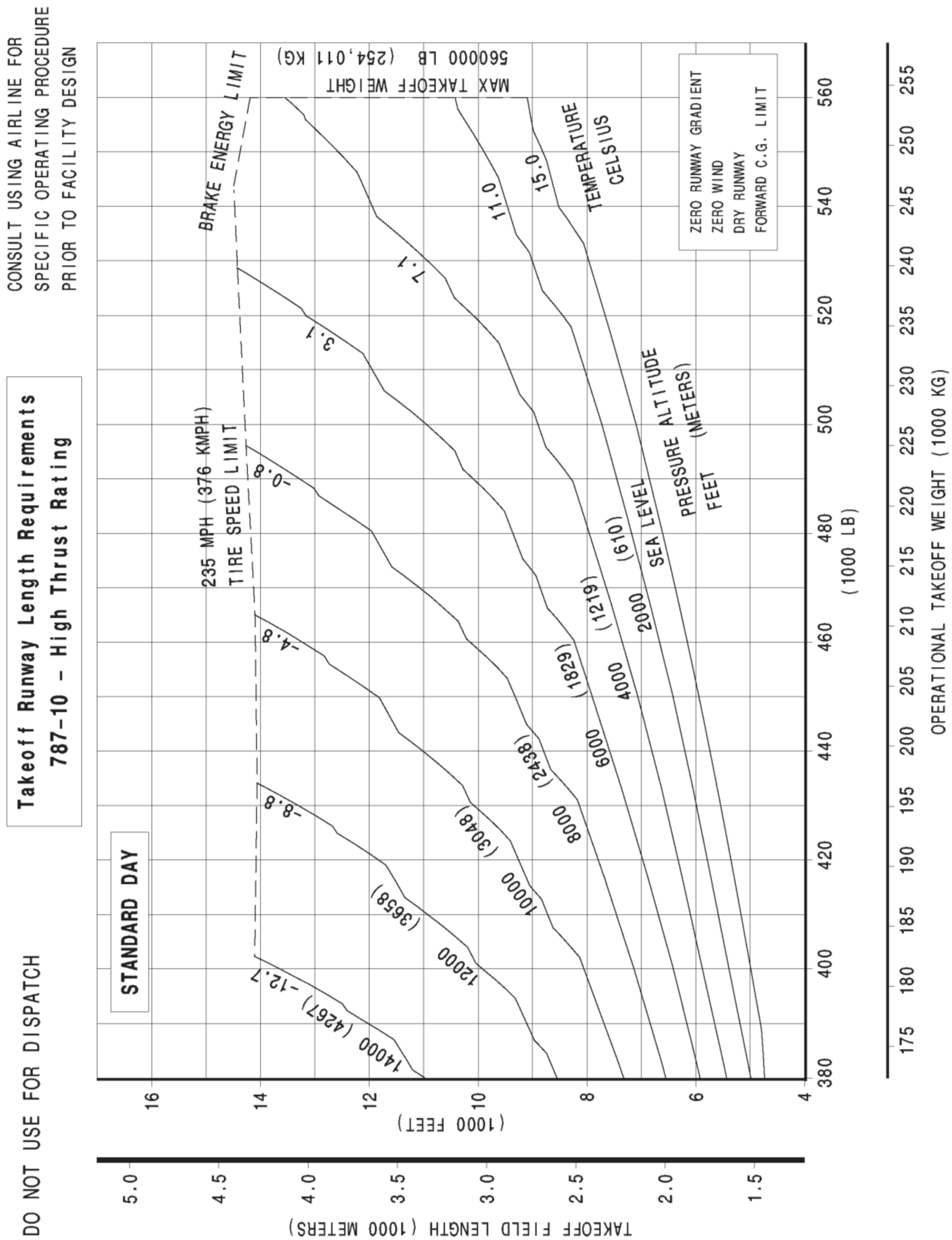
3.3.19 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 45°F (STD + 25°C), Dry Runway: Model 787-10 (Typical Engines)



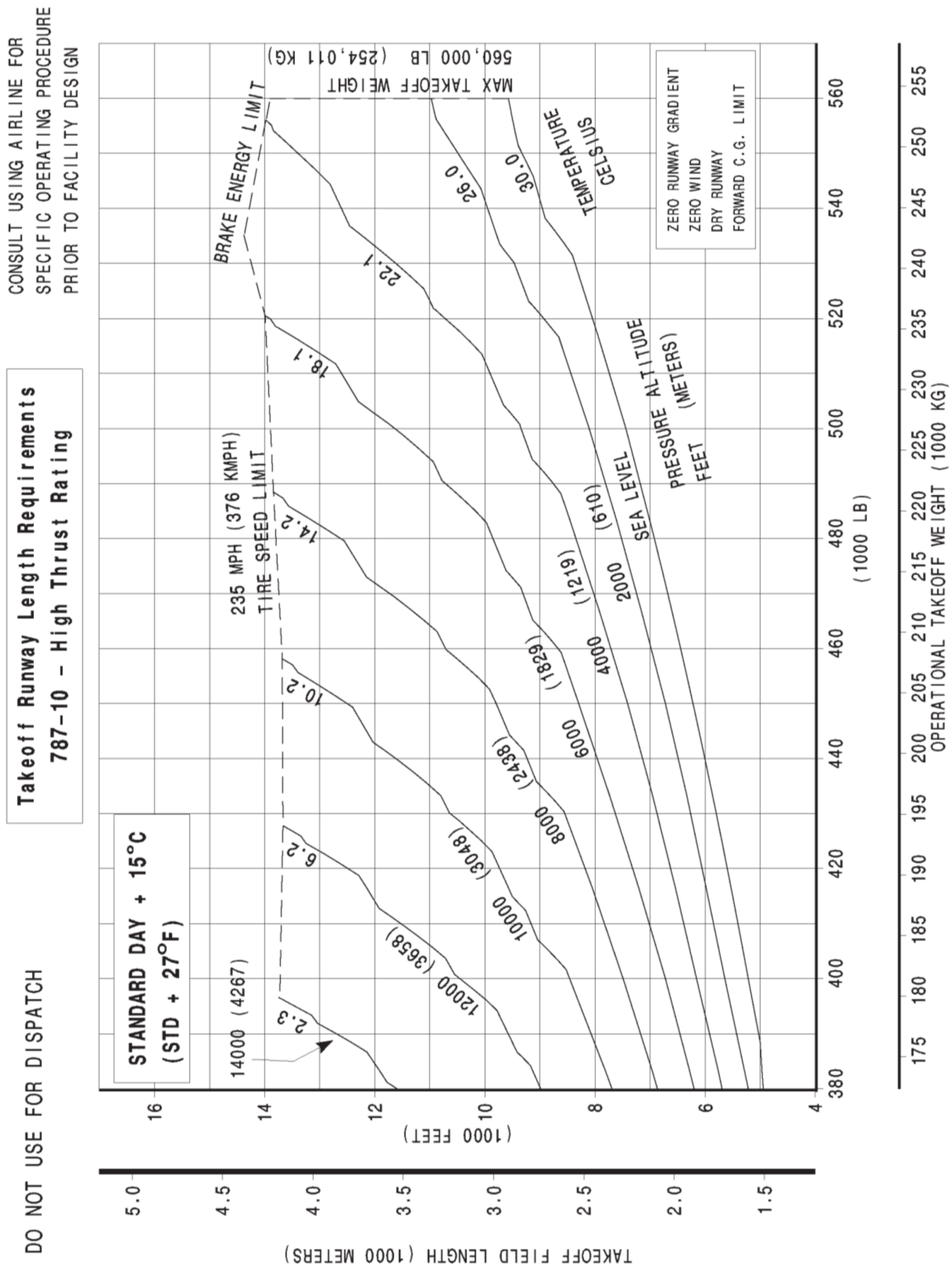
3.3.20 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 61°F (STD + 34°C), Dry Runway: Model 787-10 (Typical Engines)



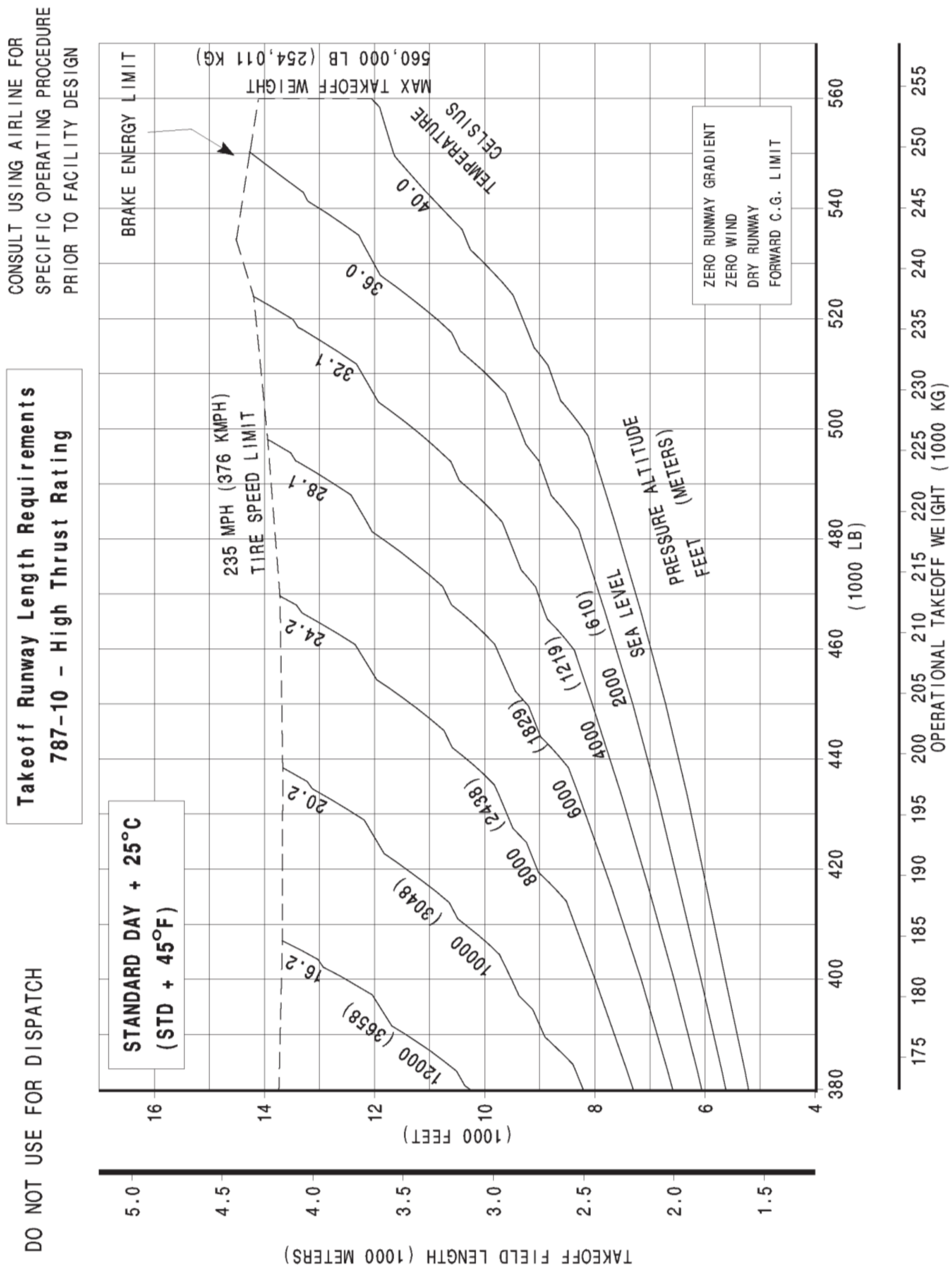
3.3.21 FAA/EASA Takeoff Runway Length Requirements - Standard Day, Dry Runway: Model 787-10 (Hi-Thrust Engines)



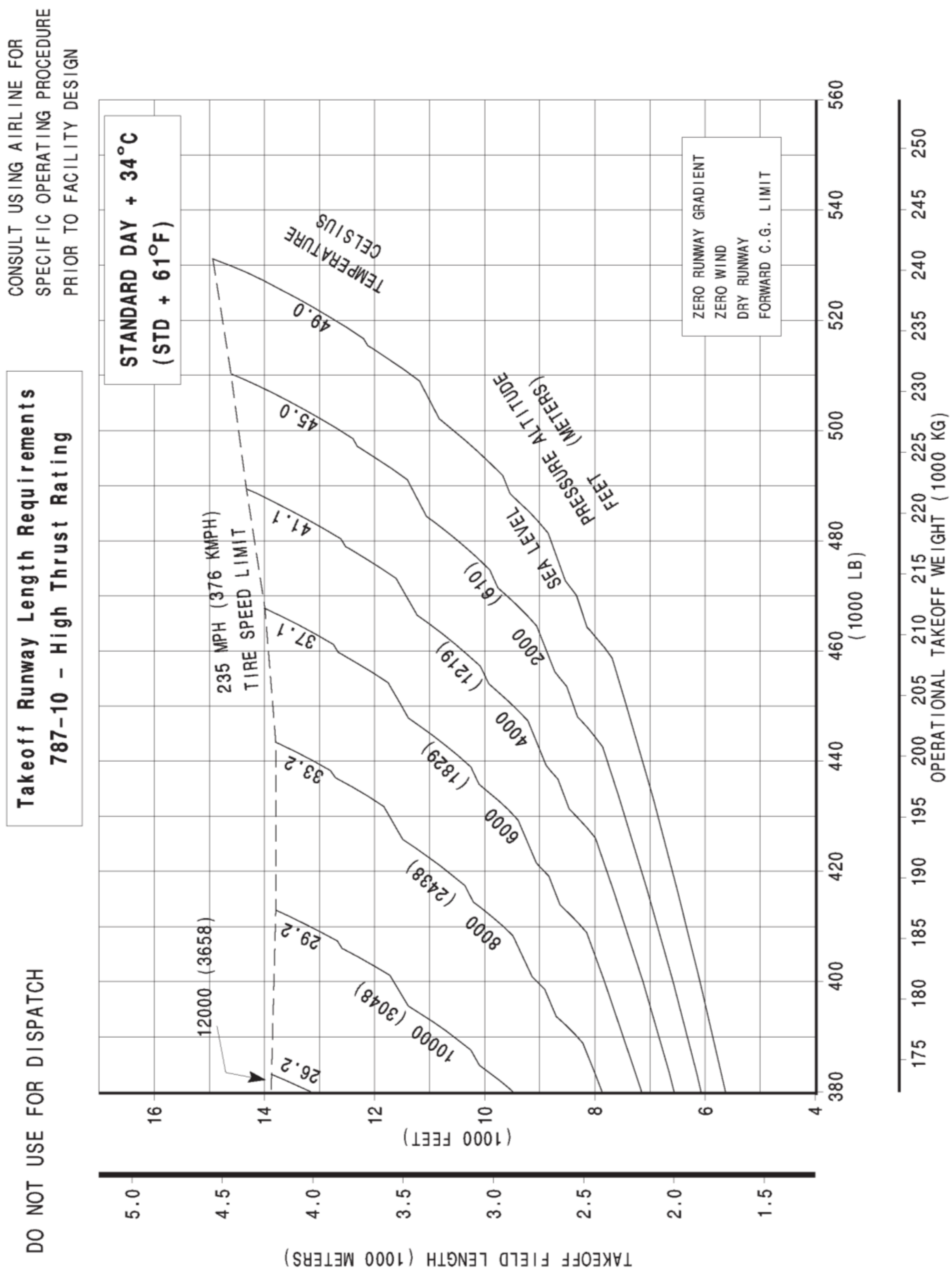
3.3.22 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 27°F (STD + 15°C), Dry Runway: Model 787-10 (Hi-Thrust Engines)



3.3.23 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 45°F (STD + 25°C), Dry Runway: Model 787-8 (Hi-Thrust Engines)

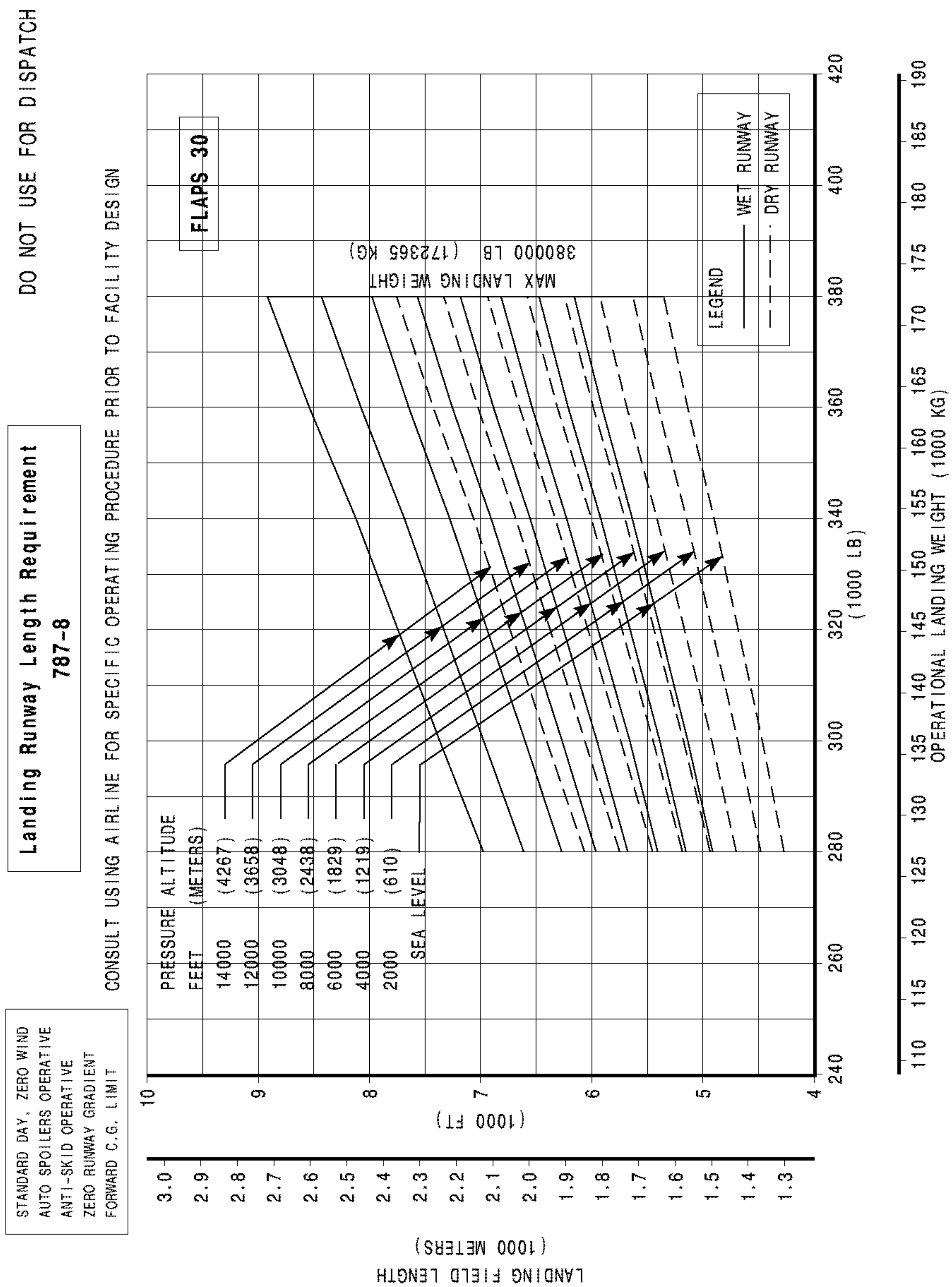


3.3.24 FAA/EASA Takeoff Runway Length Requirements - Standard Day + 61°F (STD + 34°C), Dry Runway: Model 787-8 (Hi-Thrust Engines)

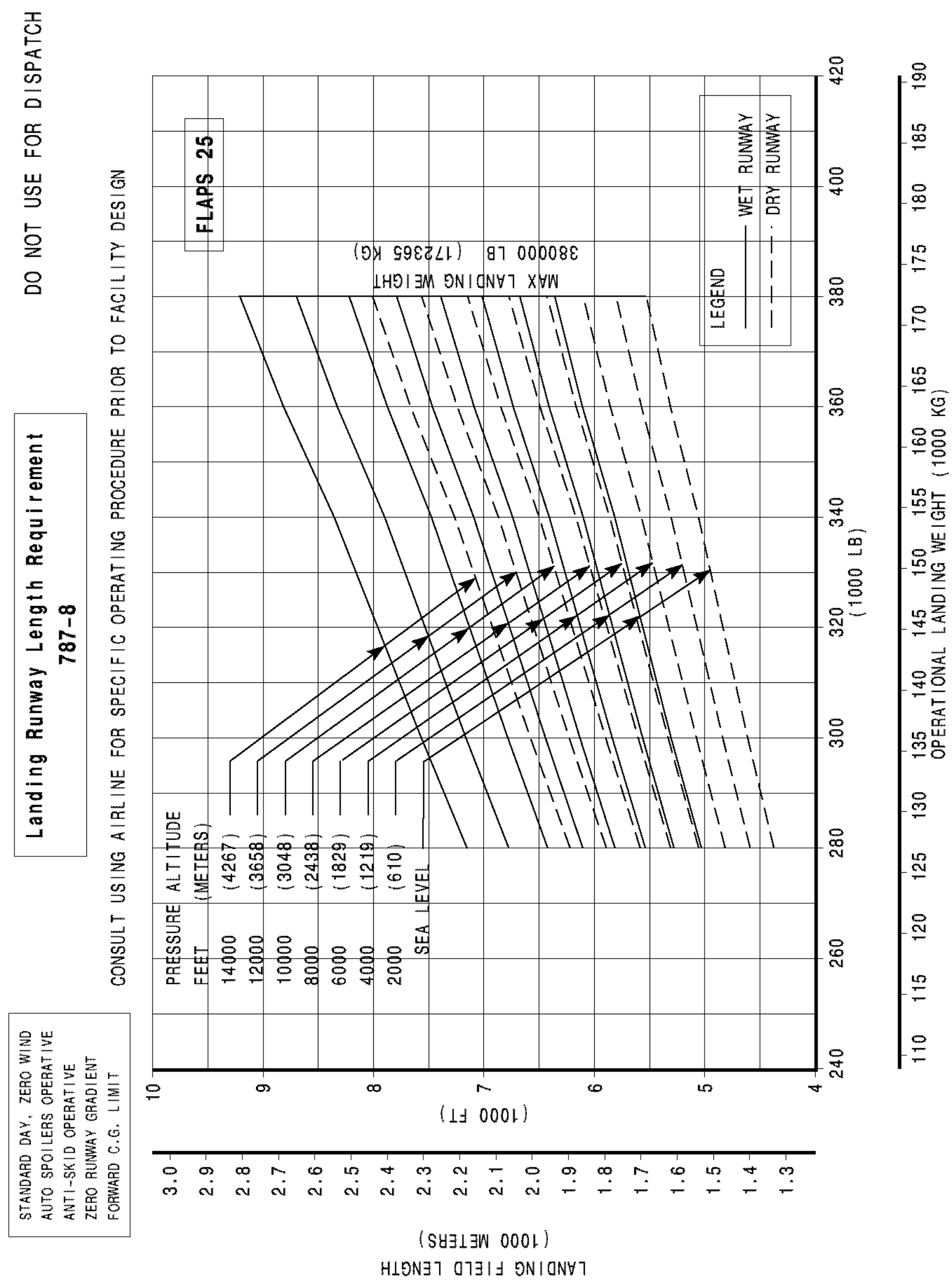


3.4 FAA/EASA LANDING RUNWAY LENGTH REQUIREMENTS

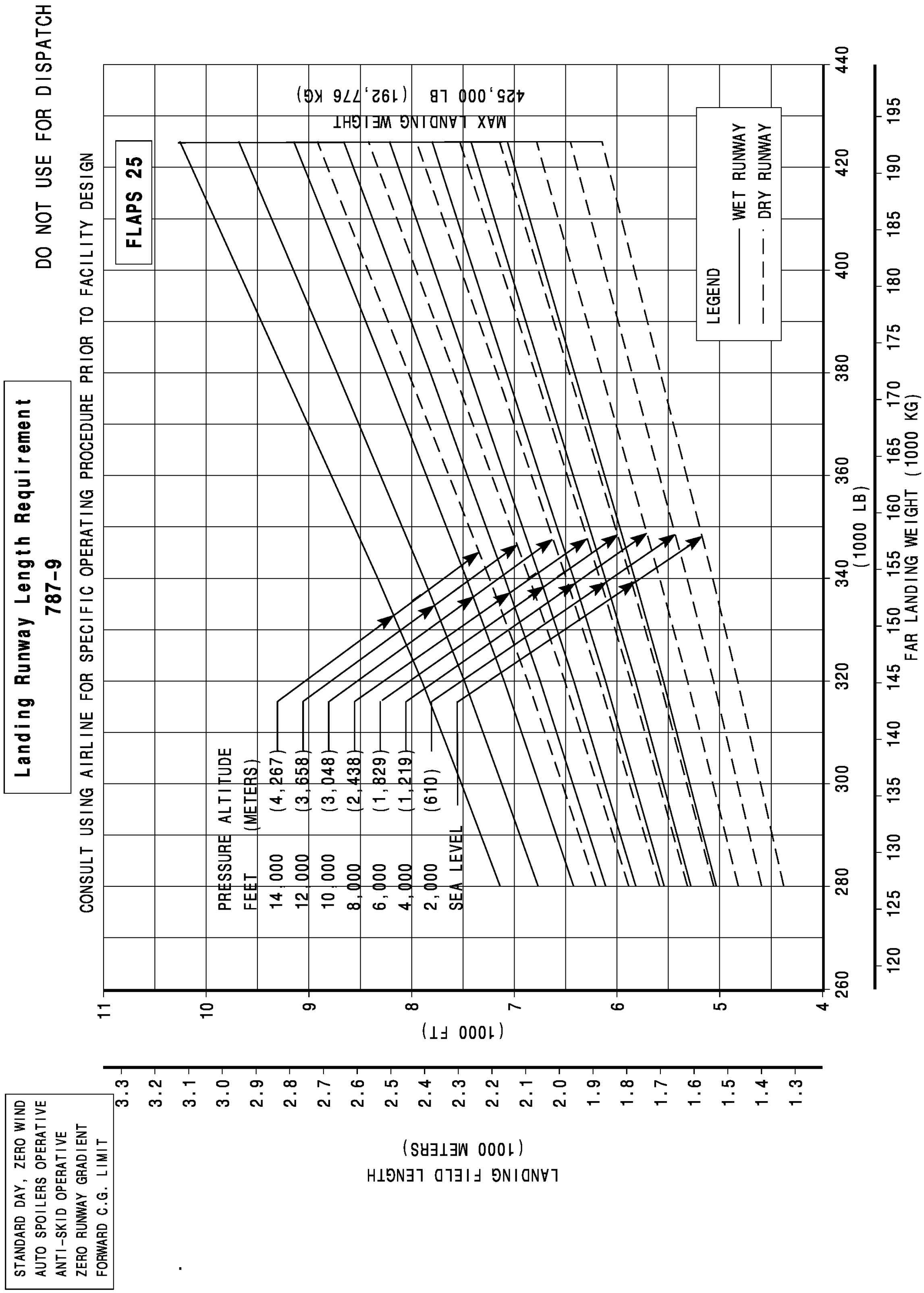
3.4.1 FAA/EASA Landing Runway Length Requirements – Flaps 30: Model 787-8 (All Engines)



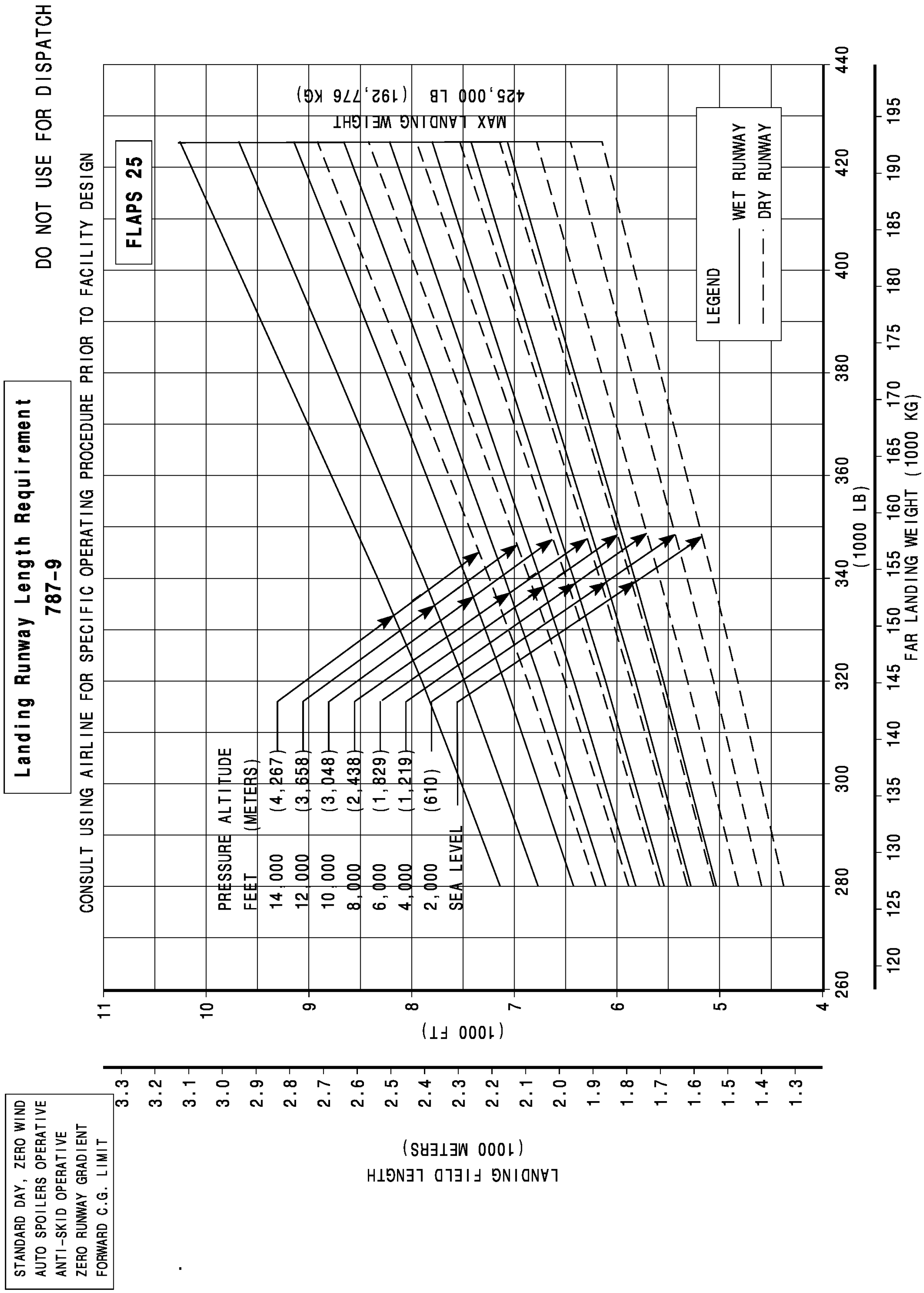
3.4.2 FAA/EASA Landing Runway Length Requirements – Flaps 25: Model 787-8 (All Engines)



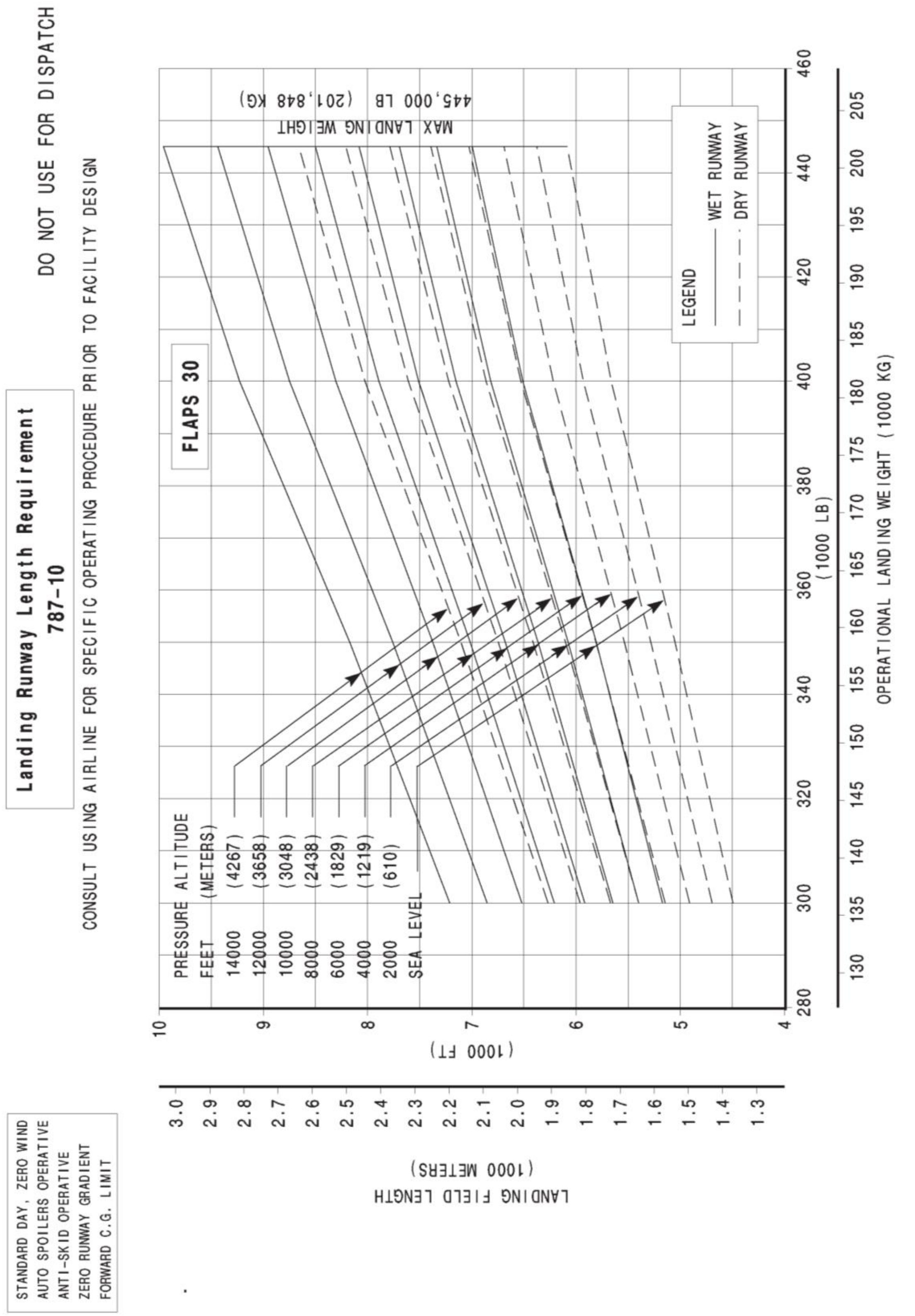
3.4.3 FAA/EASA Landing Runway Length Requirements – Flaps 30: Model 787-9 (All Engines)



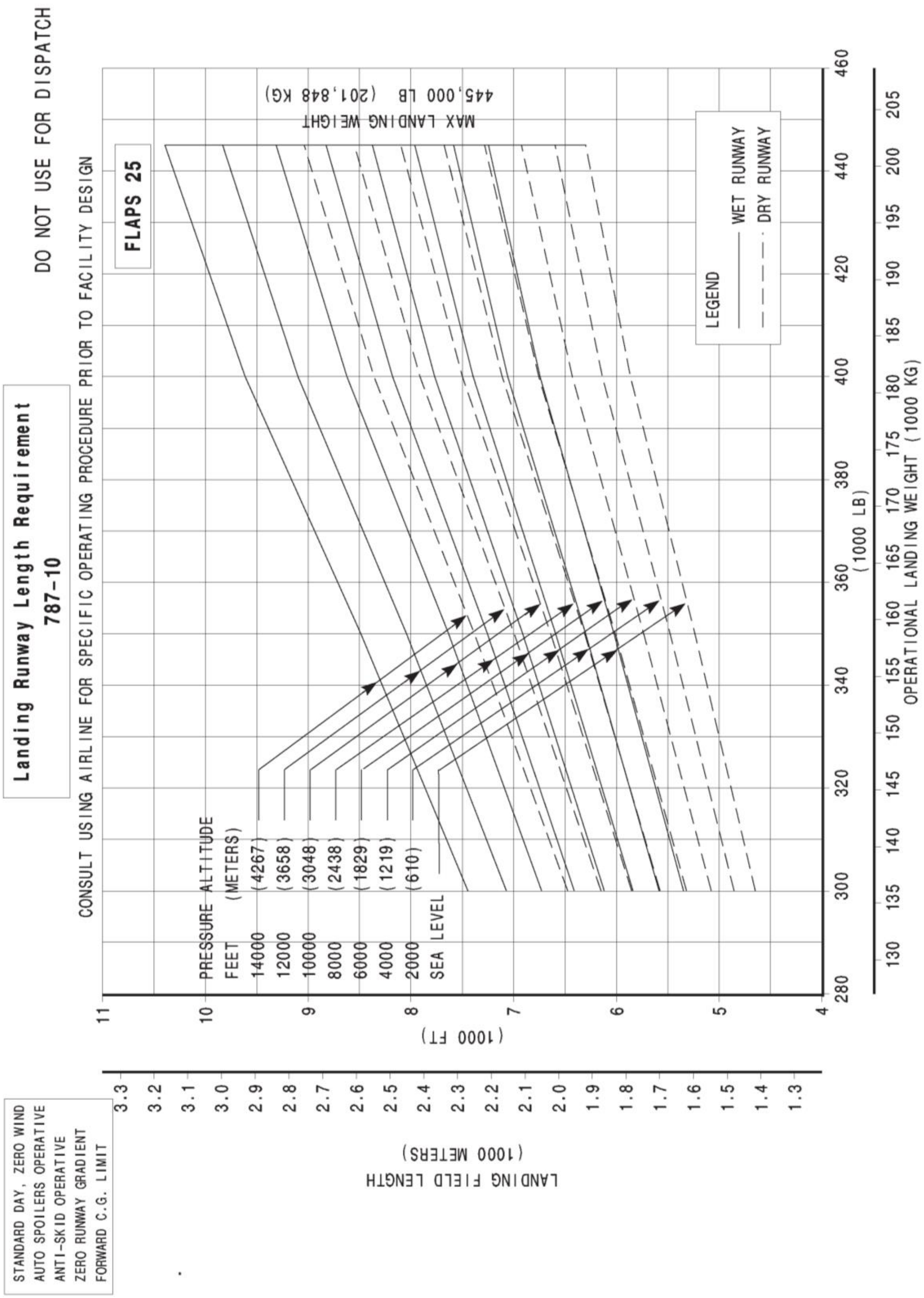
3.4.4 FAA/EASA Landing Runway Length Requirements – Flaps 25: Model 787-9 (All Engines)



3.4.5 FAA/EASA Landing Runway Length Requirements – Flaps 30: Model 787-10 (All Engines)



3.4.6 FAA/EASA Landing Runway Length Requirements – Flaps 25: Model 787-10 (All Engines)



4.0 GROUND MANEUVERING

4.1 GENERAL INFORMATION

This section provides airplane turning capability and maneuvering characteristics.

For ease of presentation, these data have been determined from the theoretical limits imposed by the geometry of the aircraft, and where noted, provide for a normal allowance for tire slippage. As such, they reflect the turning capability of the aircraft in favorable operating circumstances. These data should be used only as guidelines for the method of determination of such parameters and for the maneuvering characteristics of this aircraft.

In the ground operating mode, varying airline practices may demand that more conservative turning procedures be adopted to avoid excessive tire wear and reduce possible maintenance problems. Airline operating procedures will vary in the level of performance over a wide range of operating circumstances throughout the world. Variations from standard aircraft operating patterns may be necessary to satisfy physical constraints within the maneuvering area, such as adverse grades, limited area, or high risk of jet blast damage. For these reasons, ground maneuvering requirements should be coordinated with the using airlines prior to layout planning.

Section 4.2 presents turning radii for various nose gear steering angles. Radii for the main and nose gears are measured from the turn center to the outside of the tire.

Section 4.3 shows data on minimum width of pavement required for 180° turn.

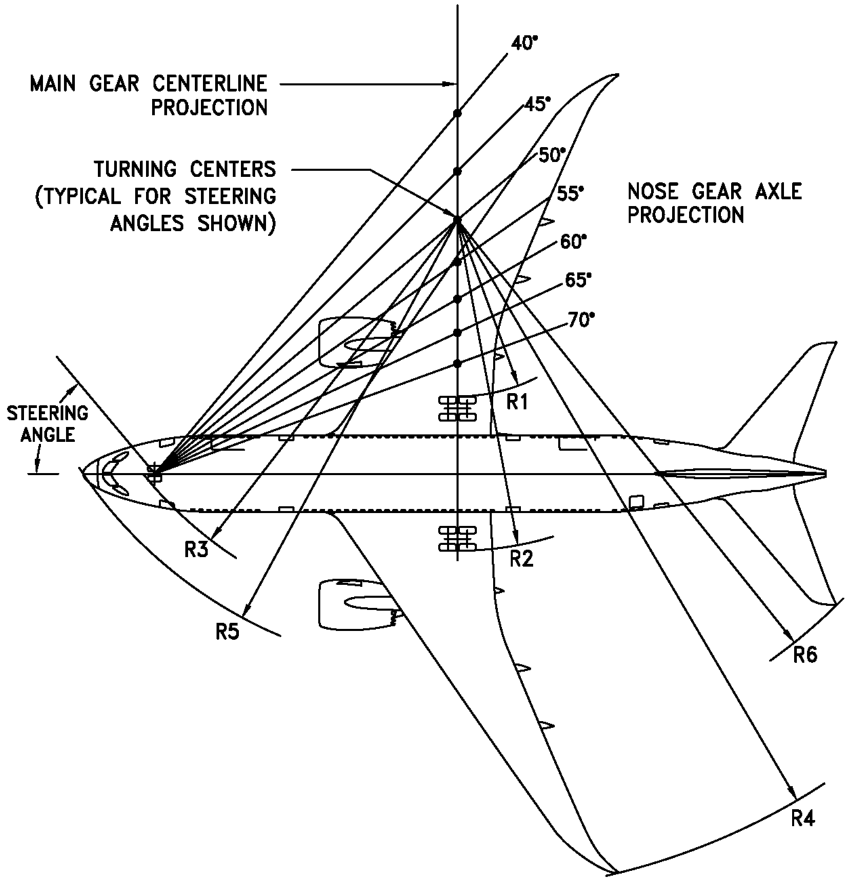
Section 4.4 provides pilot visibility data from the cockpit and the limits of ambinocular vision through the windows. Ambinocular vision is defined as the total field of vision seen simultaneously by both eyes.

Section 4.5 shows approximate wheel paths for various runway and taxiway turn scenarios. The pavement fillet geometries are based on the FAA's Advisory Circular (AC) 150/5300-13 (thru change 16). They represent typical fillet geometries built at many airports worldwide. ICAO and other civil aviation authorities publish many different fillet design methods. Prior to determining the size of fillets, airports are advised to check with the airlines regarding the operating procedures and aircraft types they expect to use at the airport. Further, given the cost of modifying fillets and the operational impact to ground movement and air traffic during construction, airports may want to design critical fillets for larger aircraft types to minimize future operational impacts.

Section 4.6 illustrates a typical runway holding bay configuration.

4.2 TURNING RADII

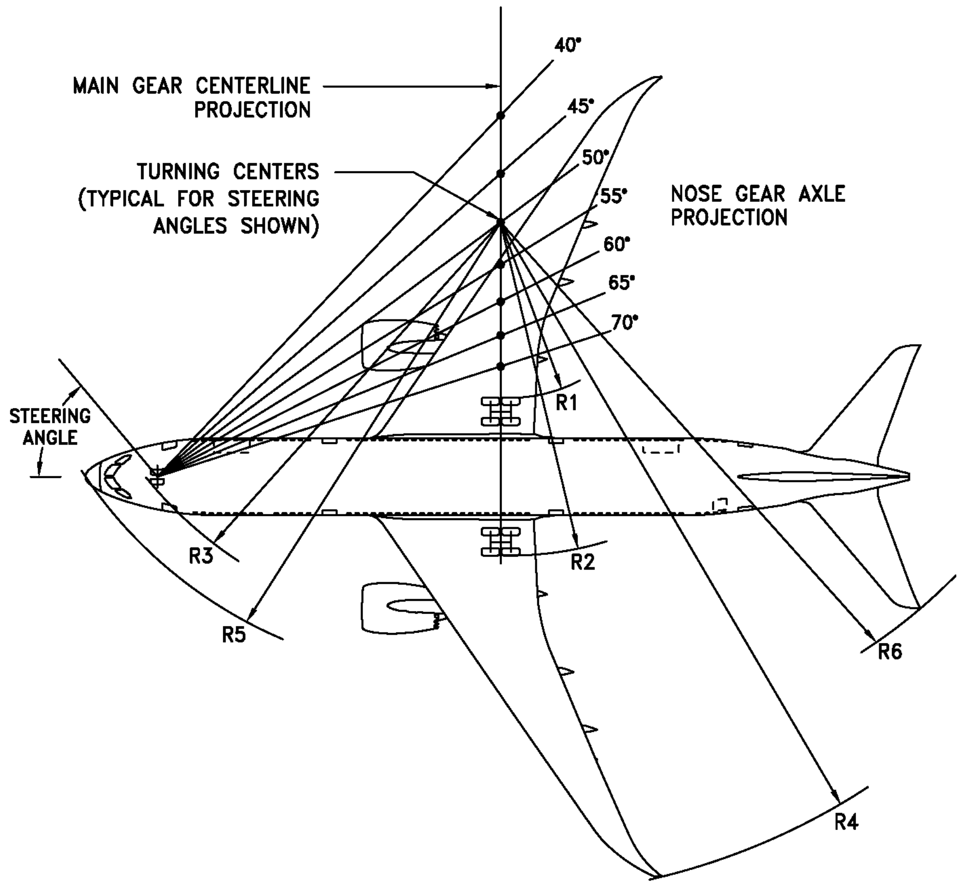
4.2.1 Turning Radii – No Slip Angle: Model 787-8



NOTES: ACTUAL OPERATING TURNING RADII MAY BE GREATER THAN SHOWN. CONSULT WITH AIRLINE FOR SPECIFIC OPERATING PROCEDURE.

STEERING ANGLE	R1 INNER GEAR		R2 OUTER GEAR		R3 NOSE GEAR		R4 WINGTIP		R5 NOSE		R6 TAIL	
(DEG)	FT	M	FT	M	FT	M	FT	M	FT	M	FT	M
30	111	33.8	149	45.4	152	46.3	232	70.7	160	48.8	188	57.3
35	88	26.8	126	38.4	133	40.5	210	64.0	142	43.3	168	51.2
40	71	21.6	109	33.2	119	36.3	192	58.5	129	39.3	154	46.9
45	56	17.1	94	28.7	108	32.9	178	54.3	119	36.3	143	43.6
50	44	13.4	82	25.0	100	30.5	167	50.9	112	34.1	134	40.8
55	34	10.4	72	21.9	94	28.7	157	47.9	107	32.6	127	38.7
60	25	7.6	63	19.2	89	27.1	148	45.1	103	31.4	121	36.9
65	16	4.9	54	16.5	85	25.9	140	42.7	99	30.2	116	35.4
70 (MAX)	9	2.7	47	14.3	82	25.0	133	40.5	97	29.6	112	34.1

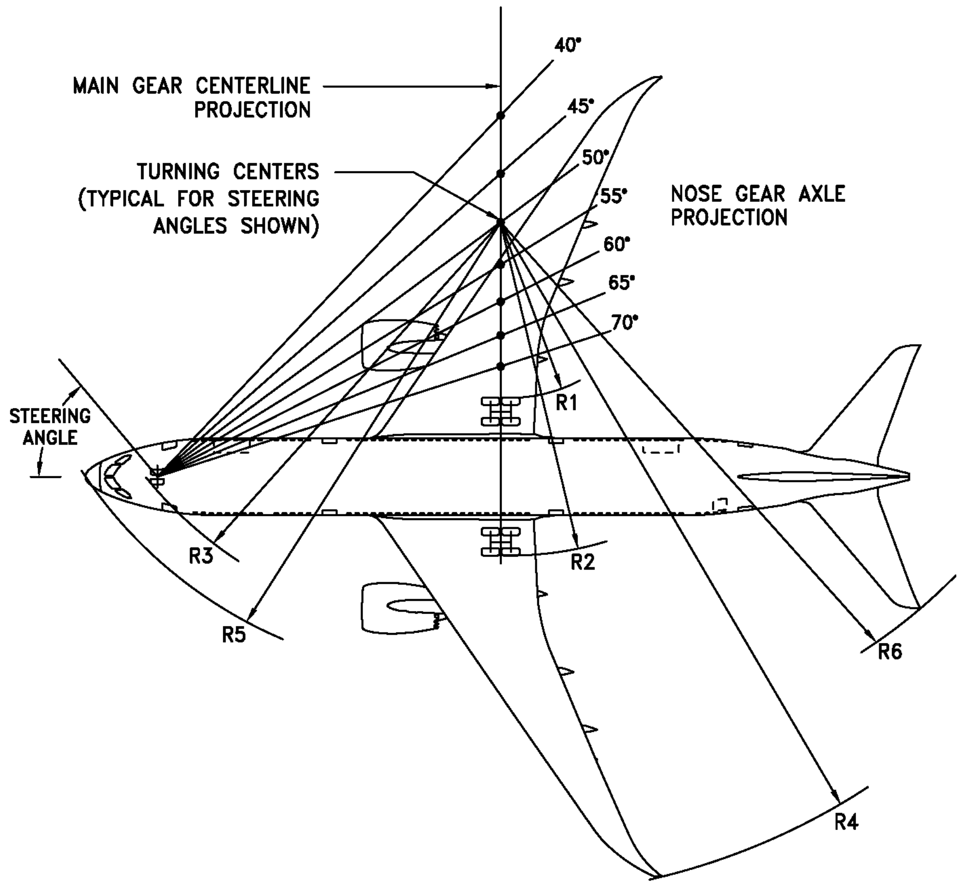
4.2.2 Turning Radii – No Slip Angle: Model 787-9



NOTES: ACTUAL OPERATING TURNING RADII MAY BE GREATER THAN SHOWN.
CONSULT WITH AIRLINE FOR SPECIFIC OPERATING PROCEDURE.

STEERING ANGLE	R1 INNER GEAR		R2 OUTER GEAR		R3 NOSE GEAR		R4 WINGTIP		R5 NOSE		R6 TAIL	
(DEG)	**FT**	**M**	**FT**	**M**	**FT**	**M**	**FT**	**M**	**FT**	**M**	**FT**	**M**
30	128	39.0	167	50.9	172	52.4	249	75.9	180	54.9	208	63.4
35	102	31.1	141	43.0	150	45.7	224	68.3	159	48.5	186	56.7
40	82	25.0	121	36.9	134	40.8	204	62.2	144	43.9	169	51.5
45	66	20.1	105	32.0	122	37.2	188	57.3	133	40.5	157	47.9
50	52	15.8	91	27.7	113	34.4	175	53.3	125	38.1	147	44.8
55	40	12.2	79	24.1	106	32.3	163	49.7	119	36.3	139	42.4
60	30	9.1	69	21.0	100	30.5	153	46.6	114	34.7	132	40.2
65	21	6.4	59	18.0	96	29.3	144	43.9	110	33.5	127	38.7
70 (MAX)	12	3.7	51	15.5	93	28.3	136	41.5	108	32.9	122	37.2

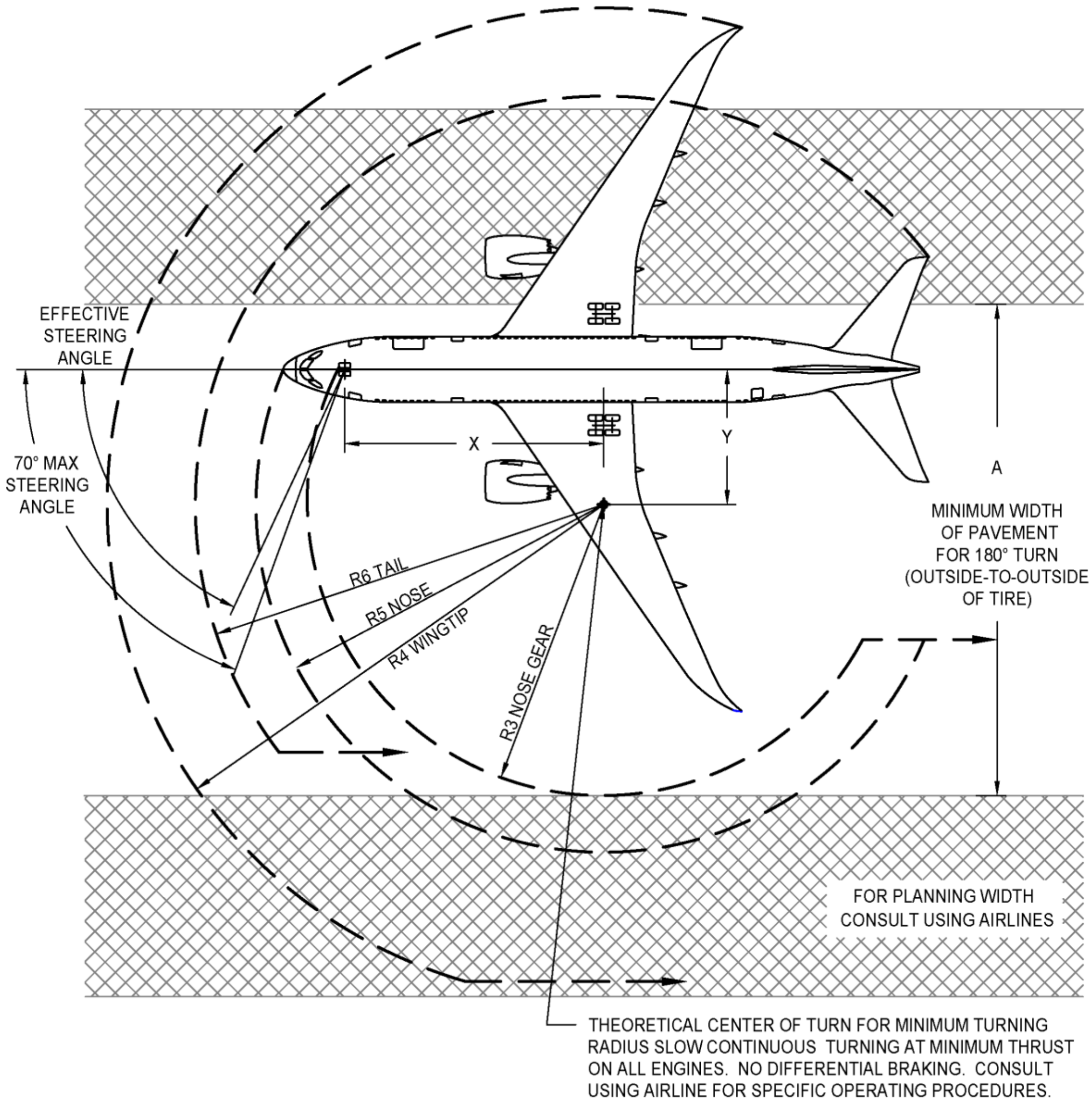
4.2.3 Turning Radii – No Slip Angle: Model 787-10



NOTES: ACTUAL OPERATING TURNING RADII MAY BE GREATER THAN SHOWN.
CONSULT WITH AIRLINE FOR SPECIFIC OPERATING PROCEDURE.

STEERING ANGLE	R1 INNER GEAR		R2 OUTER GEAR		R3 NOSE GEAR		R4 WINGTIP		R5 NOSE		R6 TAIL	
(DEG)	FT	M	FT	M	FT	M	FT	M	FT	M	FT	M
30	145	44.2	184	56.1	192	58.5	266	81.1	199	60.7	227	69.2
35	116	35.4	155	47.2	168	51.2	238	72.5	176	53.6	202	61.6
40	94	28.7	133	40.5	150	45.7	216	65.8	160	48.8	184	56.1
45	76	23.2	115	35.1	136	41.5	198	60.4	148	45.1	170	51.8
50	61	18.6	99	30.2	126	38.4	183	55.8	138	42.1	159	48.5
55	47	14.3	86	26.2	118	36.0	170	51.8	131	39.9	150	45.7
60	36	11.0	75	22.9	112	34.1	159	48.5	126	38.4	142	43.3
65	25	7.6	64	19.5	107	32.6	149	45.4	121	36.9	136	41.5
70 (MAX)	16	4.9	54	16.5	103	31.4	139	42.4	118	36.0	131	39.9

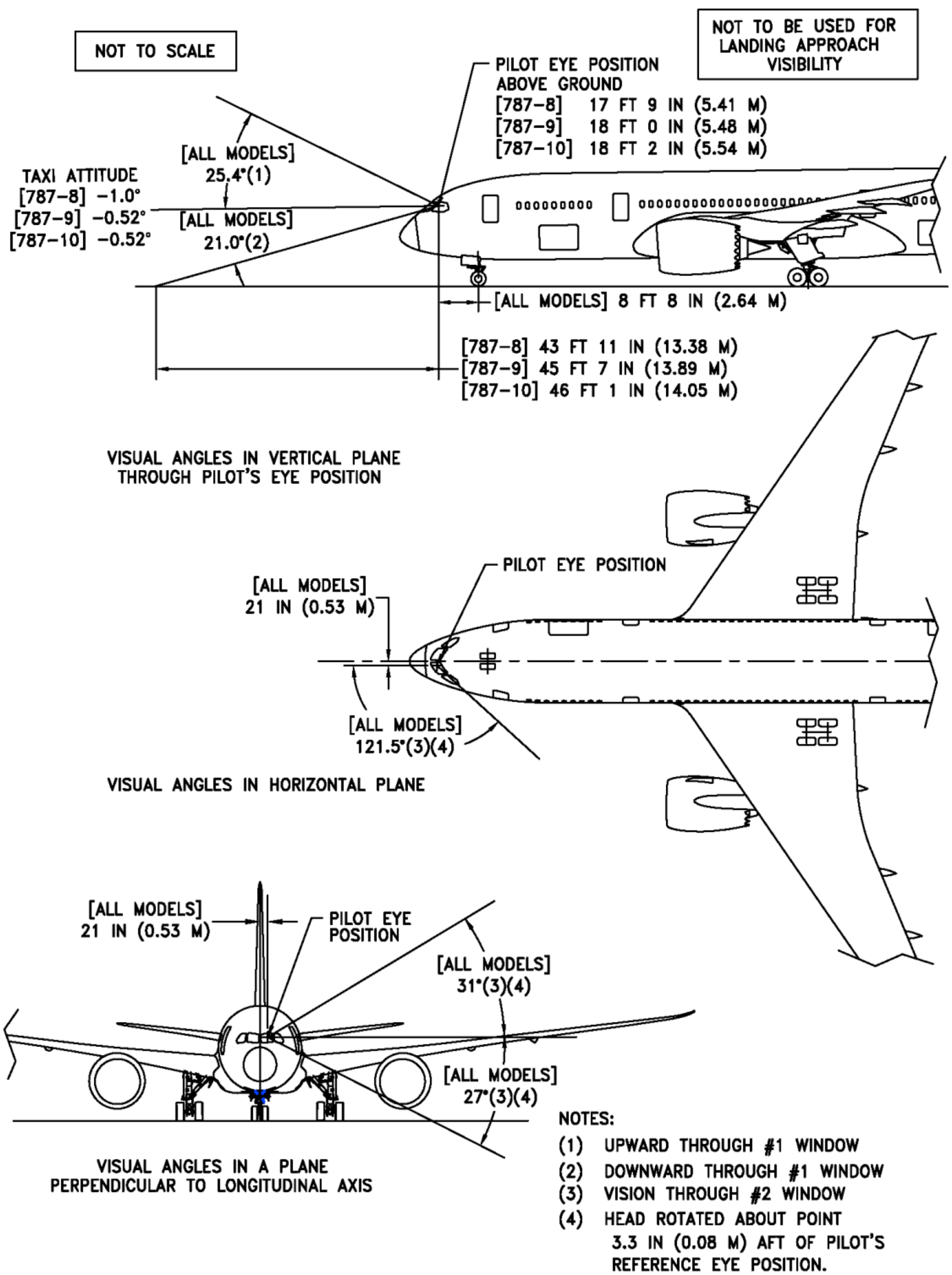
4.3 CLEARANCE RADII: MODEL 787-8, 787-9, 787-10



MODEL	EFFECTIVE TURNING ANGLE (DEG)	X		Y		A		R3		R4		R5		R6	
		FT	M	FT	M	FT	M	FT	M	FT	M	FT	M	FT	M
787-8	65	75	22.9	35	10.7	139	42.4	85	25.9	140	42.7	99	30.2	116	35.4
787-9	65	85	25.9	40	12.2	155	47.2	96	29.3	144	43.9	110	33.5	127	38.7
787-10	64	95	29.0	47	14.3	173	52.7	108	32.9	151	46.0	122	37.2	137	41.8

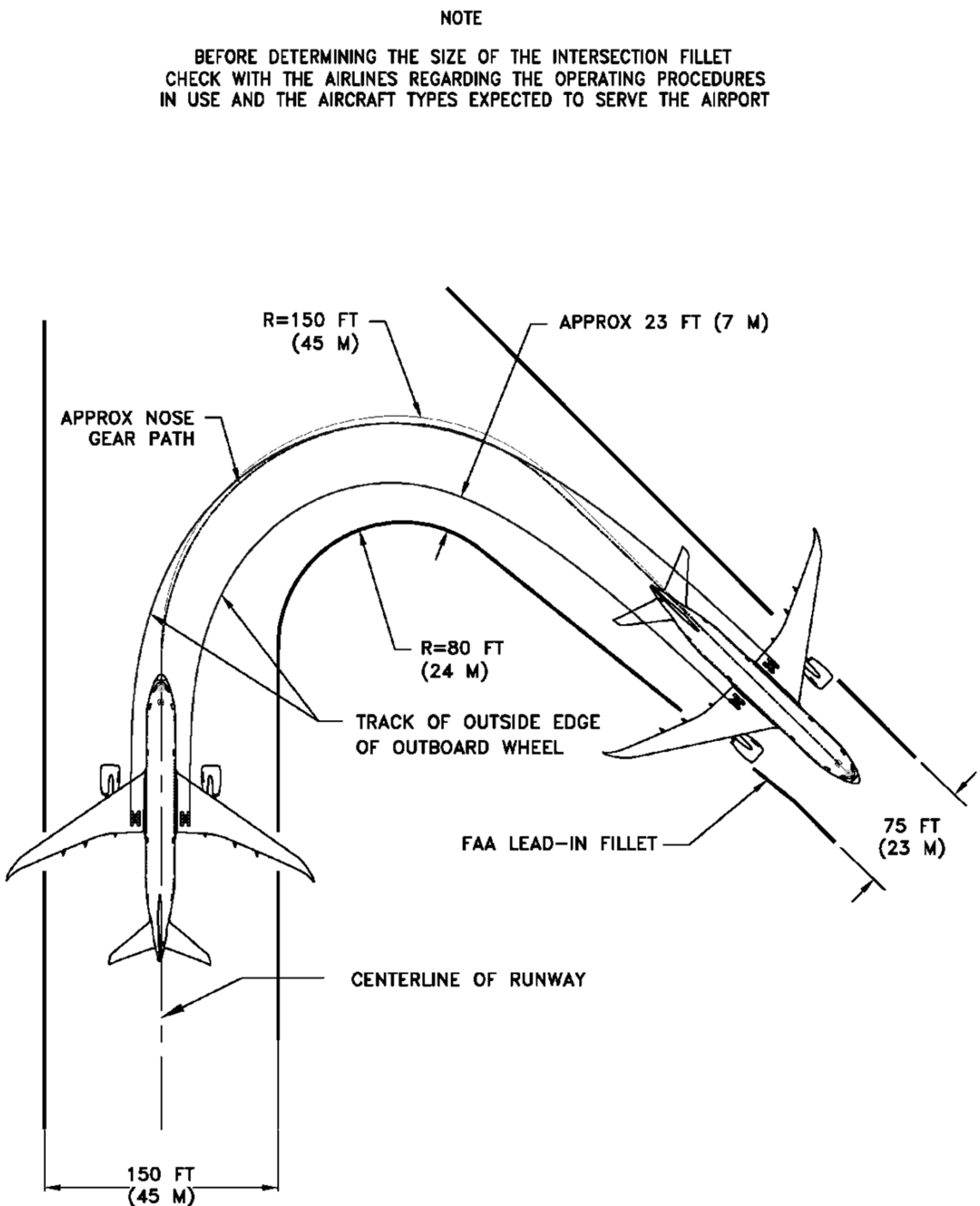
4.4 VISIBILITY FROM COCKPIT IN STATIC POSITION

4.4.1 Visibility from Cockpit in Static Position: Model 787-8, 787-9, 787-10

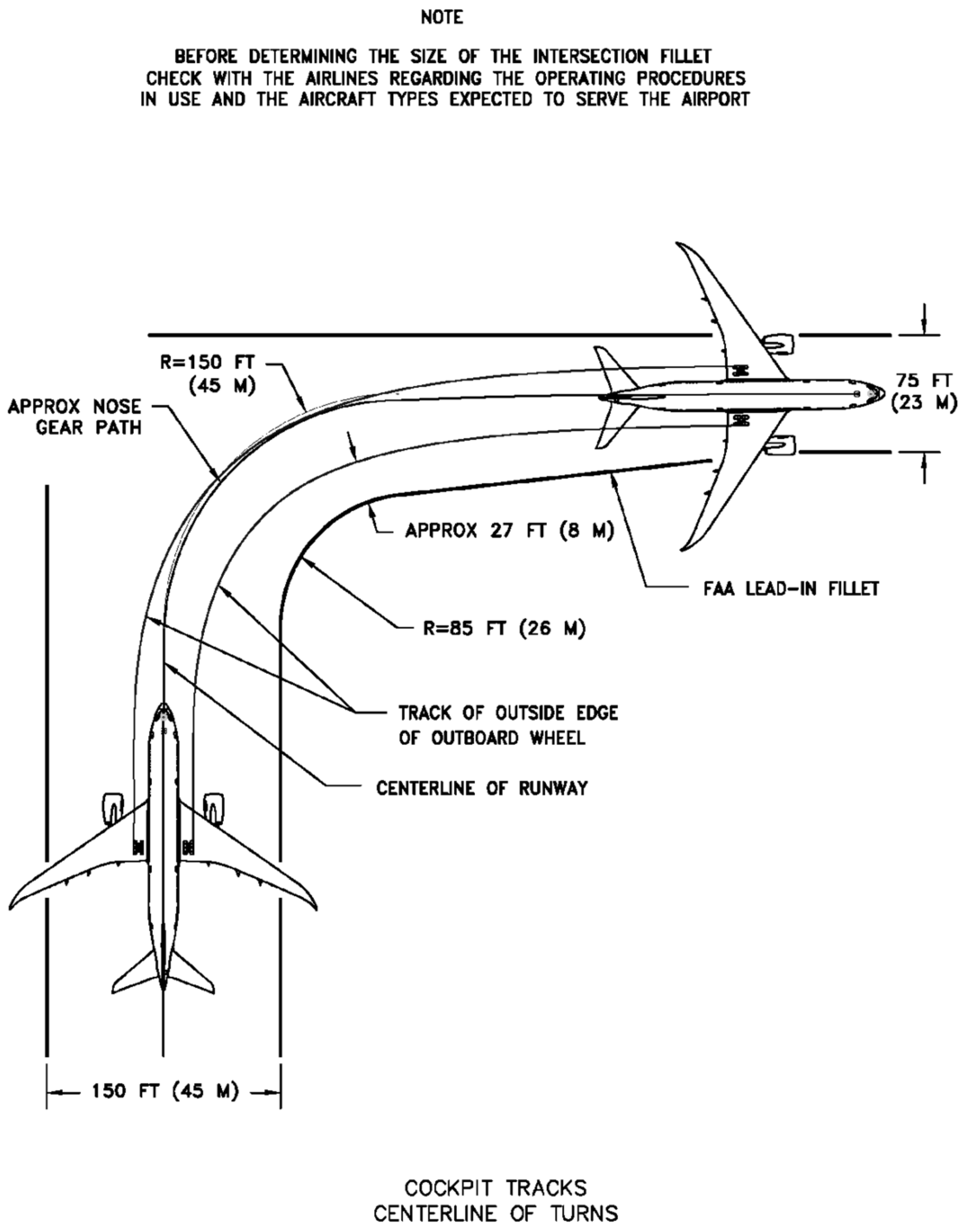


4.5 RUNWAY AND TAXIWAY TURNPATHS

4.5.1 Runway and Taxiway Turnpaths - Runway-to-Taxiway, More Than 90 Degree Turn: Model 787-8



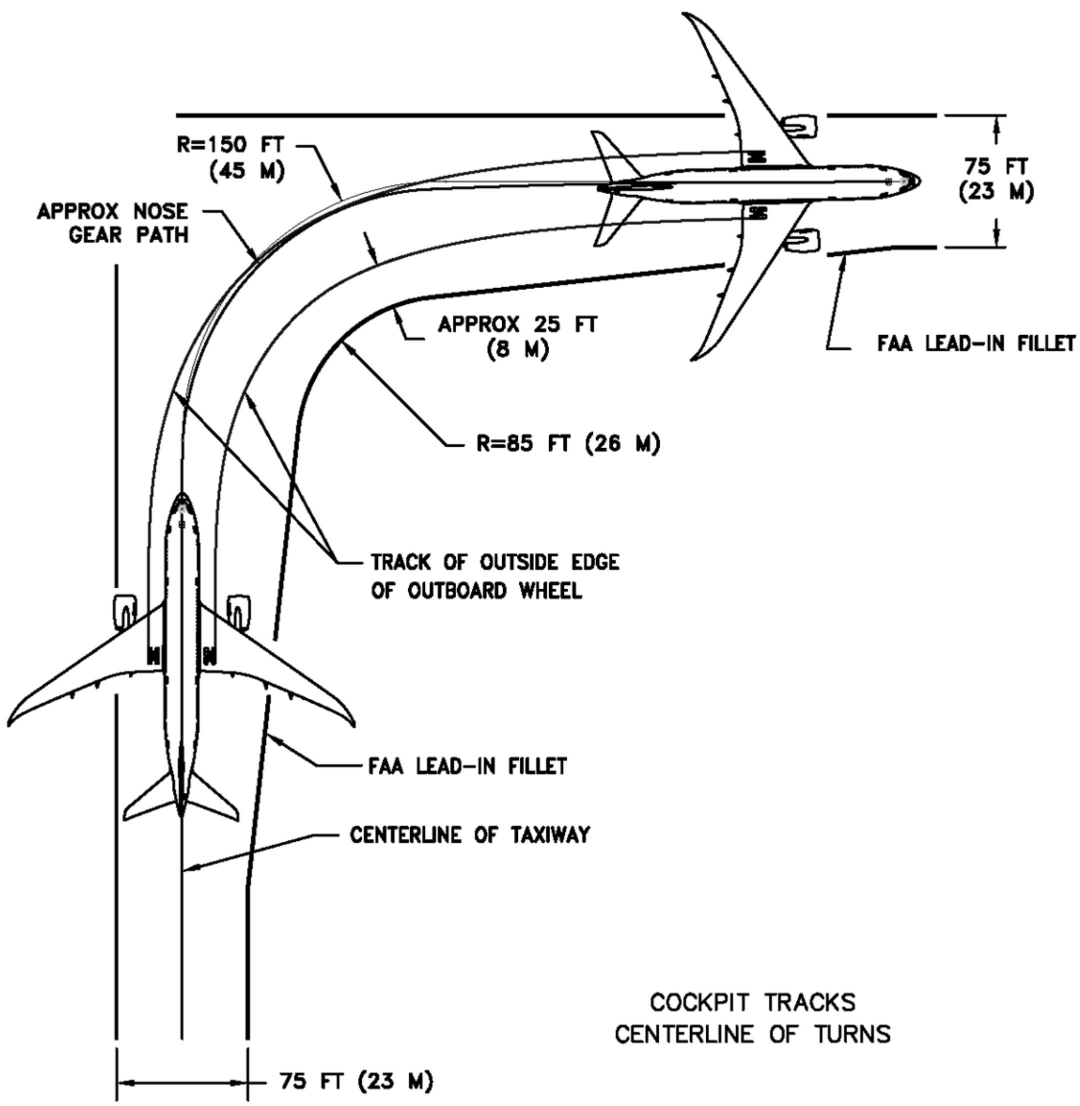
4.5.2 Runway and Taxiway Turnpaths - Runway-to-Taxiway, 90 Degree Turn: Model 787-8



4.5.3 Runway and Taxiway Turnpaths - Taxiway-to-Taxiway, 90 Degree Turn: Model 787-8

NOTE

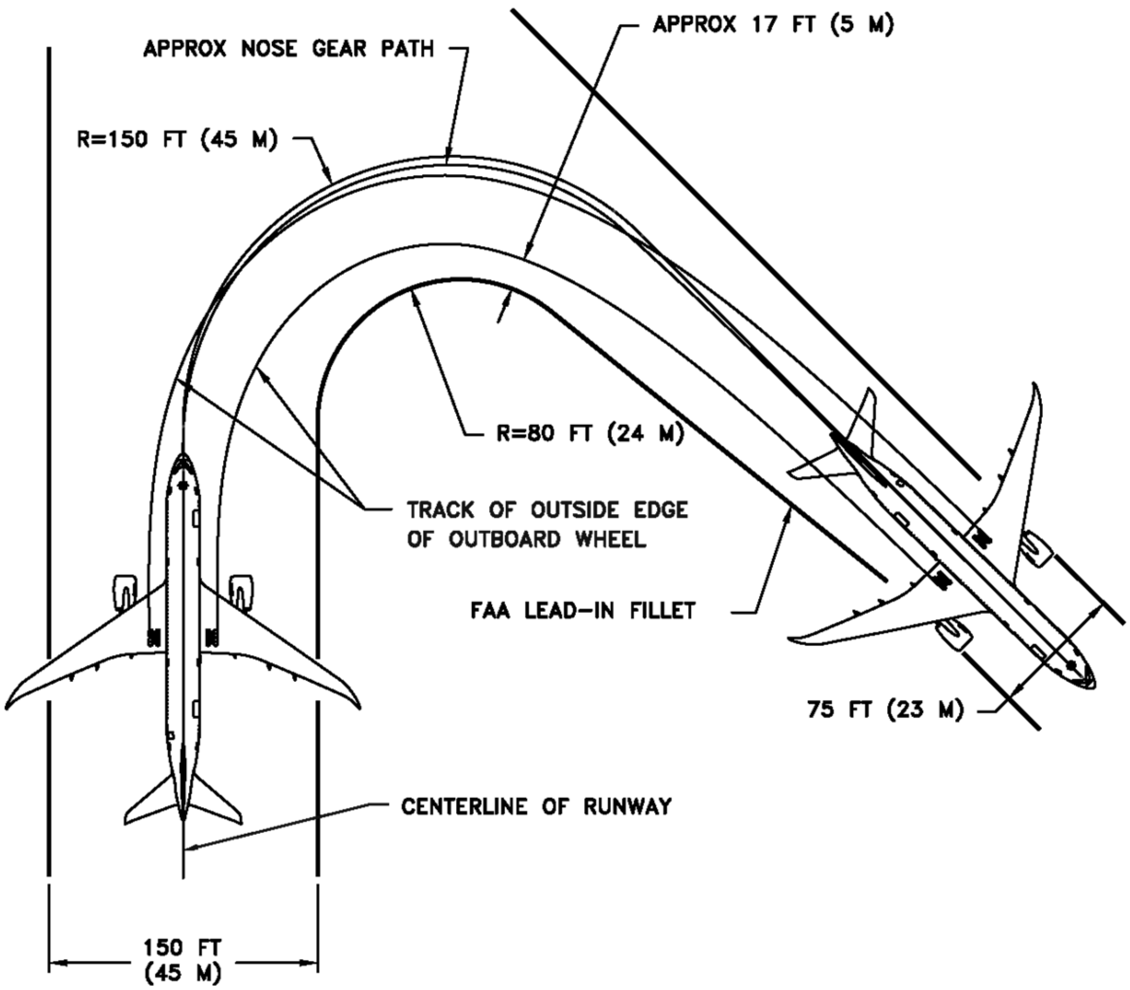
BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET
CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES
IN USE AND THE AIRCRAFT TYPES EXPECTED TO SERVE THE AIRPORT



4.5.4 Runway and Taxiway Turnpaths - Runway-to-Taxiway, More Than 90 Degree Turn: Model 787-9

NOTE

BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES IN USE AND THE AIRCRAFT TYPES EXPECTED TO SERVE THE AIRPORT

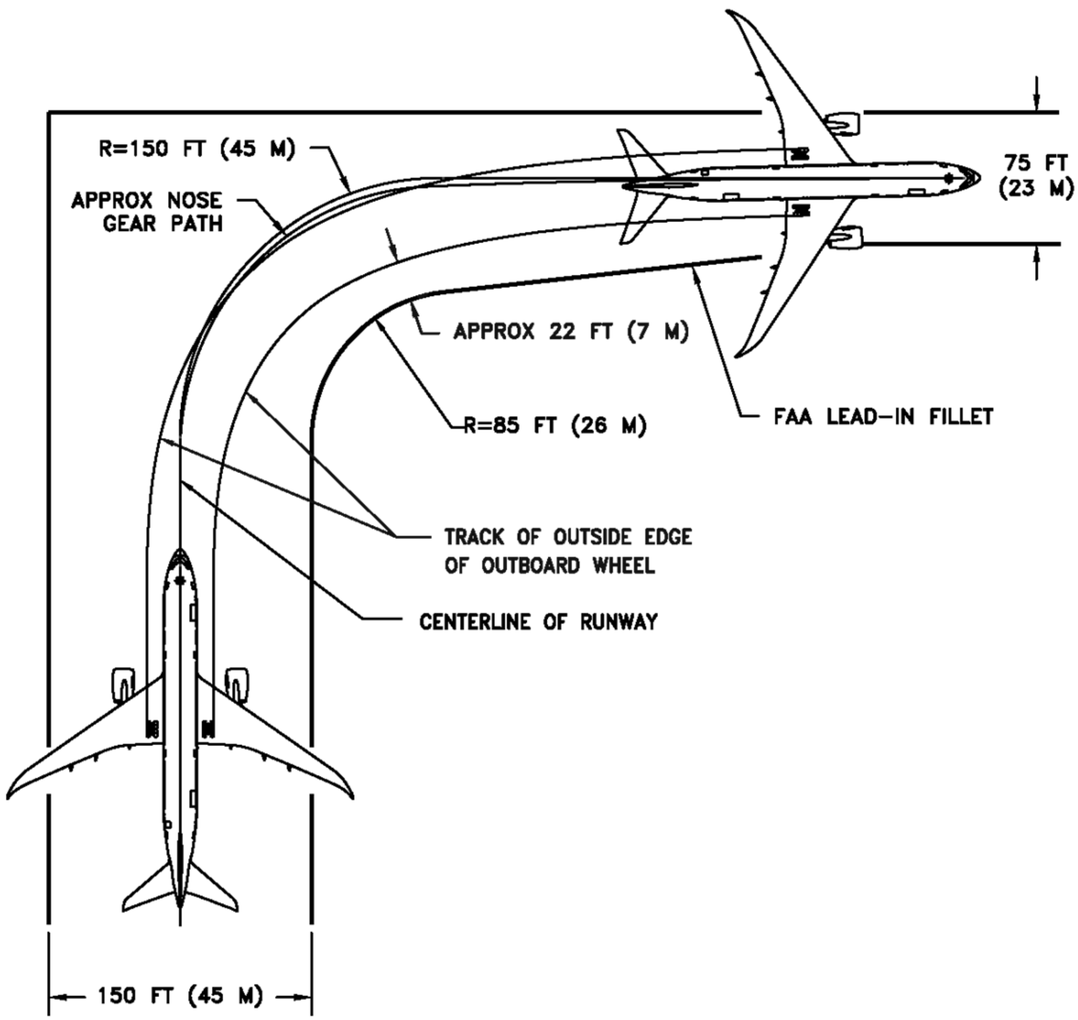


COCKPIT TRACKS CENTERLINE OF TURNS

4.5.5 Runway and Taxiway Turnpaths - Runway-to-Taxiway, 90 Degree Turn: Model 787-9

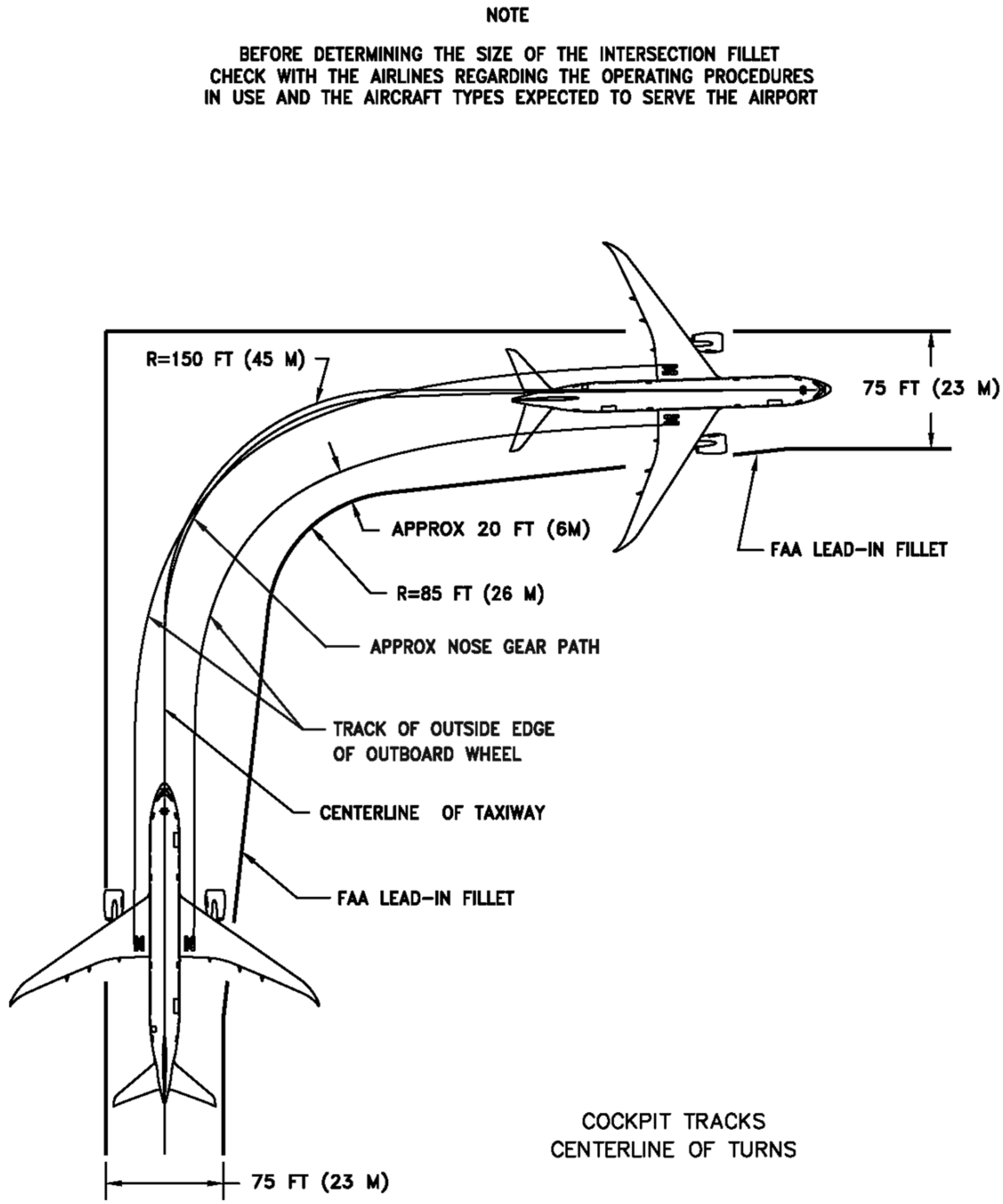
NOTE

BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES IN USE AND THE AIRCRAFT TYPES EXPECTED TO SERVE THE AIRPORT

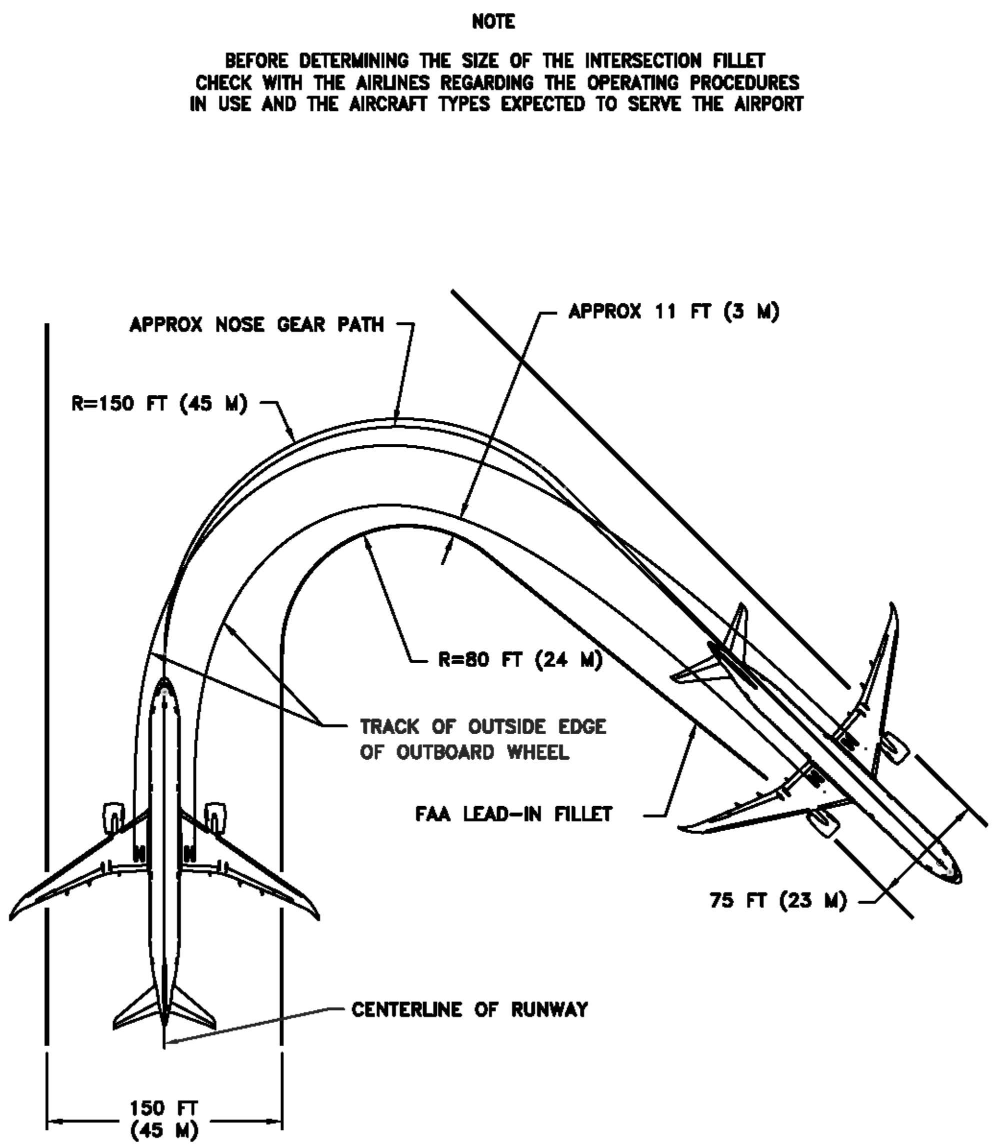


COCKPIT TRACKS
CENTERLINE OF TURNS

4.5.6 Runway and Taxiway Turnpaths - Taxiway-to-Taxiway, 90 Degree Turn: Model 787-9

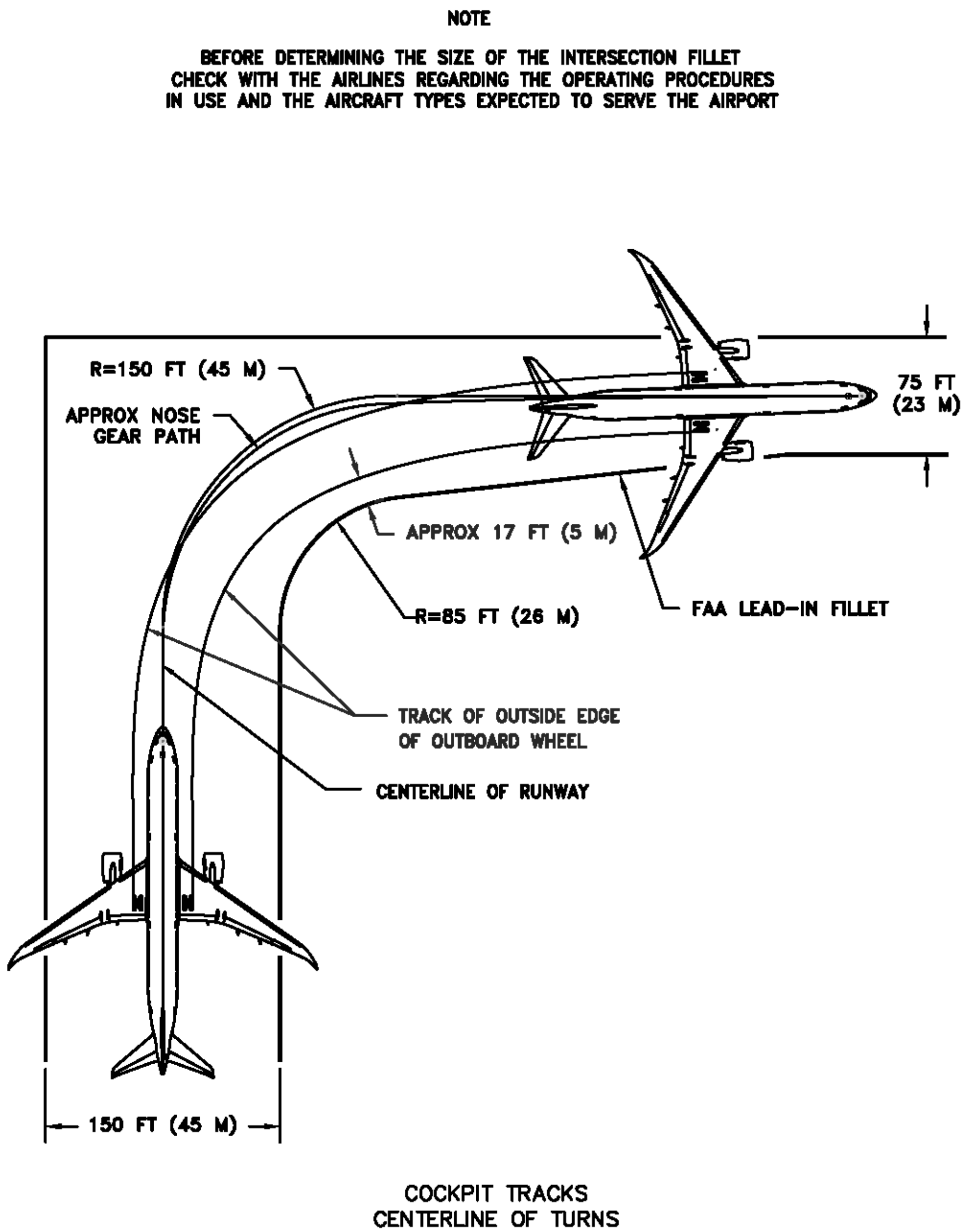


4.5.7 Runway and Taxiway Turnpaths - Runway-to-Taxiway, More Than 90 Degree Turn: Model 787-10

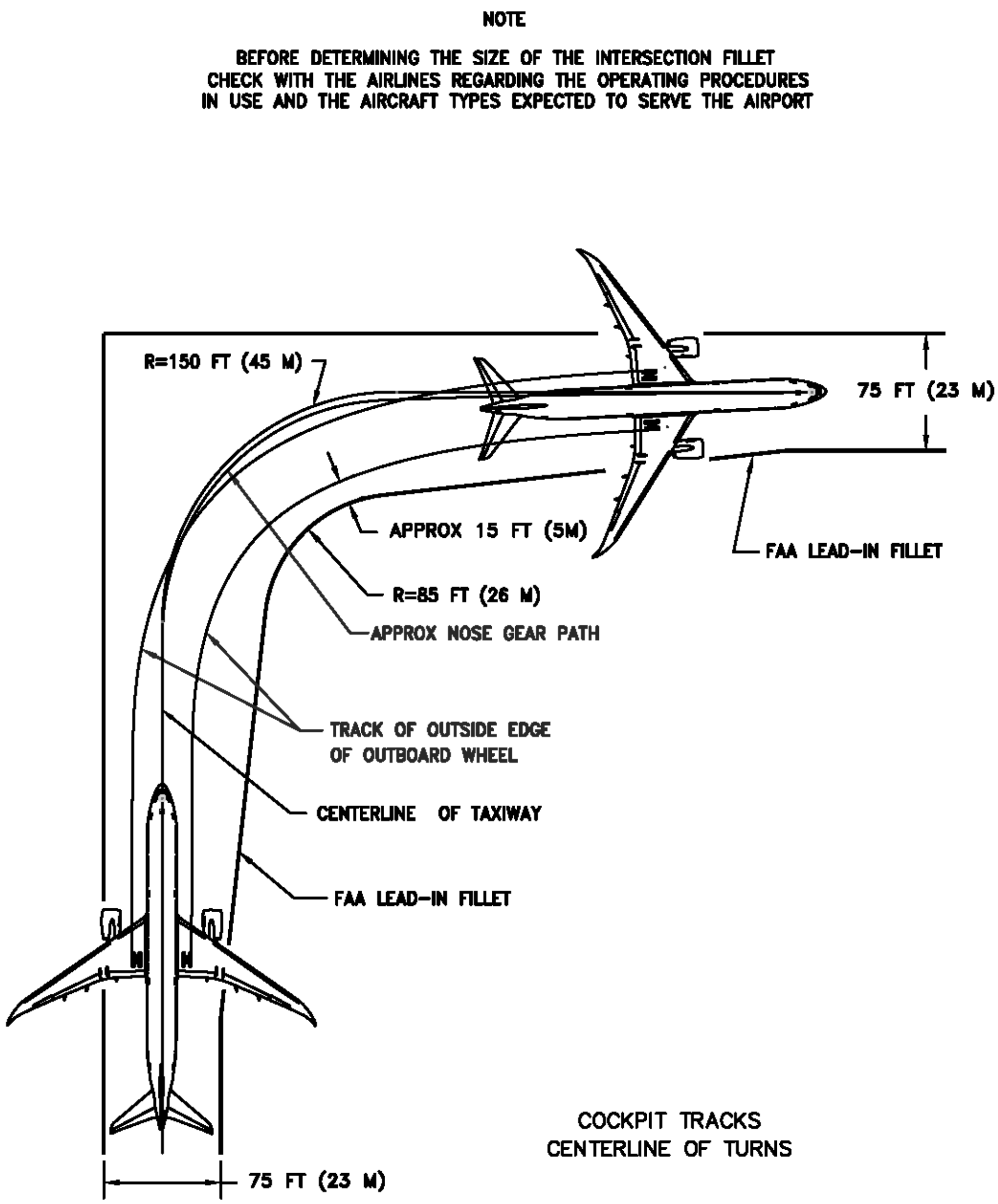


COCKPIT TRACKS
CENTERLINE OF TURNS

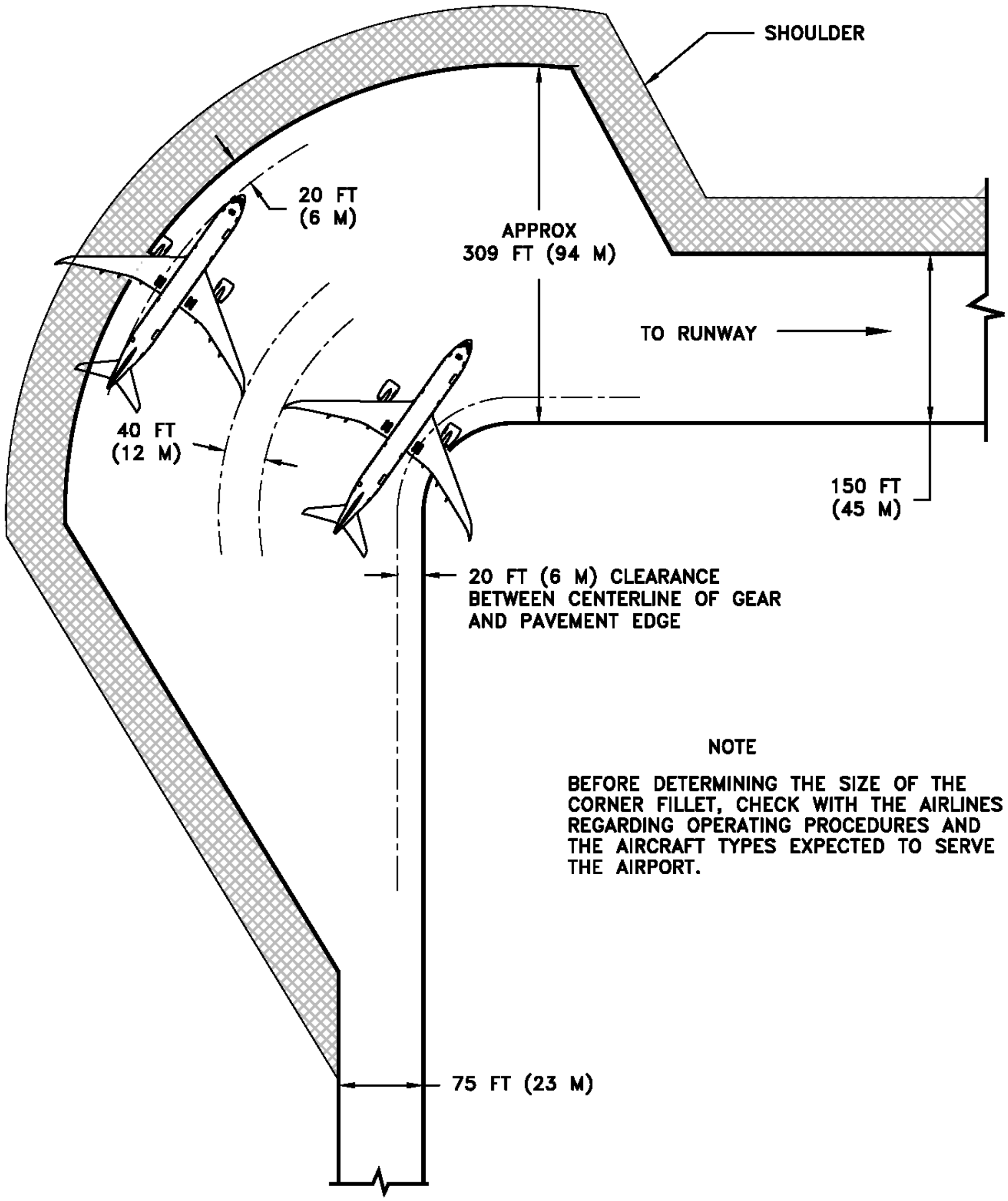
4.5.8 Runway and Taxiway Turnpaths - Runway-to-Taxiway, 90 Degree Turn: Model 787-10



4.5.9 Runway and Taxiway Turnpaths - Taxiway-to-Taxiway, 90 Degree Turn: Model 787-10



4.6 RUNWAY HOLDING BAY: MODEL 787-8, 787-9, 787-10



5.0 TERMINAL SERVICING

During turnaround at the terminal, certain services must be performed on the aircraft, usually within a given time, to meet flight schedules. This section shows service vehicle arrangements, schedules, locations of service points, and typical service requirements. The data presented in this section reflect ideal conditions for a single airplane. Service requirements may vary according to airplane condition and airline procedure.

Section 5.1 shows typical arrangements of ground support equipment during turnaround. As noted, if the auxiliary power unit (APU) is used, the electrical, air start, and air-conditioning service vehicles would not be required. Passenger loading bridges or portable passenger stairs could be used to load or unload passengers.

Sections 5.2 and 5.3 show typical service times at the terminal. These charts give typical schedules for performing service on the airplane within a given time. Service times may be rearranged to suit availability of personnel, airplane configuration, and degree of service required.

Section 5.4 shows the locations of ground service connections in graphic and in tabular forms. Typical capacities and service requirements are shown in the tables. Services with requirements that vary with conditions are described in subsequent sections.

Section 5.5 shows minimum electrical ground power requirements for engine start. The curves are based on 120-second and 180-second start times depending on the ground power unit.

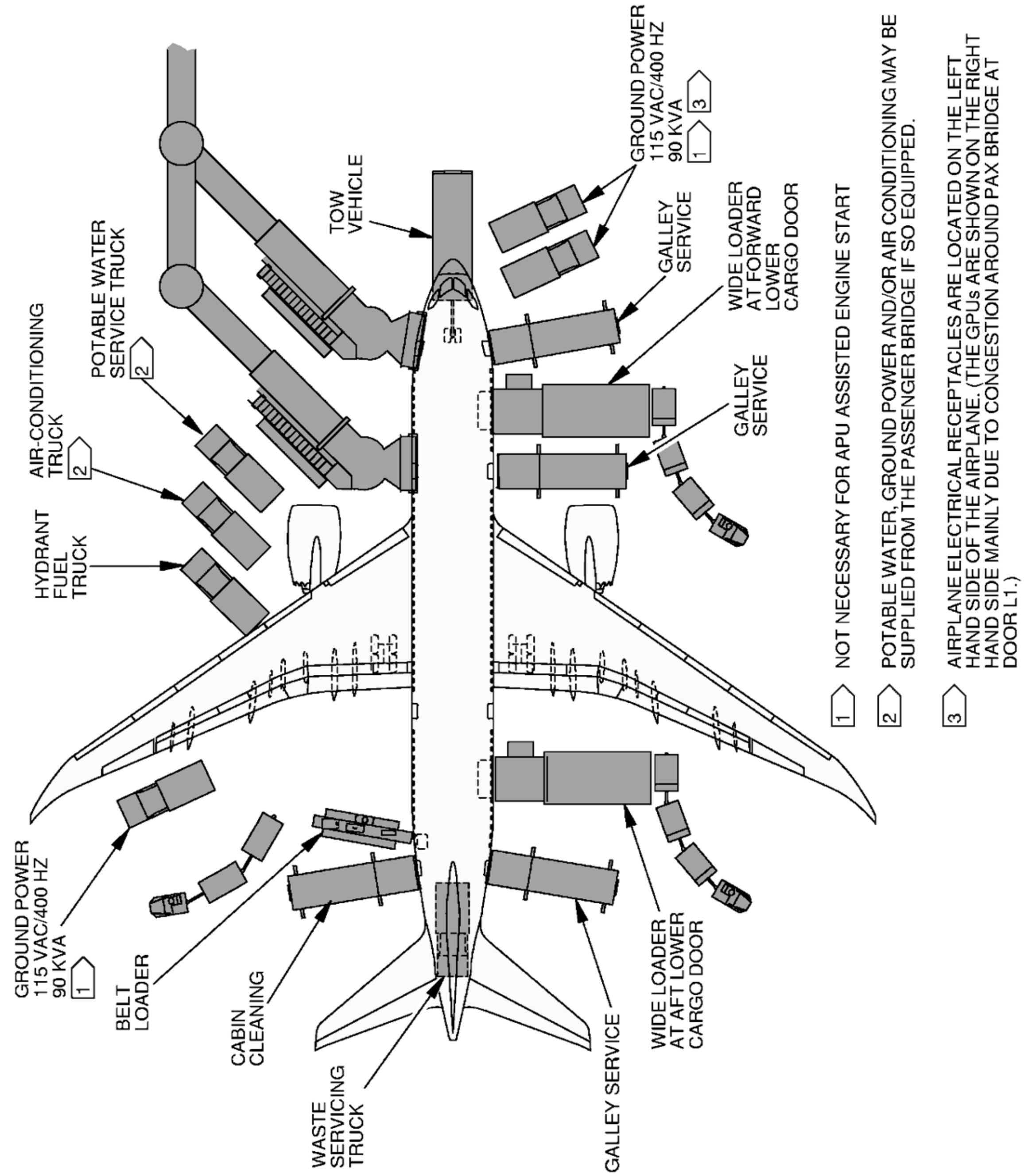
Section 5.6 shows air conditioning requirements for heating and cooling (pull-down and pull-up) using ground conditioned air. The curves show airflow requirements to heat or cool the airplane within a given time at ambient conditions.

Section 5.7 shows air conditioning requirements for heating and cooling to maintain a constant cabin air temperature using low pressure conditioned air. This conditioned air is supplied through an 8-in (20.3 cm) ground air connection (GAC) directly to the passenger cabin, bypassing the air cycle machines.

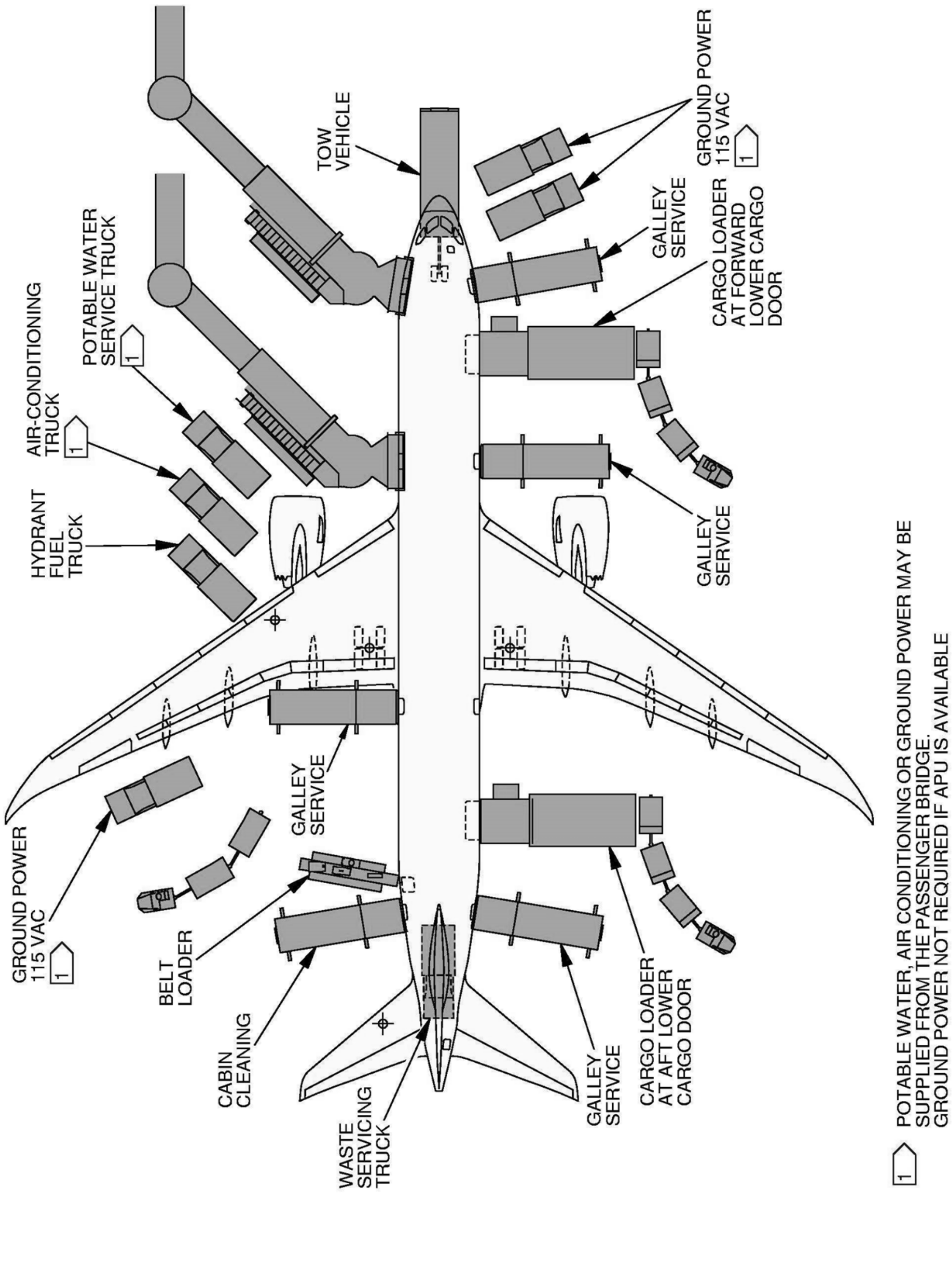
Section 5.8 shows ground towing requirements for various ground surface conditions.

5.1 AIRPLANE SERVICING ARRANGEMENT - TYPICAL TURNAROUND

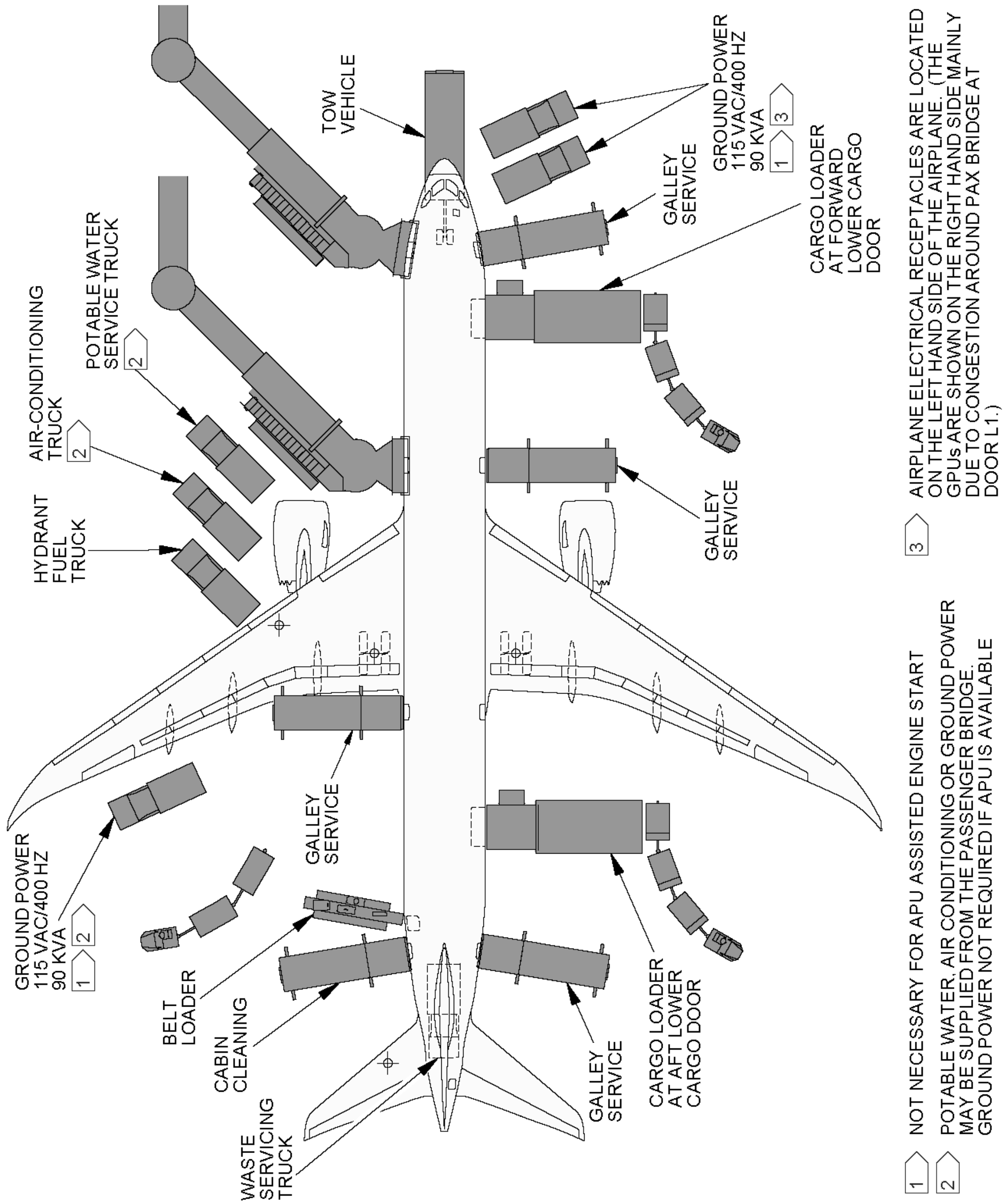
5.1.1 Airplane Servicing Arrangement - Typical Turnaround: Model 787-8



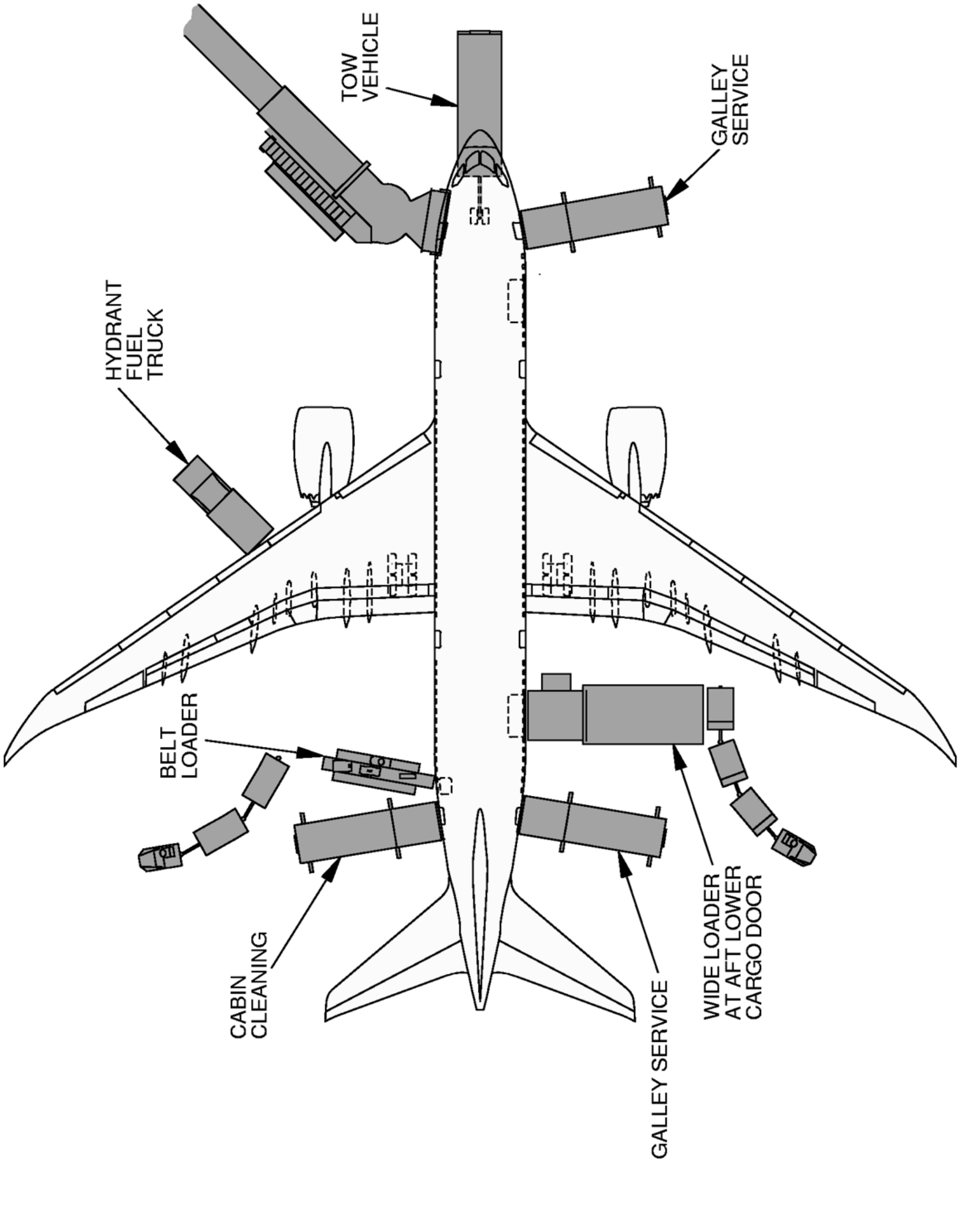
5.1.2 Airplane Servicing Arrangement - Typical Turnaround: Model 787-9



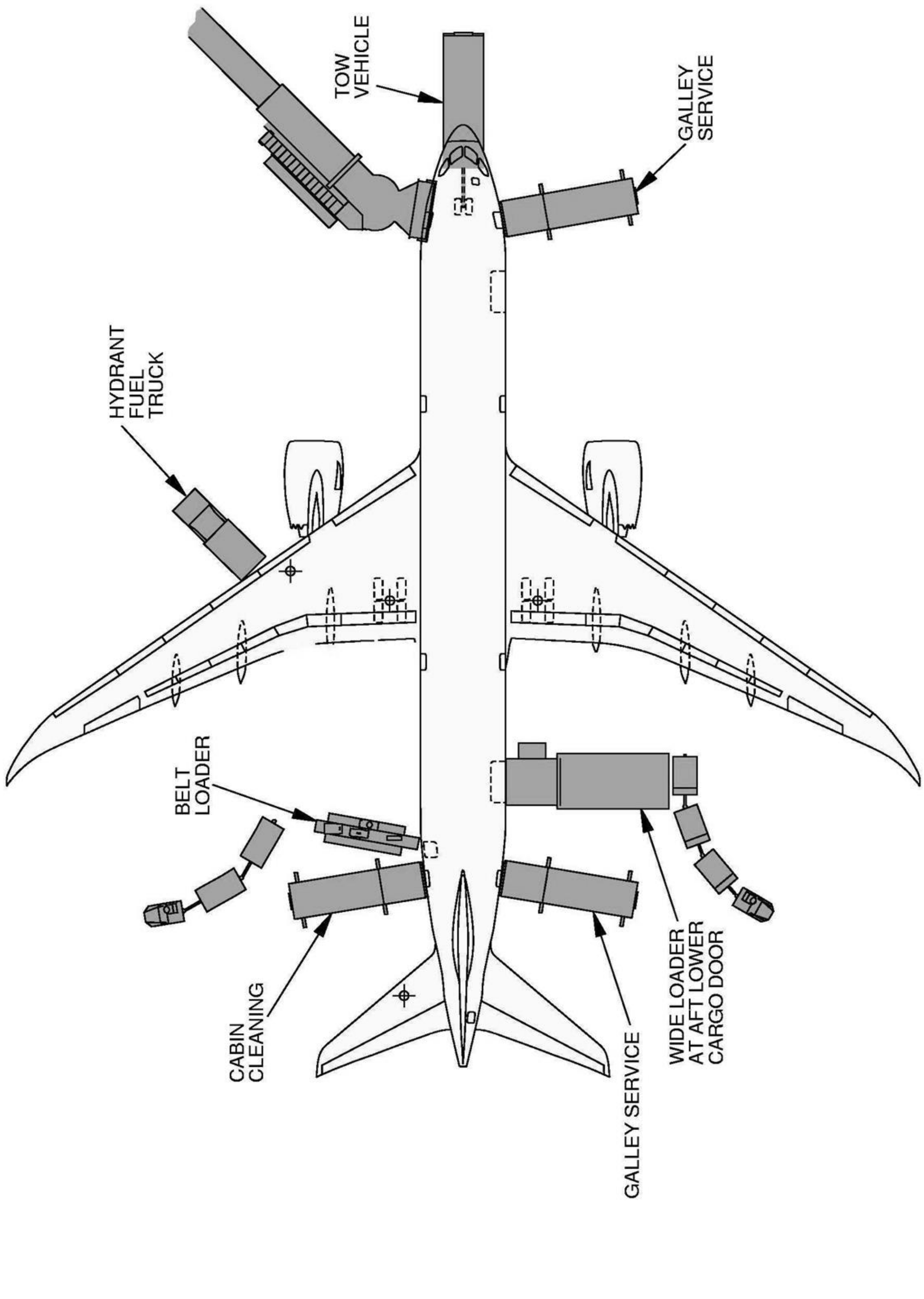
5.1.3 Airplane Servicing Arrangement - Typical Turnaround: Model 787-10



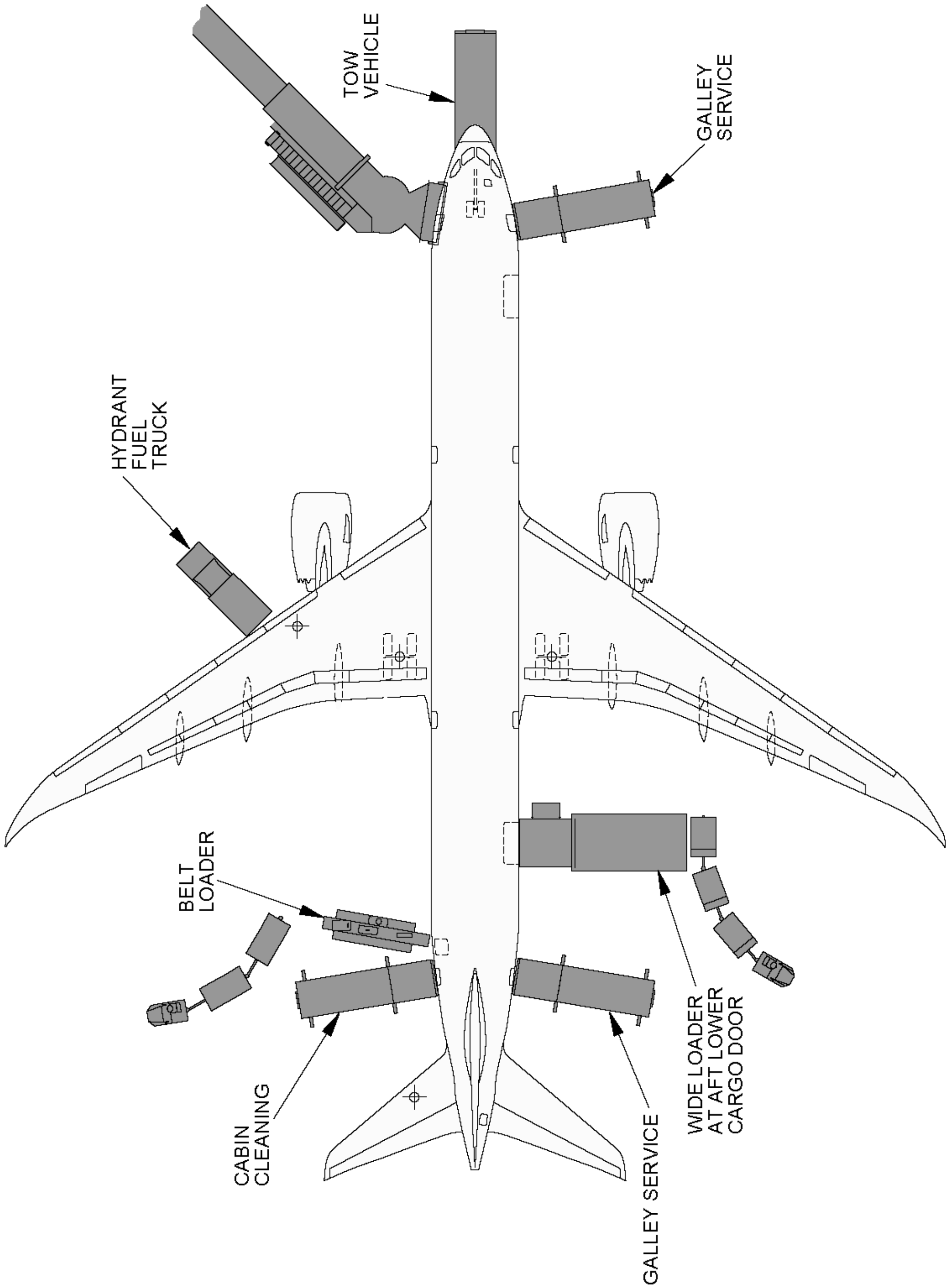
5.1.4 Airplane Servicing Arrangement - Typical En Route: Model 787-8



5.1.5 Airplane Servicing Arrangement - Typical En Route: Model 787-9

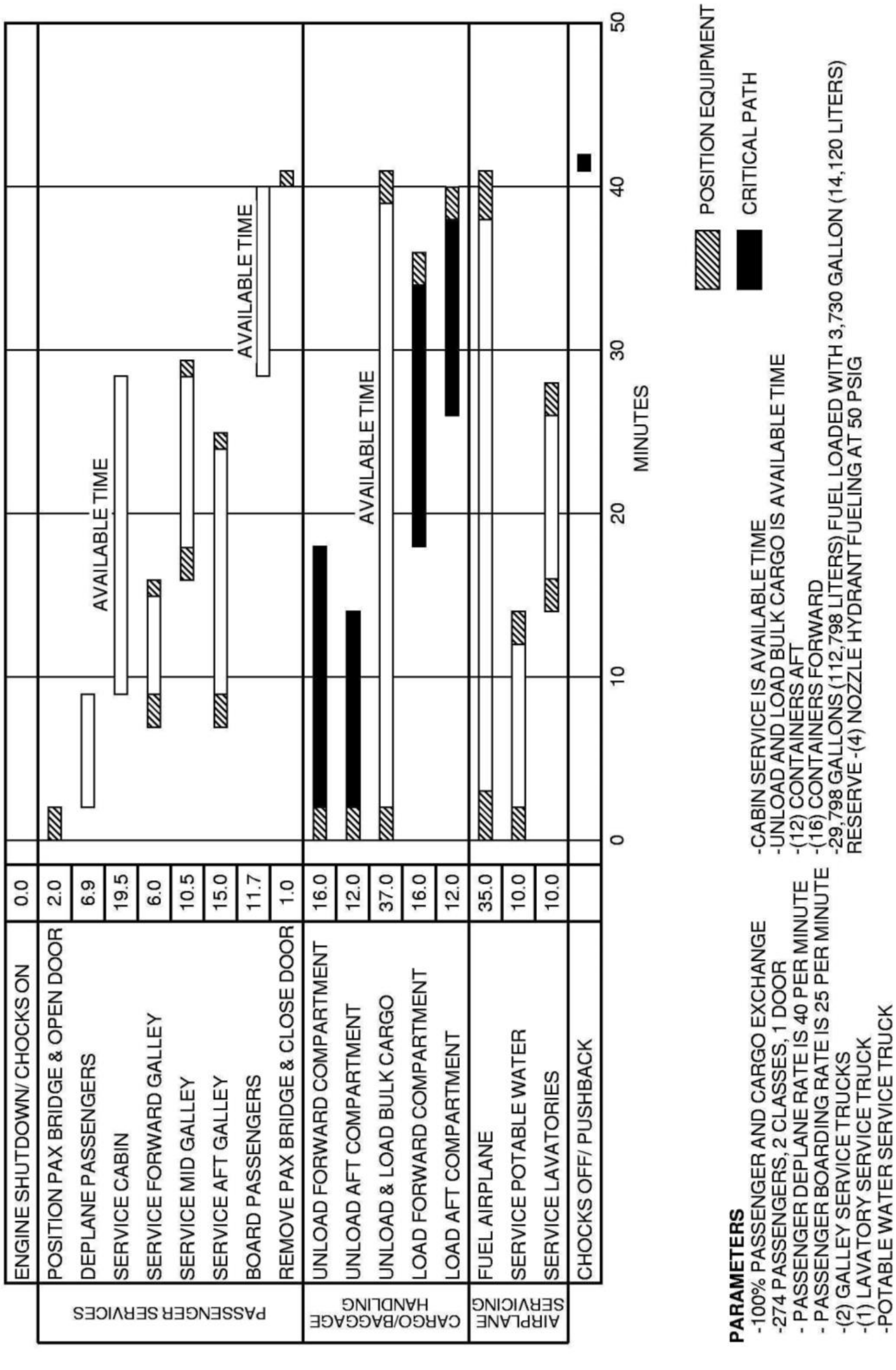


5.1.6 Airplane Servicing Arrangement - Typical En Route: Model 787-10

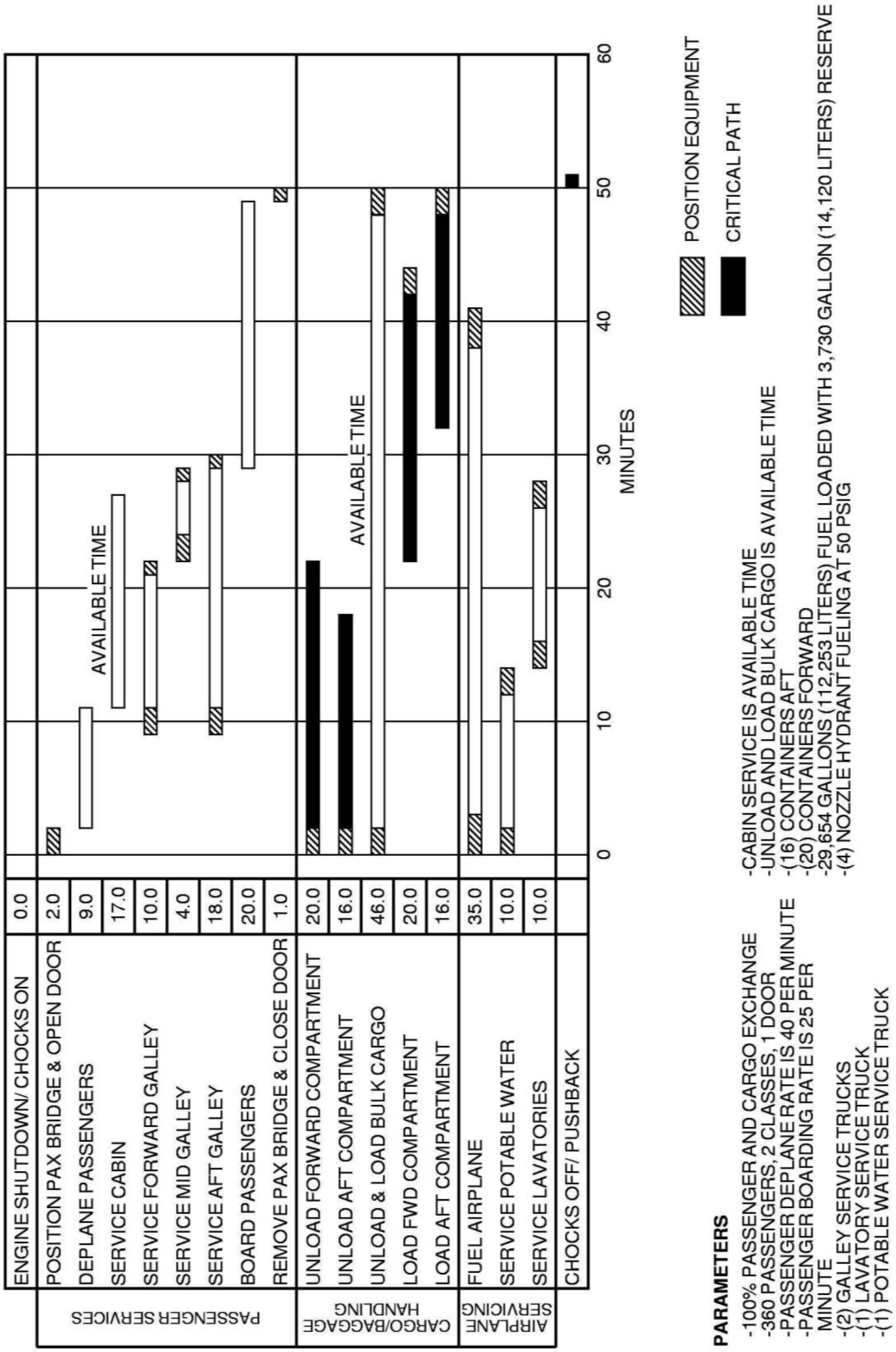


5.2 TERMINAL OPERATIONS - TURNAROUND STATION

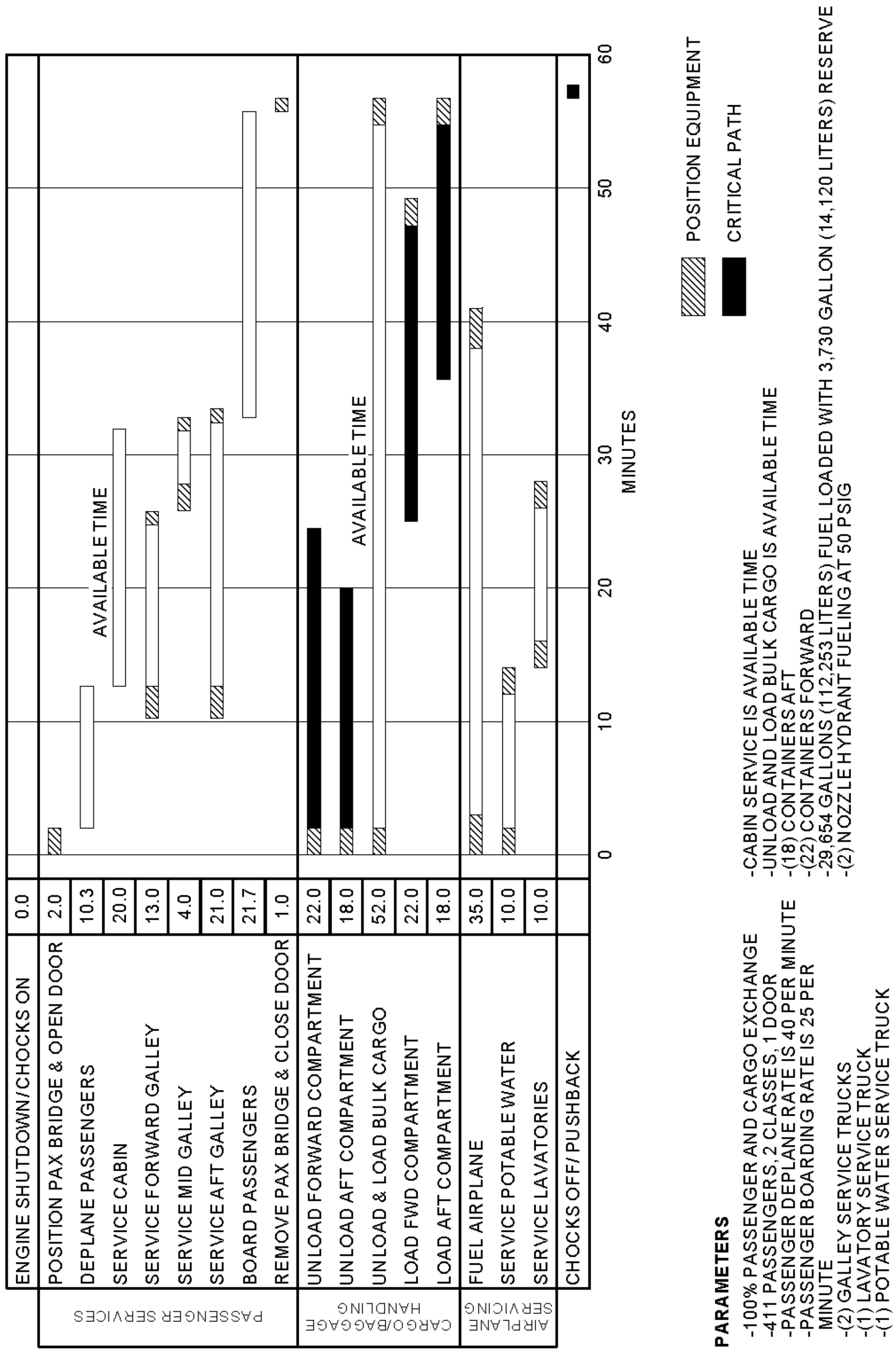
5.2.1 Terminal Operations, Turntime Analysis - Turnaround Station: Model 787-8



5.2.2 Terminal Operations, Turntime Analysis - Turnaround Station: Model 787-9

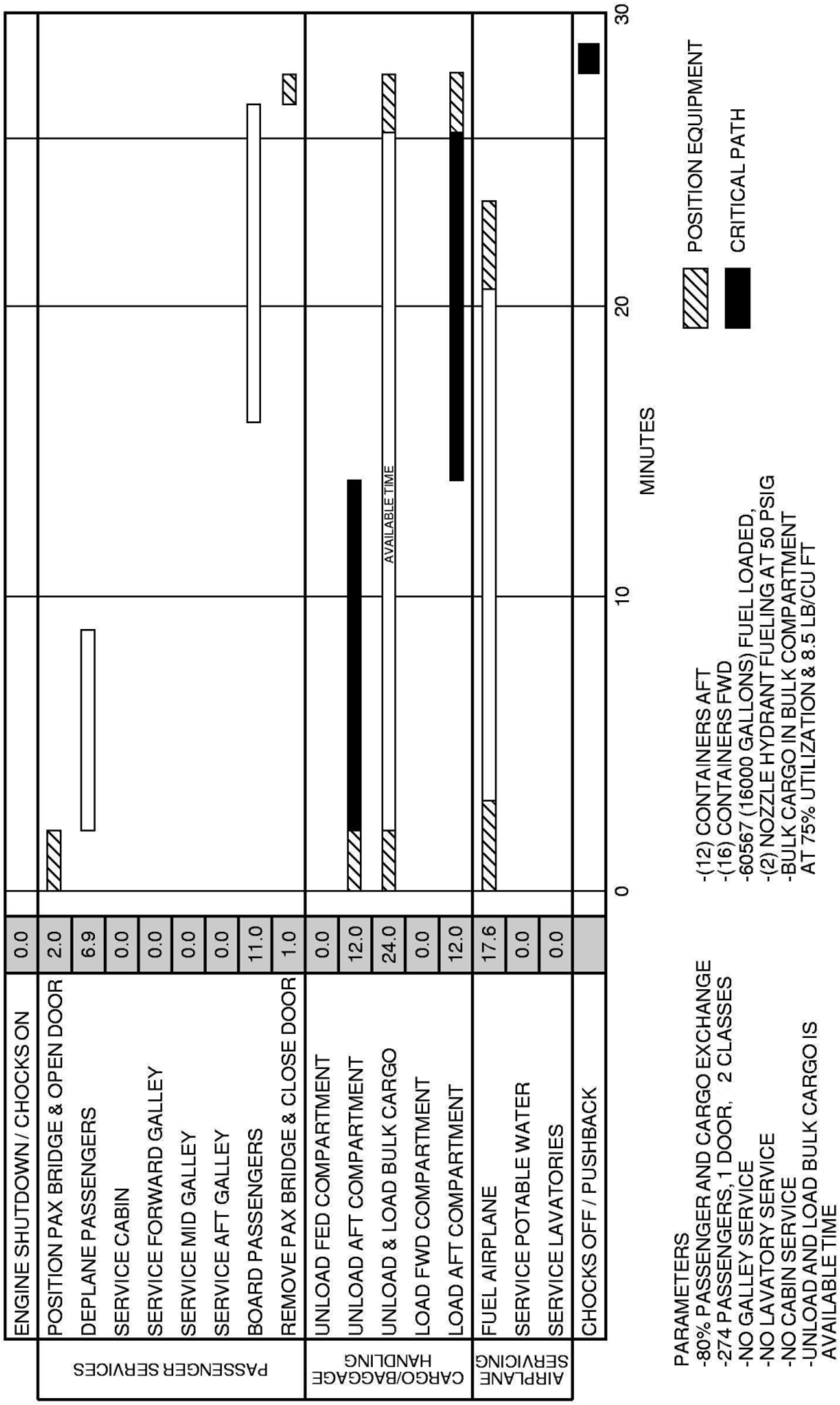


5.2.3 Terminal Operations, Turntime Analysis - Turnaround Station: Model 787-10

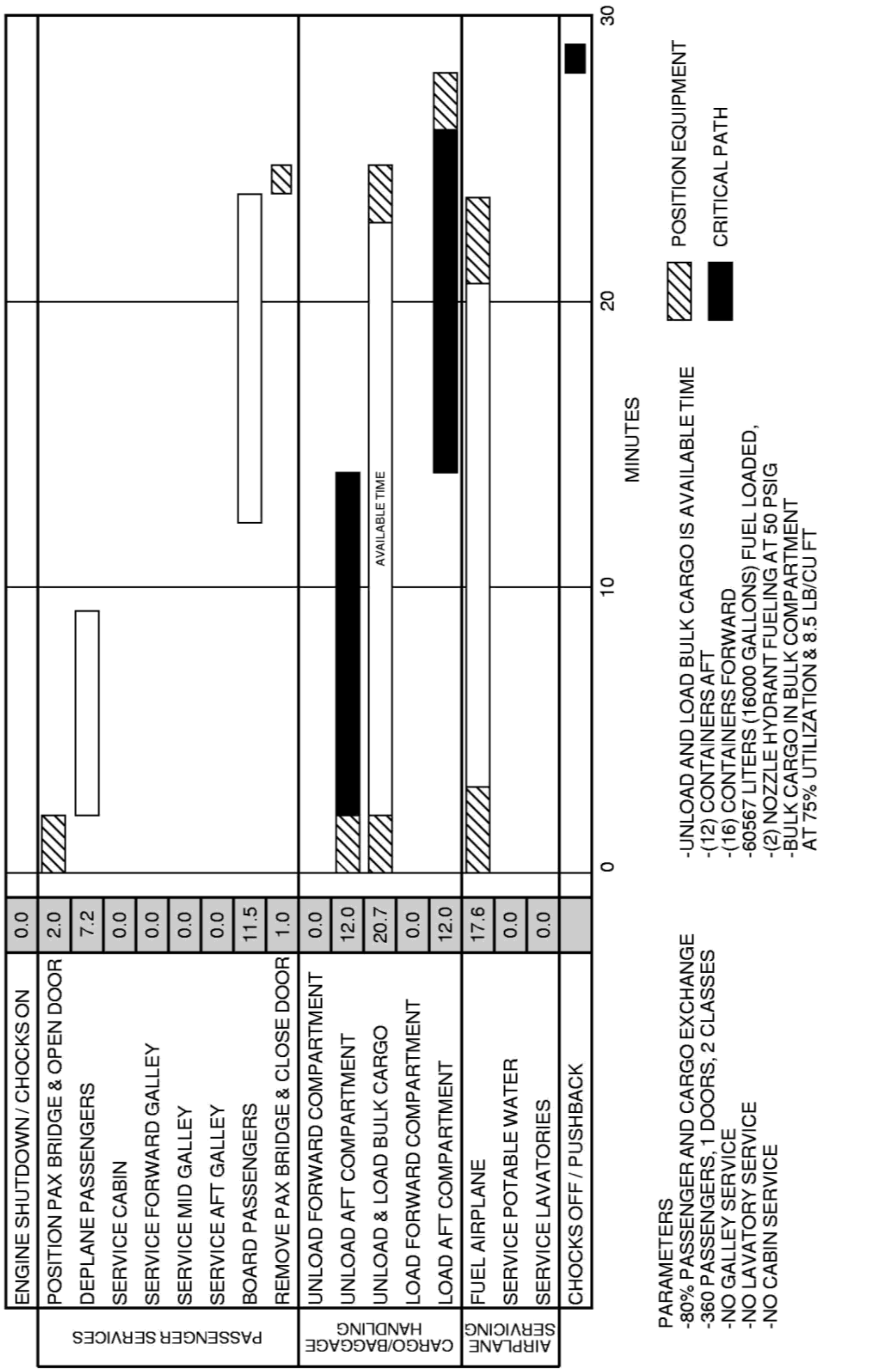


5.3 TERMINAL OPERATIONS - EN ROUTE STATION

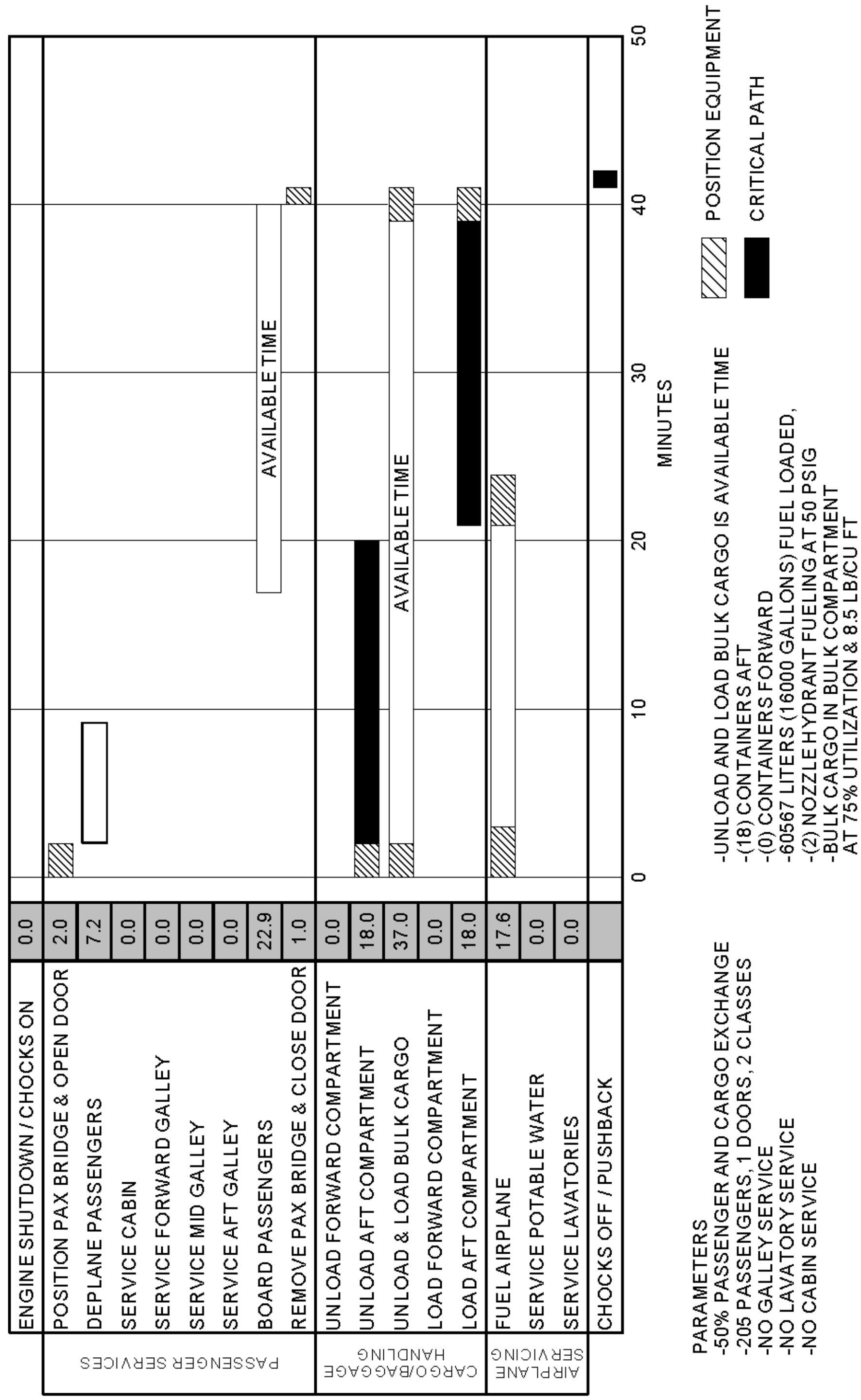
5.3.1 Terminal Operations, Turntime Analysis - En Route Station: Model 787-8



5.3.2 Terminal Operations, Turntime Analysis - En Route Station: Model 787-9

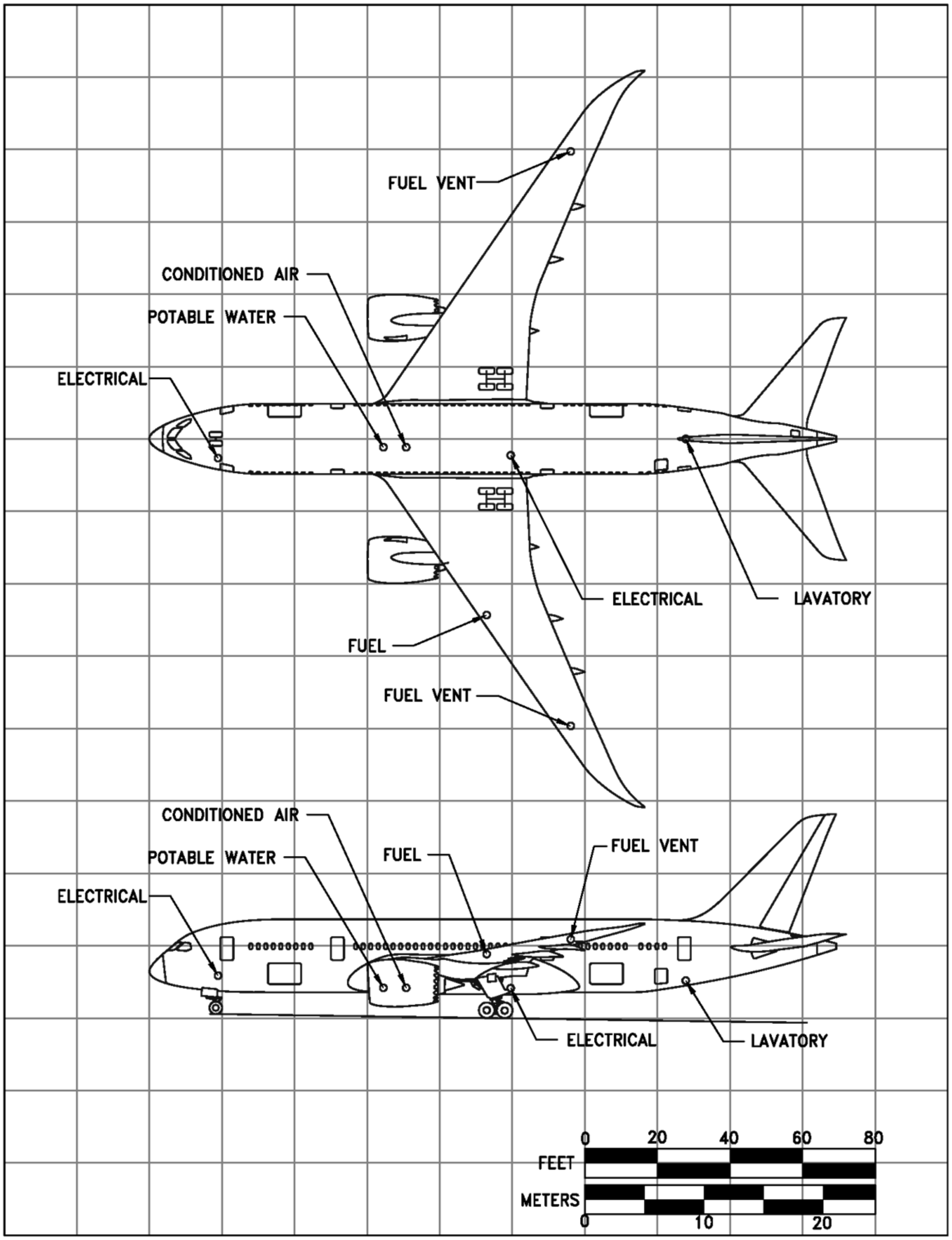


5.3.3 Terminal Operations, Turntime Analysis - En Route Station: Model 787-10



5.4 GROUND SERVICE CONNECTIONS

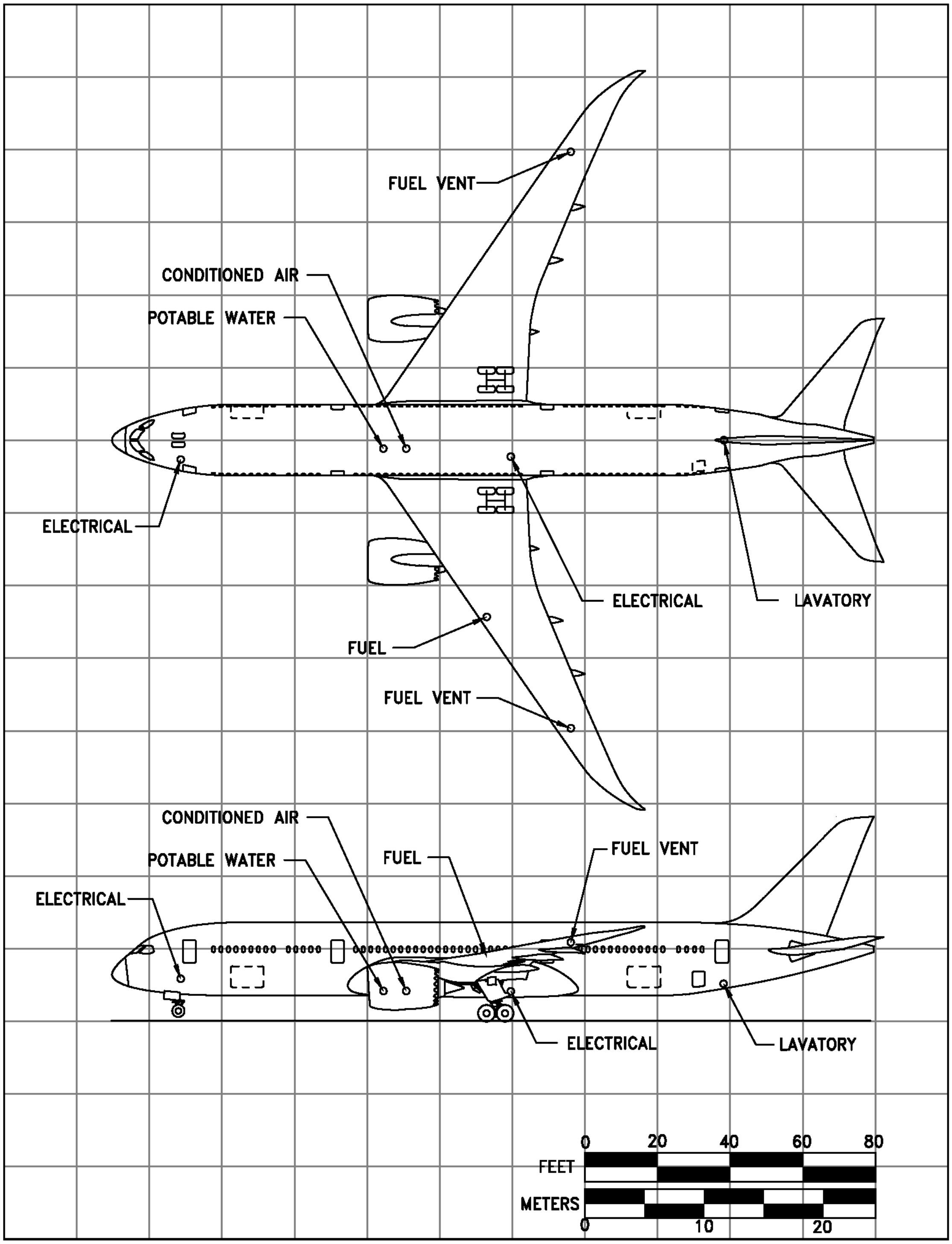
5.4.1 Ground Service Connections: Model 787-8



5.4.2 Ground Service Connections and Capacities: Model 787-8

SYSTEM	MODEL	DISTANCE AFT OF NOSE		DISTANCE FROM AIRPLANE CENTERLINE				MAX HEIGHT ABOVE GROUND	
				LH SIDE		RH SIDE			
		FT	M	FT	M	FT	M	FT	M
CONDITIONED AIR ONE 8-IN (20.3 CM) PORT	787-8	71	21.7	3	0.7	-	-	7	2.0
ELECTRICAL TWO FORWARD GROUND POWER RECEPTACLES	787-8	20	5.9	5	1.4	-	-	8	2.5
ONE MID-AFT GROUND POWER RECEPTACLE ALL RECEPTACLES ARE 90 KVA , 200/115 V AC 400 HZ,	787-8	99	30.3	5	1.6	-	-	7	2.2
TWLU ANTENNA LOCATION IS ON THE CENTERLINE	787-8	23	7.1	0	0.0	0	0.0	25	7.7
POTABLE WATER ONE SERVICE CONNECTION	787-8	63	19.3	4	1.1	-	-	7	2.2
FUEL ONE UNDERWING-PRESSURE CONNECTOR WITH TWO FUELING PORTS	787-8	90	27.5	49	14.8	-	-	18	5.4
FUEL VENTS TOTAL CAPACITY 33,340 US GAL (126,205 LITERS)	787-8	114	34.6	78	23.7	78	23.7	22	6.6
LAVATORY BOTH FORWARD AND AFT TOILETS ARE SERVICED THROUGH ONE SERVICE PANEL	787-8	144	43.8	0	0.0	0	0.0	10	2.9

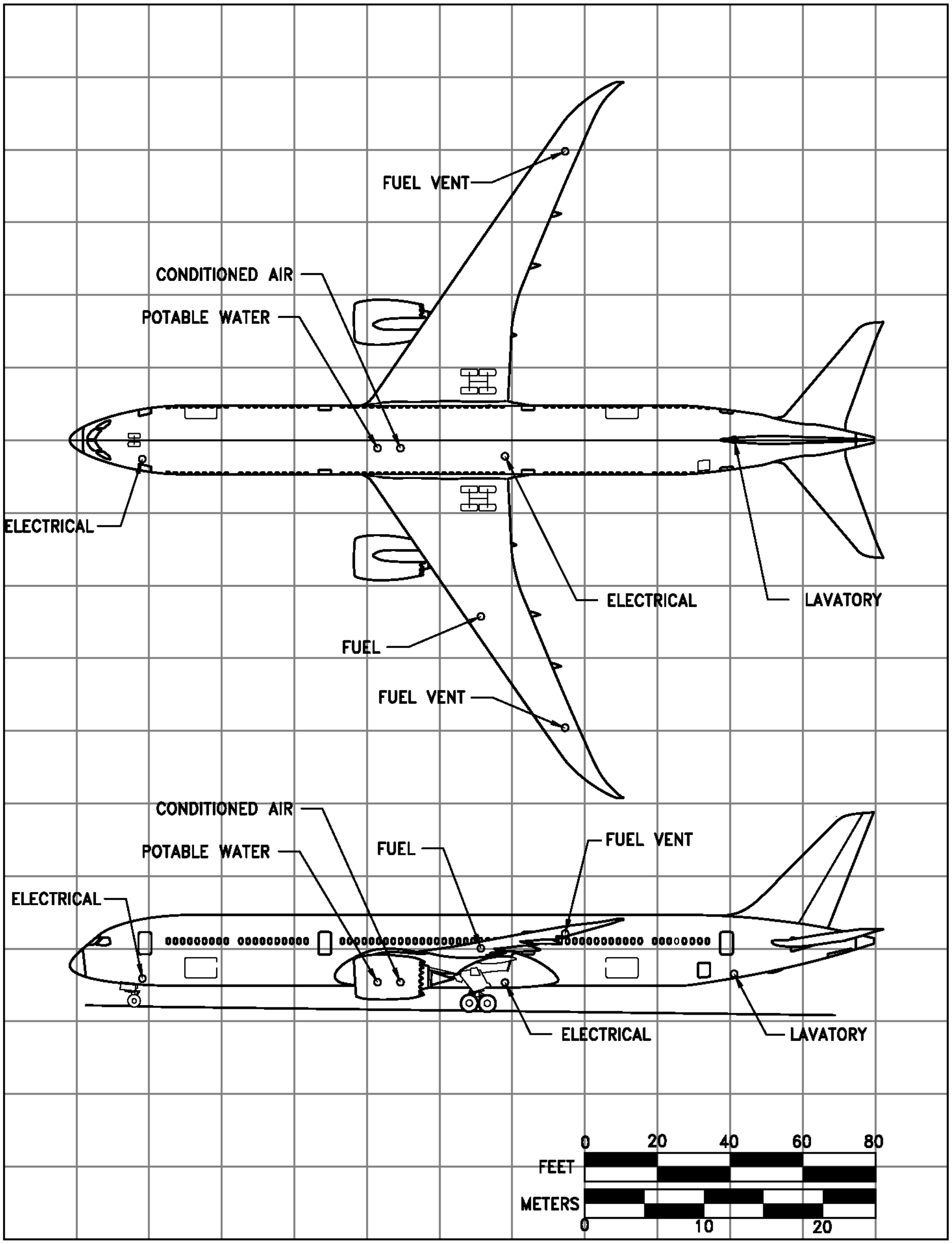
5.4.3 Ground Servicing Connections: Model 787-9



5.4.4 Ground Servicing Connections and Capacities: Model 787-9

SYSTEM	MODEL	DISTANCE AFT OF NOSE		DISTANCE FROM AIRPLANE CENTERLINE				MAX HEIGHT ABOVE GROUND	
				LH SIDE		RH SIDE			
		FT	M	FT	M	FT	M	FT	M
CONDITIONED AIR TWO 8-IN (20.3 CM) PORTS	787-9	81	24.7	3	0.7	3	0.7	7	2.0
ELECTRICAL TWO FORWARD GROUND POWER RECEPTACLES	787-9	20	5.9	5	1.4	-	-	8	2.5
ONE MID-AFT GROUND POWER RECEPTACLE ALL RECEPTACLES ARE 90 KVA , 200/115 V AC 400 HZ,		109	33.3	5	1.6	-	-	7	2.2
TWLU ANTENNA LOCATION IS ON THE CENTERLINE	787-9	23	7.1	0	0.0	0	0.0	25	7.7
POTABLE WATER ONE SERVICE CONNECTION	787-9	73	22.4	4	1.1	-	-	7	2.3
FUEL ONE UNDERWING-PRESSURE CONNECTOR WITH TWO FUELING PORTS	787-9	100	30.5	49	14.8	-	-	18	5.4
FUEL VENTS TOTAL CAPACITY 33,380 US GAL (126,205 LITERS)		124	37.6	78	23.7	78	23.7	22	6.6
LAVATORY BOTH FORWARD AND AFT TOILETS ARE SERVICED THROUGH ONE SERVICE PANEL	787-9	164	49.9	0	0.0	0	0.0	8	2.5

5.4.5 Ground Servicing Connections: Model 787-10

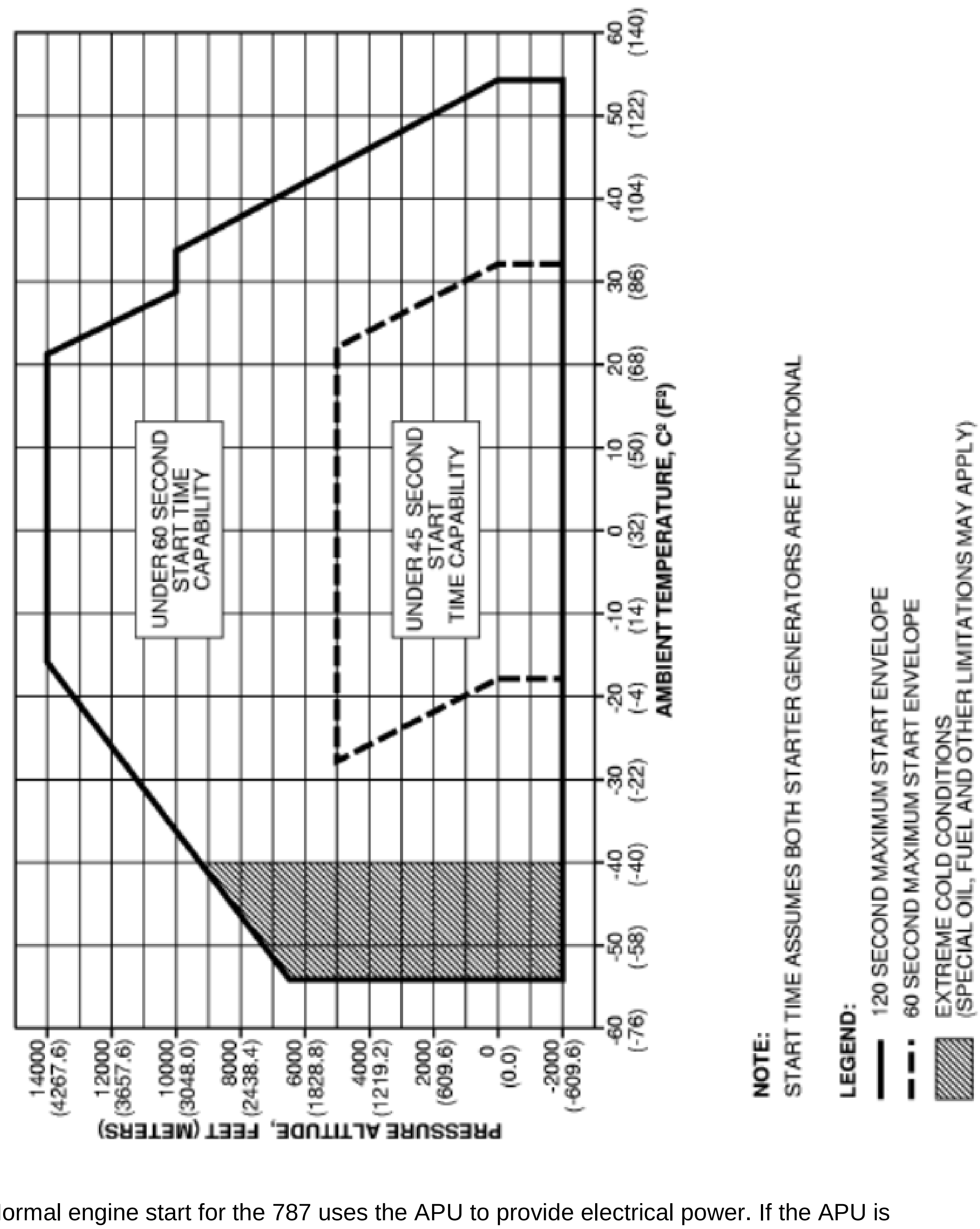


5.4.6 Ground Servicing Connections and Capacities: Model 787-10

SYSTEM	MODEL	DISTANCE AFT OF NOSE		DISTANCE FROM AIRPLANE CENTERLINE				MAX HEIGHT ABOVE GROUND	
				LH SIDE		RH SIDE			
		FT	M	FT	M	FT	M	FT	M
CONDITIONED AIR TWO 8-IN (20.3 CM) PORTS	787-10	91	27.8	2	0.6	2	0.6	7.0	2.1
ELECTRICAL TWO FORWARD GROUND POWER RECEPTACLES	787-10	20	5.9	5	1.4	-	-	8	2.5
ONE MID-AFT GROUND POWER RECEPTACLE ALL RECEPTACLES ARE 90 KVA , 200/115 V AC 400 HZ,		119	36.4	5	1.6	-	-	8	2.3
TWLU ANTENNA LOCATION IS ON THE CENTERLINE	787-10	23	7.1	0	0.0	0	0.0	25	7.7
POTABLE WATER ONE SERVICE CONNECTION	787-10	88	26.7	4	1.1	-	-	8	2.4
FUEL ONE UNDERWING-PRESSURE CONNECTOR WITH TWO FUELING PORTS	787-10	110	33.6	49	14.8	-	-	18	5.5
FUEL VENTS TOTAL CAPACITY 33,380 US GAL (126,205 LITERS)		134	40.7	78	23.7	78	23.7	22	6.7
LAVATORY BOTH FORWARD AND AFT TOILETS ARE SERVICED THROUGH ONE SERVICE PANEL	787-10	182	55.3	0	0.0	0	0.0	10	3.2

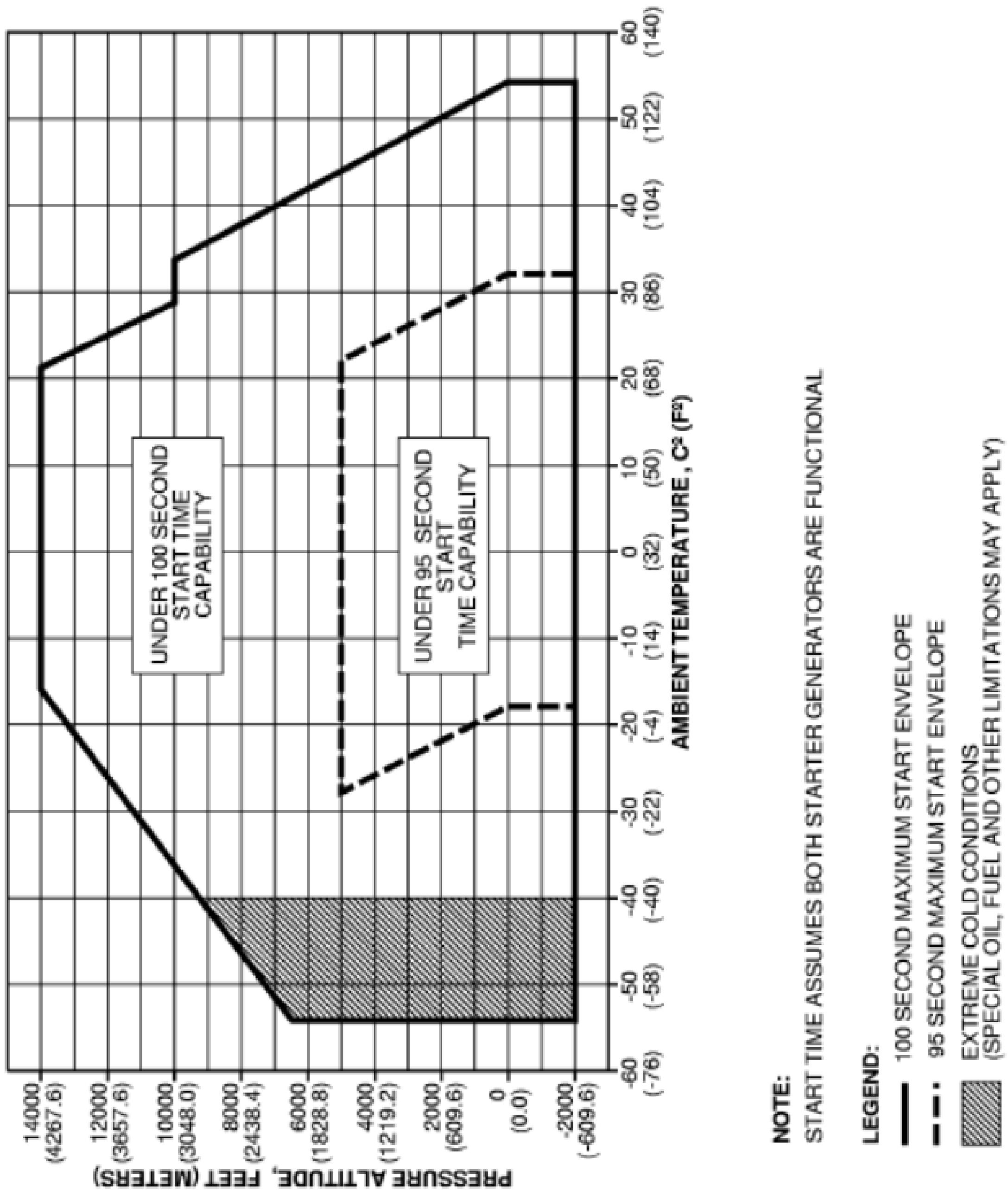
5.5 ENGINE STARTING AND GROUND POWER REQUIREMENTS

5.5.1 Engine Starting Ground Power Requirements – Electrical – APU: Model 787-8, 787-9, 787-10



Normal engine start for the 787 uses the APU to provide electrical power. If the APU is inoperative or unavailable, an engine start can be accomplished using a minimum of two 90 kVA external ground power units connected to the two forward external receptacles. Boeing recommends using three 90 kVA ground power sources to minimize the effect on cabin load shedding of ventilation, In Flight Entertainment, and cabin lighting.

5.5.2 Engine Starting Ground Power Requirements – Electrical – APU Inoperative – Two/Three GPU: Model 787-8, 787-9, 787-10



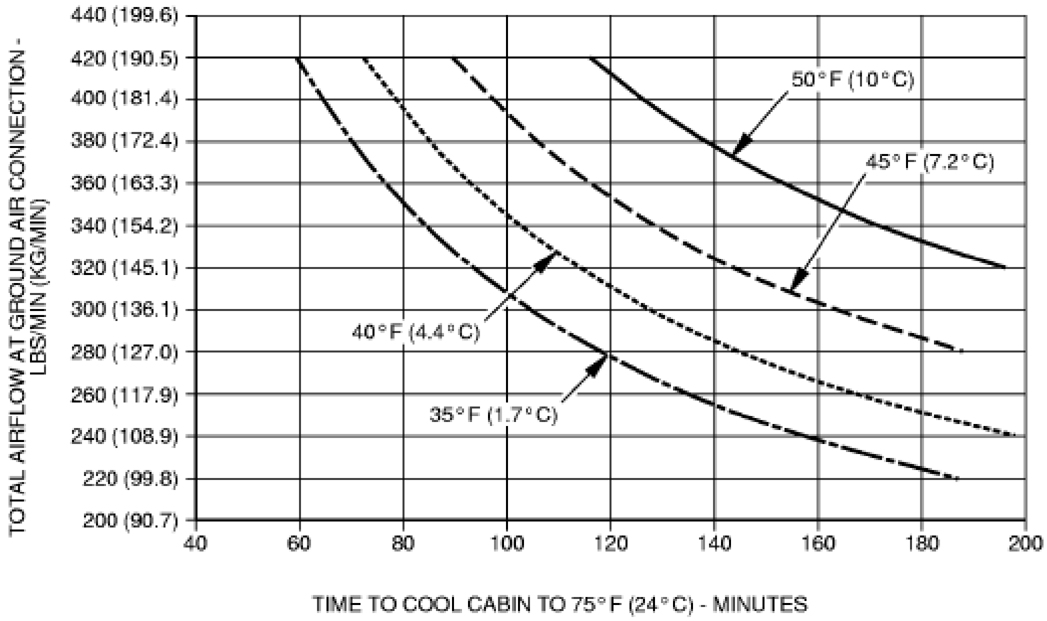
Normal engine start for the 787 uses the APU to provide electrical power. If the APU is inoperative or unavailable, an engine start can be accomplished using a minimum of two 90 kVA external ground power units connected to the two forward external receptacles. Boeing recommends using three 90 kVA ground power sources to minimize the effect on cabin load shedding of ventilation, In Flight Entertainment, and cabin lighting.

5.5.3 Engine Power Requirements – Pneumatic: Model 787-8, 787-9, 787-10

The 787 aircraft is an electric aircraft and does not have a traditional pneumatic system onboard, thus there are no ground pneumatic connections.

5.6 CONDITIONED AIR REQUIREMENTS

5.6.1 Conditioned Air Flow Requirements – Cooling Time: Model 787-8

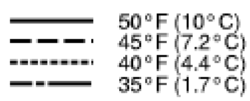


CONDITIONS:

- OUTSIDE AIR TEMPERATURE: 103° F (39.4° C)
- INITIAL CABIN TEMPERATURE: 115° F (46.1° C)
- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL TO DIM WINDOWS AND LIGHTING
- RECIRCULATION FANS SELECTED OFF
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- NO OCCUPANTS
- FULL SOLAR LOAD

LEGEND:

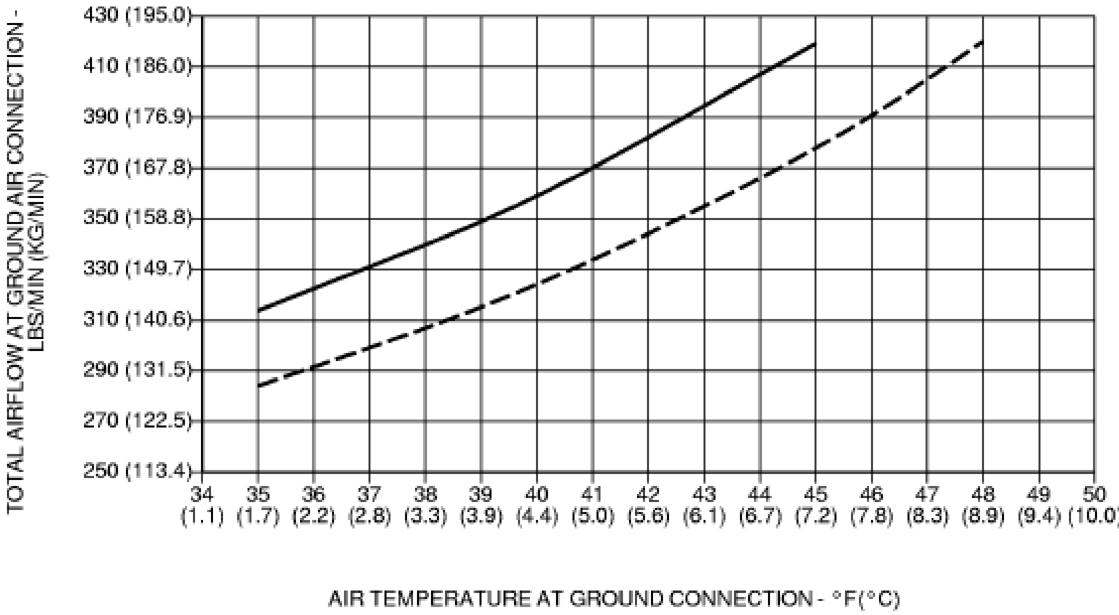
PCA TEMPERATURE AT GROUND CONNECTION



NOTE:

THIS GRAPH PROVIDES THE PREDICTED TIME REQUIRED TO COOL THE AIRPLANE'S CABIN TO A BULK AVERAGE OF 75° F (24° C) AS A FUNCTION OF AIRFLOW AND TEMPERATURE, AT THE GROUND AIR CONNECTION, WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.2 Conditioned Air Flow Requirements – Cooling – Steady State (103 F Ambient Air): Model 787-8



CONDITIONS:

- OUTSIDE AIR TEMPERATURE: 103°F (39.4°C)
- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL TO DIM WINDOWS AND LIGHTING
- RECIRCULATION FANS SELECTED OFF
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- 100% OCCUPANT LOAD
- FULL SOLAR LOAD

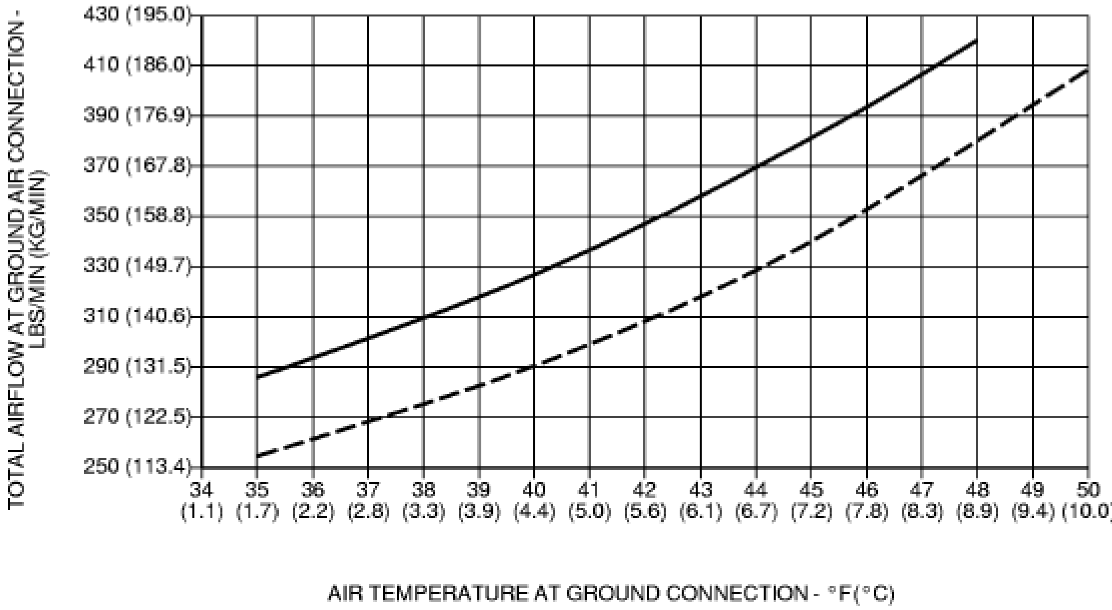
LEGEND:

———	353 SEATS
— — —	284 SEATS

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE, AT THE AIRPLANE'S GROUND AIR CONNECTION, THAT IS REQUIRED TO MAINTAIN THE AIRPLANE'S CABIN AT A BULK AVERAGE OF 75°F (24°C) WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.3 Conditioned Air Flow Requirements – Cooling – Steady State (80 F Ambient Air): Model 787-8



CONDITIONS:

- OUTSIDE AIR TEMPERATURE: 80°F (26.7°C)
- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL TO DIM WINDOWS AND LIGHTING
- RECIRCULATION FANS SELECTED OFF
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- 100% OCCUPANT LOAD
- FULL SOLAR LOAD

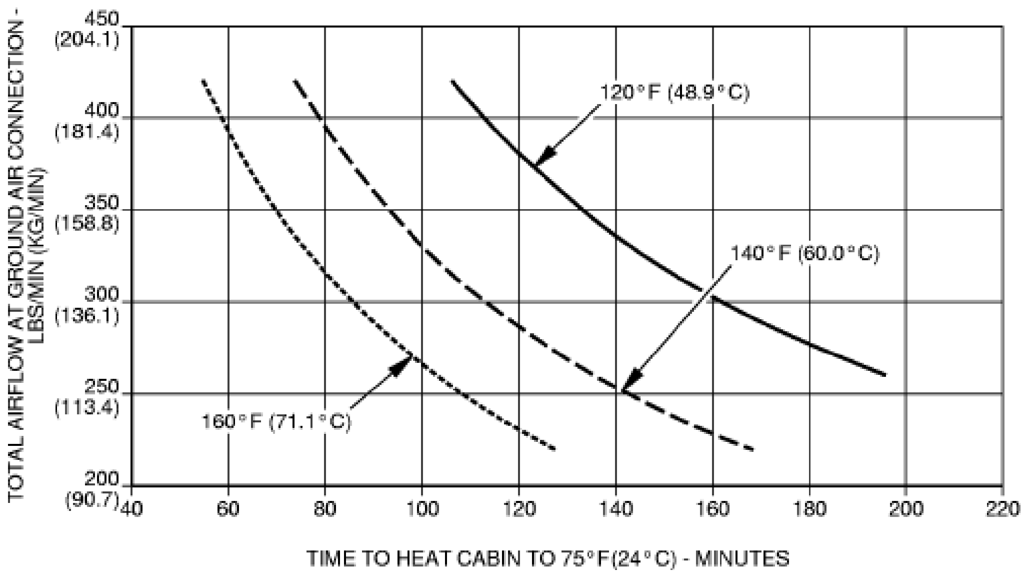
LEGEND:

- ——— 353 SEATS
- – – – 284 SEATS

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE, AT THE AIRPLANE'S GROUND AIR CONNECTION, THAT IS REQUIRED TO MAINTAIN THE AIRPLANES'S CABIN AT A BULK AVERAGE OF 75°F (24°C) WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.4 Conditioned Air Flow Requirements – Heating Time: Model 787-8



CONDITIONS:

- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- OUTSIDE AIR TEMPERATURE IS -40°F (-40°C)
- INITIAL CABIN TEMPERATURE IS -25°F (-32°C)
- NO SOLAR LOAD
- RECIRCULATION FANS SELECTED OFF
- ICS RECIRCULATION CHILLING OFF
- NO OCCUPANTS
- IFE OFF
- NO ELECTRICAL LOADS

LEGEND:

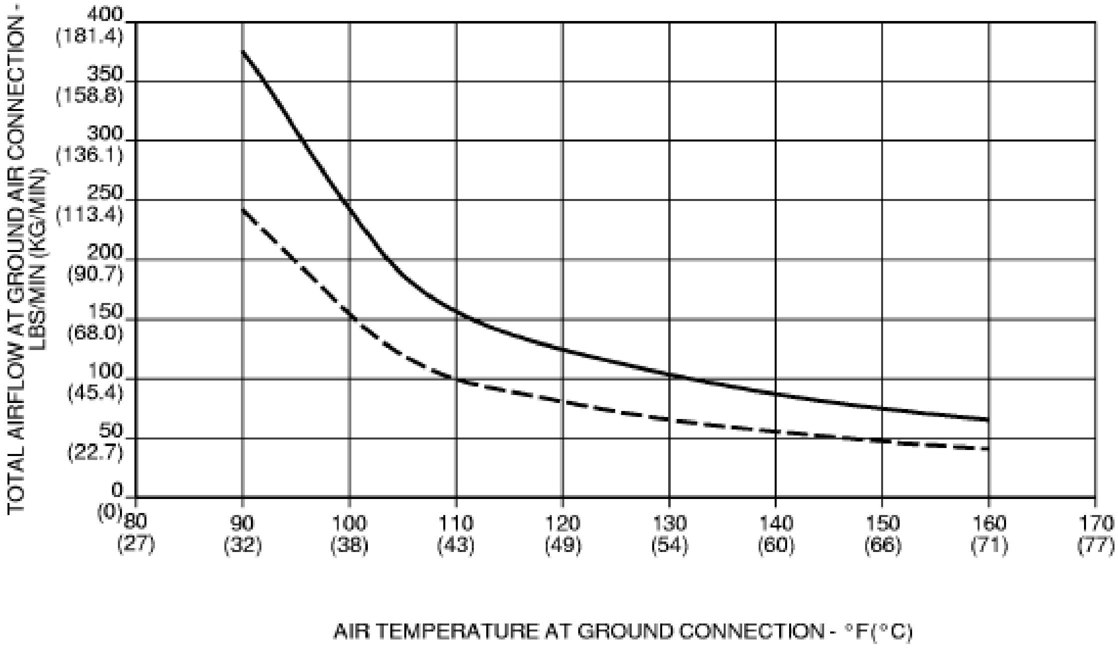
PCA TEMPERATURES AT GROUND CONNECTION

- (solid line) 120°F(48.9°C)
- (dashed line) 140°F(60.0°C)
- (dotted line) 160°F(71.1°C)

NOTE:

THIS GRAPH PROVIDES THE PREDICTED TIME REQUIRED TO HEAT THE AIRPLANE'S CABIN TO A BULK AVERAGE OF 75°F (24°C) AS A FUNCTION OF AIRFLOW AND TEMPERATURE, AT THE GROUND AIR CONNECTION, WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.5 Conditioned Air Flow Requirements – Heating – Steady State: Model 787-8



CONDITIONS:

- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- NO SOLAR HEAT LOAD
- RECIRCULATION FANS SELECTED OFF
- ICS RECIRCULATION CHILLING OFF
- NO OCCUPANTS
- NO ELECTRICAL HEAT LOADS

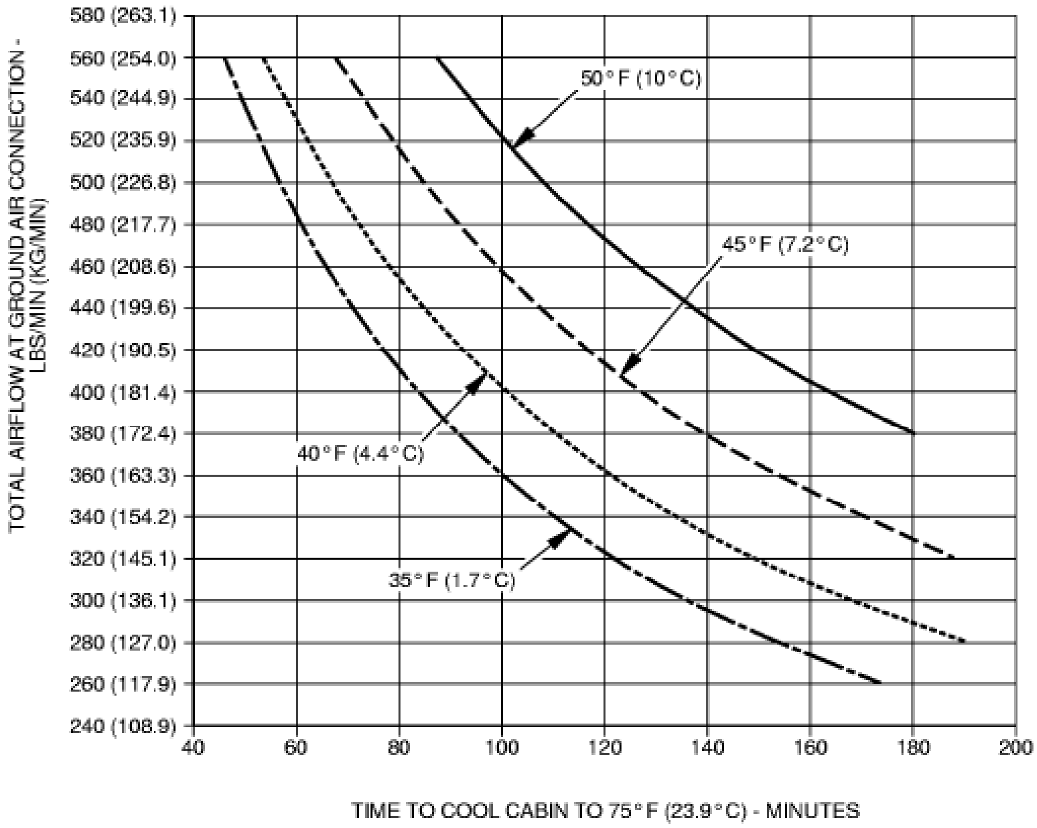
LEGEND:

40°F(-40°C) AMBIENT
0°F(-17.8°C) AMBIENT

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE, AT THE GROUND AIR CONNECTION, THAT IS REQUIRED TO HEAT THE AIRPLANE'S CABIN TO A BULK AVERAGE OF 75° F (24° C) WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.6 Conditioned Air Flow Requirements – Cooling Time: Model 787-9



CONDITIONS:

- OUTSIDE AIR TEMPERATURE: 103° F (39.4° C)
- INITIAL CABIN TEMPERATURE: 115° F (46.1° C)
- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL TO DIM WINDOWS AND LIGHTING
- RECIRCULATION FANS SELECTED OFF
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- NO OCCUPANTS
- FULL SOLAR LOAD

LEGEND:

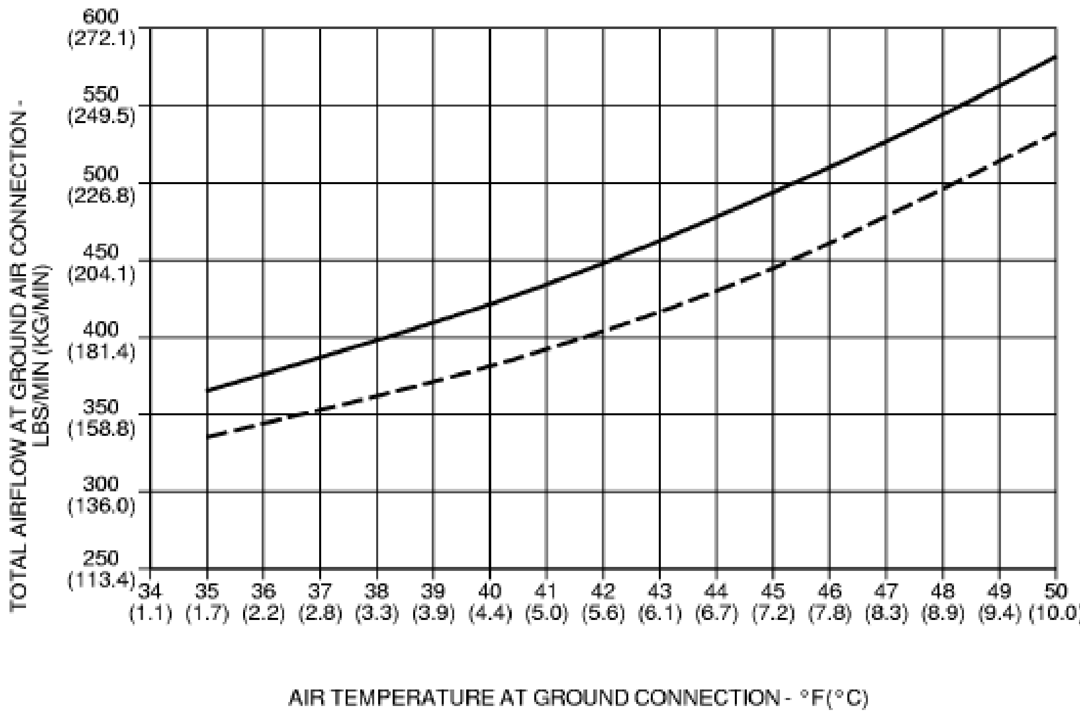
PCA TEMPERATURE AT GROUND CONNECTION

50° F (10° C)
45° F (7.2° C)
40° F (4.4° C)
35° F (1.7° C)

NOTE:

THIS GRAPH PROVIDES THE PREDICTED TIME REQUIRED TO COOL THE AIRPLANE'S CABIN TO A BULK AVERAGE OF 75° F (24° C) AS A FUNCTION OF AIRFLOW AND TEMPERATURE, AT THE GROUND AIR CONNECTION, WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.7 Conditioned Air Flow Requirements – Cooling – Steady State (103 F Ambient Air): Model 787-9



CONDITIONS:

- OUTSIDE AIR TEMPERATURE: 103°F (39.4°C)
- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL, DIMMED WINDOWS AND LIGHTING
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- 100% OCCUPANT LOAD FACTOR
- FULL SOLAR LOAD

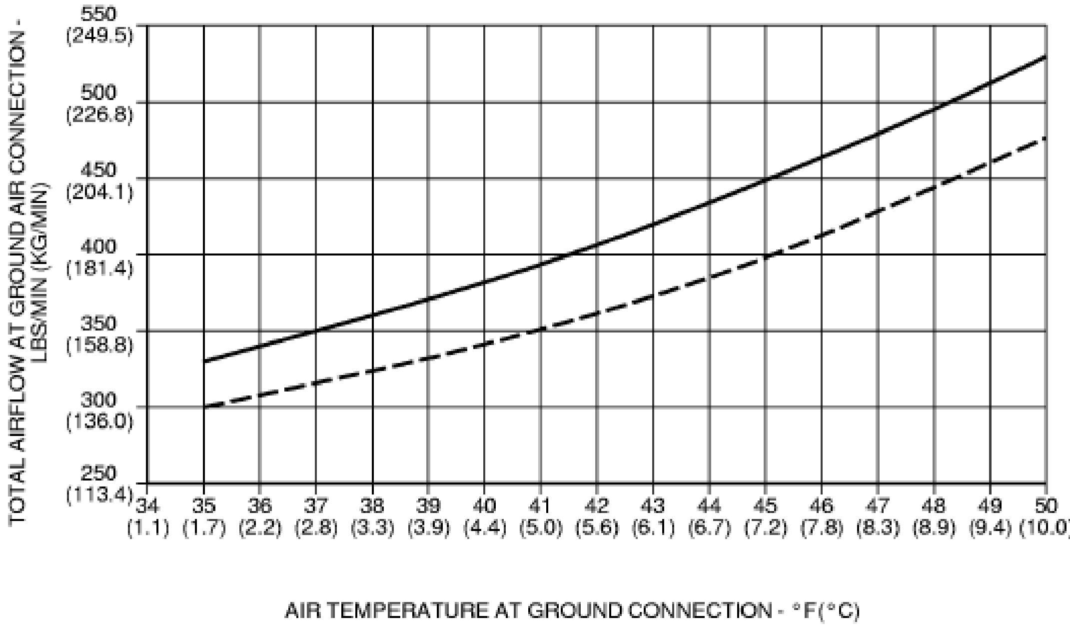
LEGEND:

- (solid line) 402 SEATS
- (dashed line) 330 SEATS

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE, AT THE AIRPLANE'S GROUND AIR CONNECTION, THAT IS REQUIRED TO MAINTAIN THE AIRPLANE'S CABIN AT A BULK AVERAGE OF 75°F (24°C) WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.8 Conditioned Air Flow Requirements – Cooling – Steady State (80 F Ambient Air): Model 787-9



CONDITIONS:

- OUTSIDE AIR TEMPERATURE: 80° F (26.7° C)
- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL, DIMMED WINDOWS AND LIGHTING
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- 100% OCCUPANT LOAD FACTOR
- FULL SOLAR LOAD

LEGEND:

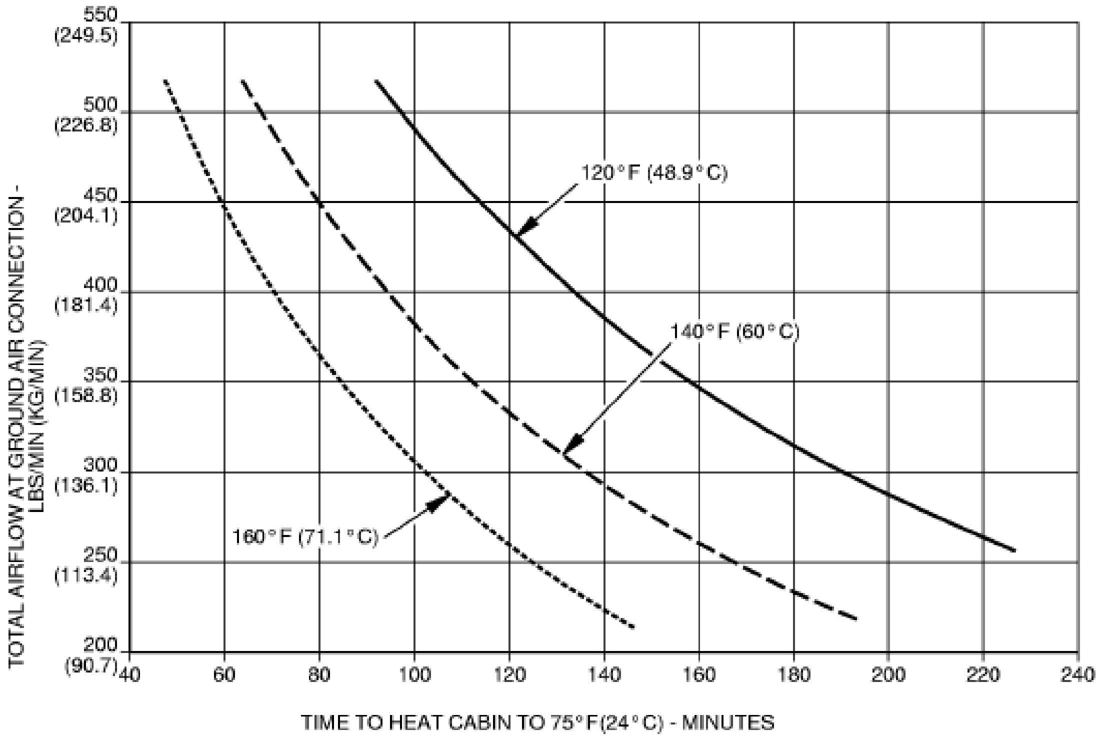
——— 402 SEATS

– – – 330 SEATS

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE, AT THE AIRPLANE'S GROUND AIR CONNECTION, THAT IS REQUIRED TO MAINTAIN THE AIRPLANES CABIN AT A BULK AVERAGE OF 75° F (24° C) WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.9 Conditioned Air Flow Requirements – Heating Time: Model 787-9



CONDITIONS:

- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- OUTSIDE AIR TEMPERATURE IS -40°F (-40°C)
- INITIAL CABIN TEMPERATURE IS -25°F (-31.7°C)
- NO SOLAR HEAT LOAD
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- NO OCCUPANTS
- IFE OFF
- NO ELECTRICAL HEAT LOADS

LEGEND:

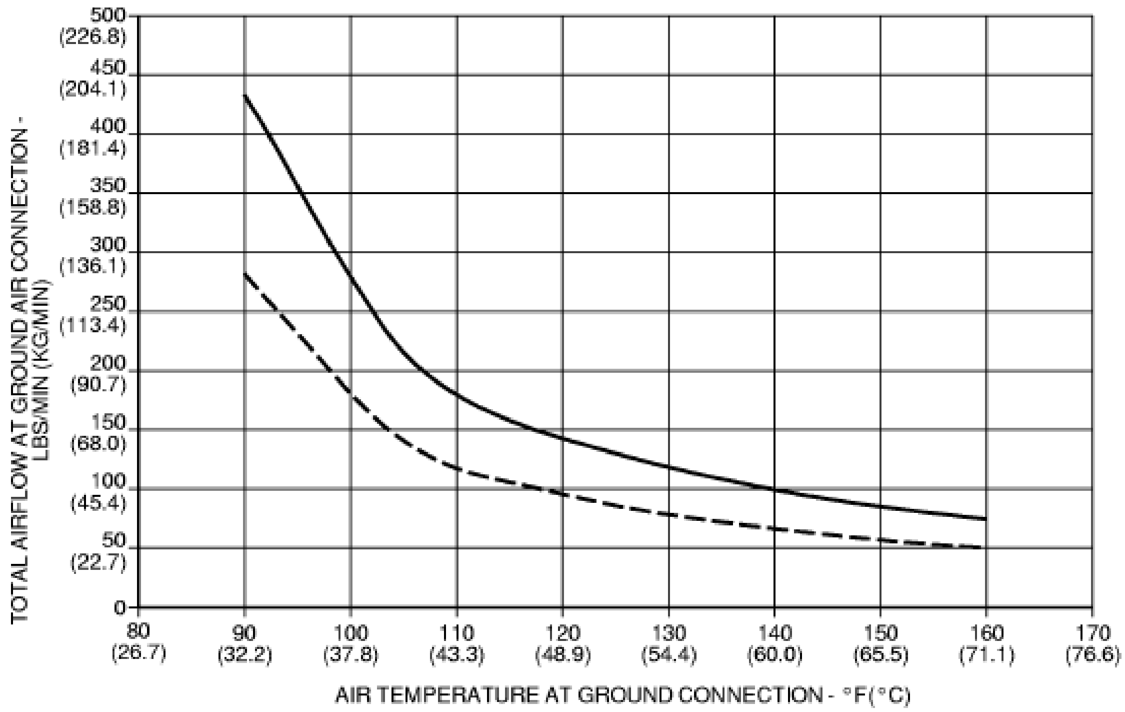
PCA TEMPERATURE AT GROUND CONNECTION

- 120°F(48.9°C)
- 140°F(60.0°C)
- 160°F(71.1°C)

NOTE:

THIS GRAPH PROVIDES THE PREDICTED TIME REQUIRED TO HEAT THE AIRPLANE'S CABIN TO A BULK AVERAGE OF 75°F (24°C) AS A FUNCTION OF AIRFLOW AND TEMPERATURE, AT THE GROUND AIR CONNECTION, WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.10 Conditioned Air Flow Requirements – Heating – Steady State: Model 787-9



CONDITIONS:

- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- NO SOLAR HEAT LOAD
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- NO OCCUPANTS
- IFE OFF
- NO ELECTRICAL HEAT LOADS

LEGEND:

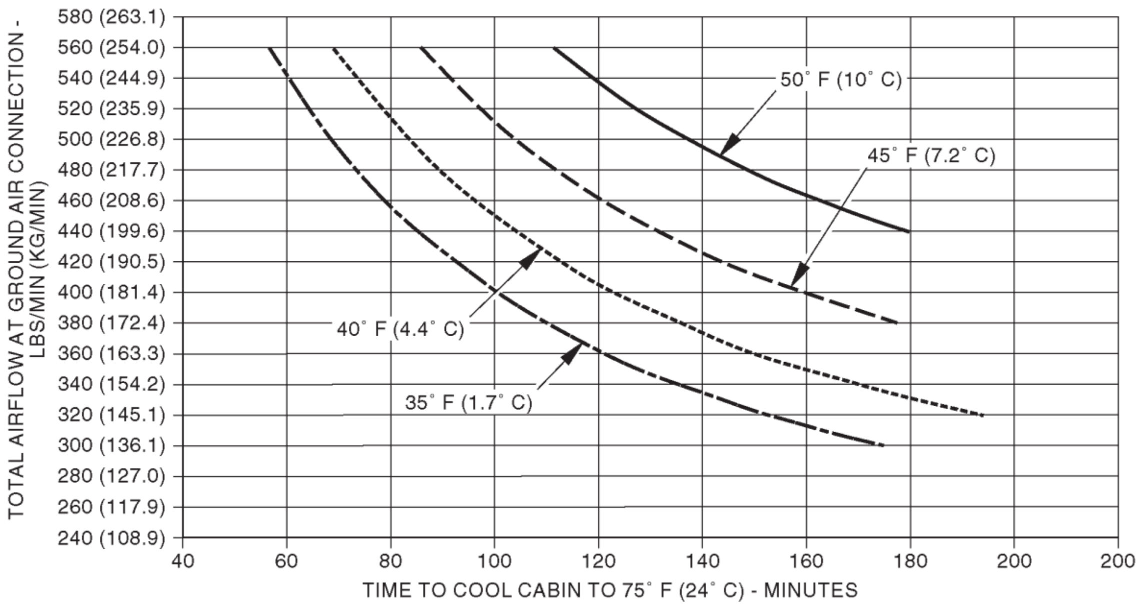
——— 40°F(-40°C) AMBIENT

– – – 0°F(-17.8°C) AMBIENT

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE, AT THE GROUND AIR CONNECTION, THAT IS REQUIRED TO HEAT THE AIRPLANE'S CABIN TO A BULK AVERAGE OF 75°F (24°C) WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.11 Conditioned Air Flow Requirements – Cooling Time: Model 787-10

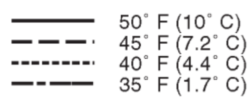


CONDITIONS:

- OUTSIDE AIR TEMPERATURE: 103° F (39.4° C)
- INITIAL CABIN TEMPERATURE: 115° F (46.1° C)
- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL (CAP) (FULL SOLAR LOAD WITH DIMMED WINDOWS AND LIGHTING)
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- NO OCCUPANTS

LEGEND:

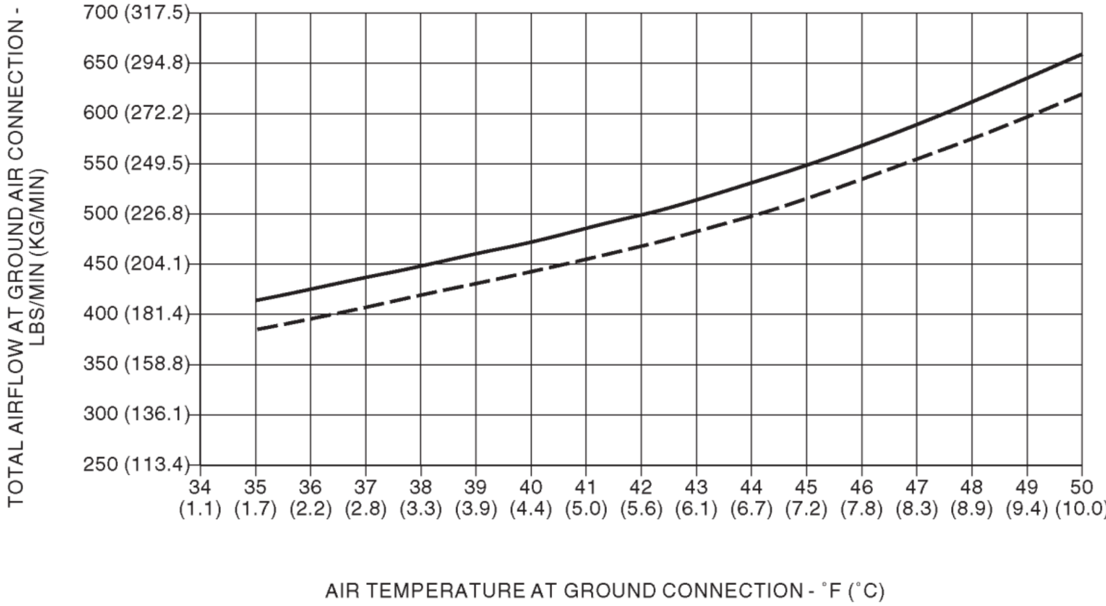
PCA TEMPERATURE AT GROUND CONNECTION



NOTE:

THIS GRAPH PROVIDES THE PREDICTED TIME REQUIRED TO COOL THE AIRPLANE'S CABIN TO 75° F (24° C) AS A FUNCTION OF AIRFLOW AND TEMPERATURE, AT THE GROUND AIR CONNECTION, WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.12 Conditioned Air Flow Requirements – Cooling – Steady State (103 F Ambient Air): Model 787-10



CONDITIONS:

- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL (CAP) (FULL SOLAR LOAD WITH DIMMED WINDOWS AND LIGHTING)
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- 100% OCCUPANT LOAD FACTOR

LEGEND:

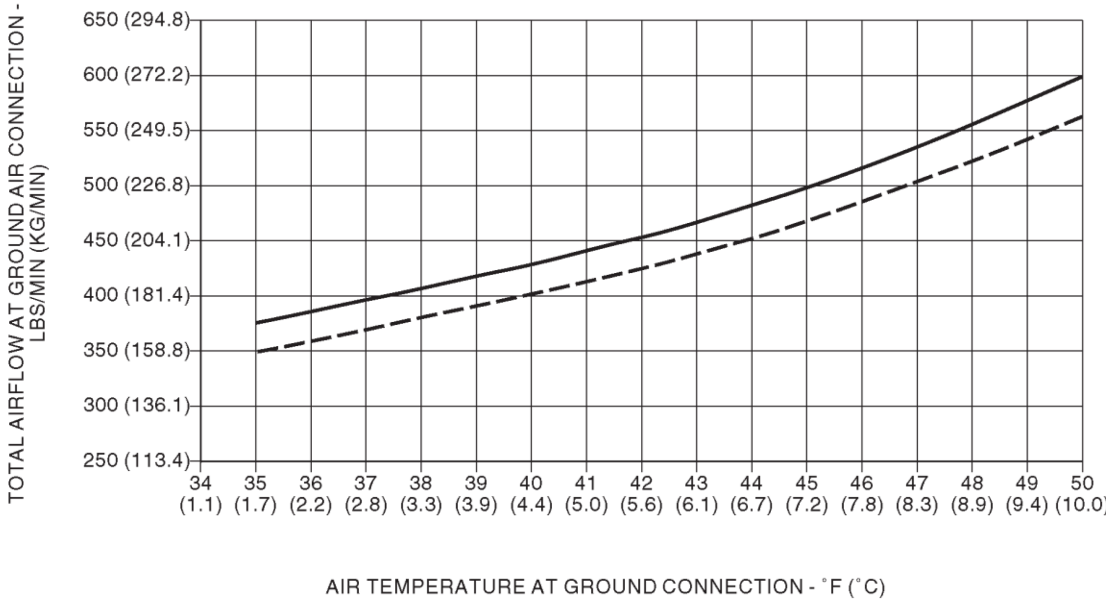
——— 440 SEATS

– – – 382 SEATS

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE REQUIRED TO COOL A BULK AVERAGE TEMPERATURE OF 75°F WHEN UTILIZING A PRE-CONDITIONED AIR PCA SOURCE(S).

5.6.13 Conditioned Air Flow Requirements – Cooling – Steady State (80 F Ambient Air): Model 787-10



CONDITIONS:

- ALL EXTERIOR DOORS AND WINDOWS CLOSED
- "HEAT REDUCTION MODE" SELECTED VIA CABIN ATTENDANT PANEL (CAP) (FULL SOLAR LOAD WITH DIMMED WINDOWS AND LIGHTING)
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- IFE OFF
- 100% OCCUPANT LOAD FACTOR

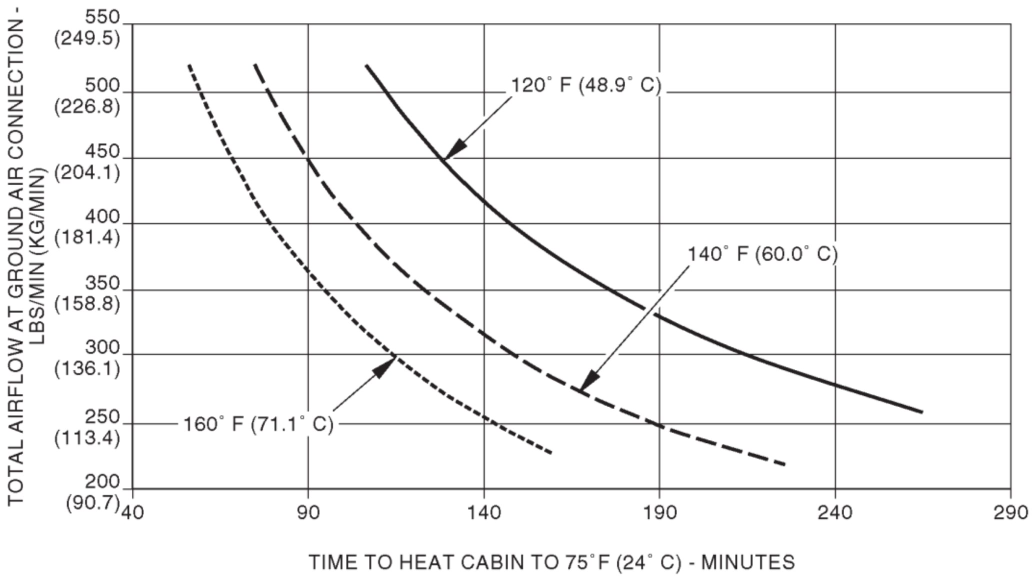
LEGEND:

———	440 SEATS
– – –	382 SEATS

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE REQUIRED TO COOL A BULK AVERAGE TEMPERATURE OF 75˚F WHEN UTILIZING A PRE-CONDITIONED AIR PCA SOURCE(S).

5.6.14 Conditioned Air Flow Requirements – Heating Time: Model 787-10



CONDITIONS:

- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- OUTSIDE AIR TEMPERATURE IS -40˚ F (-40˚ C)
- INITIAL CABIN TEMPERATURE IS -25˚ F (-32˚ C)
- NO SOLAR LOAD
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- NO OCCUPANTS
- IFE OFF
- NO ELECTRICAL HEAT LOADS

LEGEND:

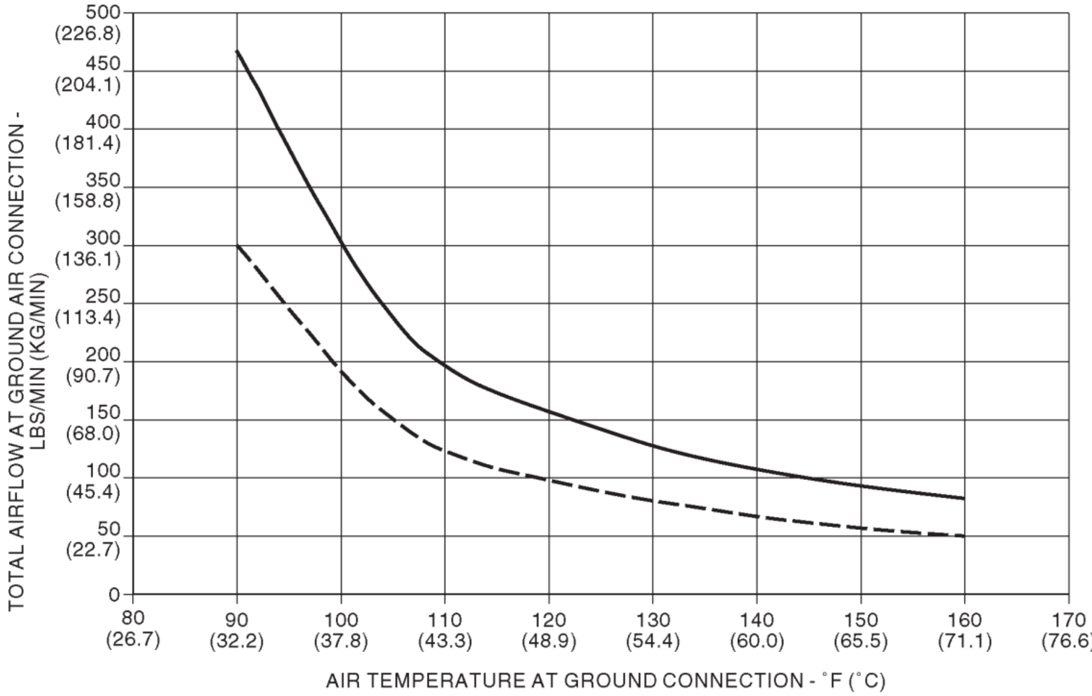
PCA TEMPERATURES AT GROUND CONNECTION

120˚F (48.9˚ C)
140˚F (60.0˚ C)
160˚F (71.1˚ C)

NOTE:

THIS GRAPH PROVIDES THE PREDICTED TIME REQUIRED TO HEAT THE AIRPLANE'S CABIN TO A BULK AVERAGE OF 75˚ F (24˚ C) AS A FUNCTION OF AIRFLOW AND TEMPERATURE, AT THE GROUND AIR CONNECTION, WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.6.15 Conditioned Air Flow Requirements – Heating – Steady State: Model 787-10



CONDITIONS:

- ALL EXTERIOR DOORS AND WINDOWS ARE CLOSED
- NO SOLAR HEAT LOAD
- LOWER RECIRCULATION FANS SELECTED OFF (UPPER FAN ON)
- ICS RECIRCULATION CHILLING OFF
- NO OCCUPANTS
- IFE OFF
- NO ELECTRICAL HEAT LOADS

LEGEND:

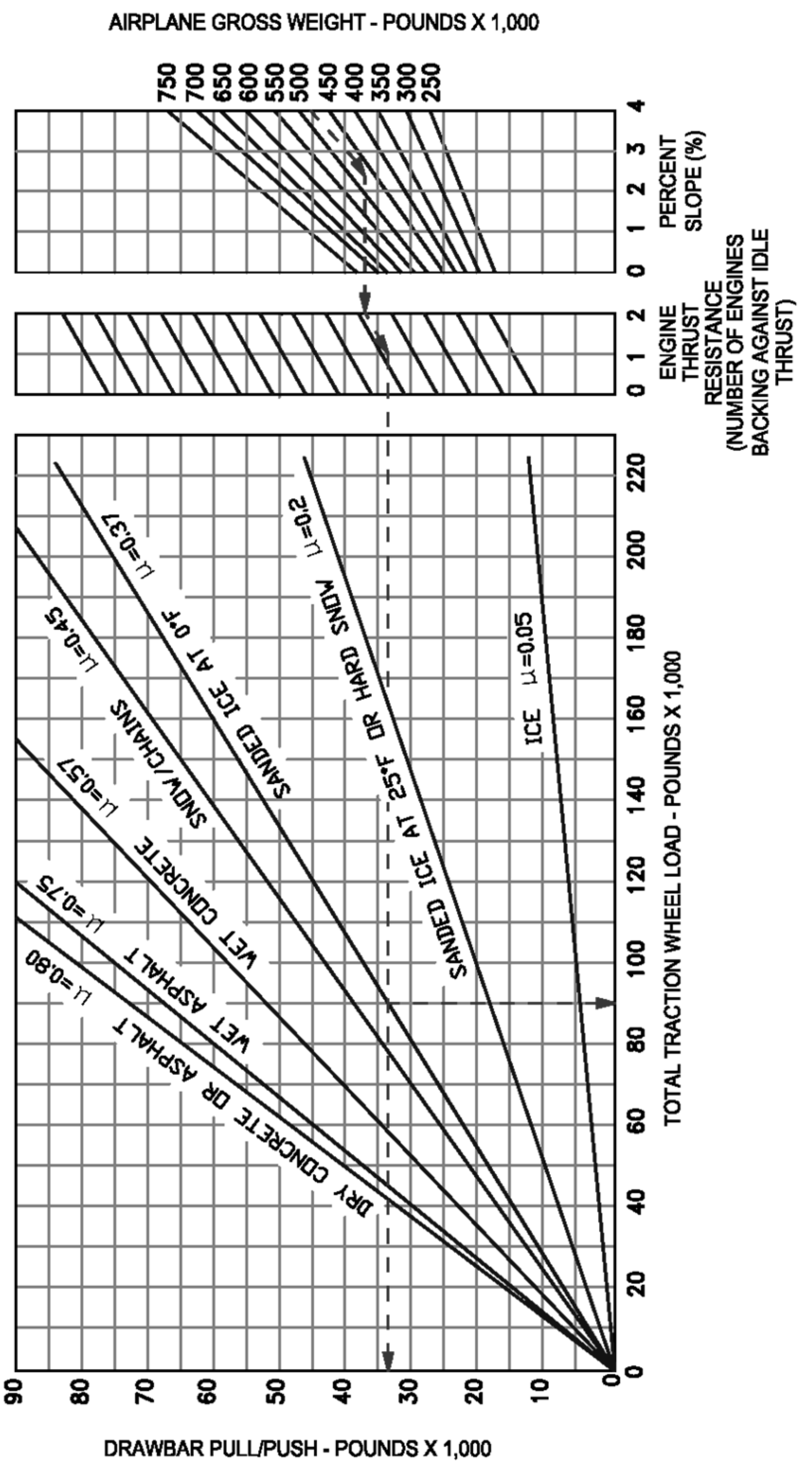
- (solid line) 40˚F (-40˚ C) AMBIENT
- (dashed line) 0˚F (-17.8˚ C) AMBIENT

NOTE:

THIS GRAPH PROVIDES THE FLOW RATE AND TEMPERATURE, AT THE GROUND AIR CONNECTION, THAT IS REQUIRED TO HEAT THE AIRPLANE'S CABIN TO A BULK AVERAGE OF 75˚ F (24˚ C) WHEN USING A PRE-CONDITIONED AIR (PCA) SOURCE.

5.7 GROUND TOWING REQUIREMENTS

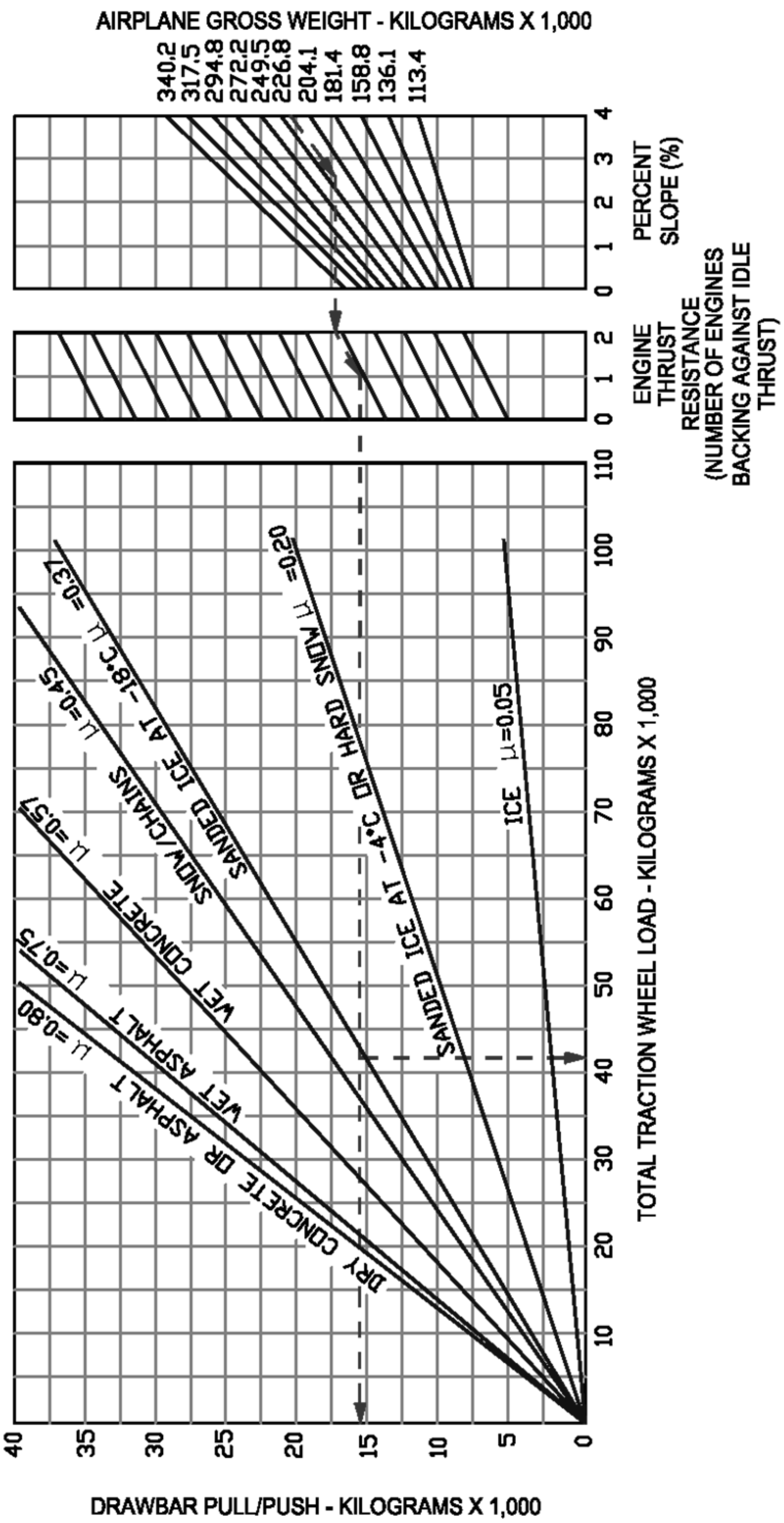
5.7.1 Ground Towing Requirements - English Units: Model 787-8, 787-9, 787-10



NOTE:

1. EXAMPLE-----SHOWS A 787 WEIGHING 486,000 POUNDS BEING PUSHED UP A 2.5% SLOPE ON SANDED ICE AT 0°F BACKING AGAINST ONE ENGINE AT IDLE THRUST 33,460 POUNDS OF DRAW BAR PUSH AND A WHEEL TRACTION LOAD OF 90,000 POUNDS ARE REQUIRED FOR TOWING
2. UNUSUAL BREAKAWAY CONDITIONS NOT SHOWN
3. STRAIGHT-LINE TOW
4. COEFFICIENTS OF FRICTION (μ) ARE ESTIMATED FOR RUBBER-TIRED TOW VEHICLES

5.7.2 Ground Towing Requirements - Metric Units: Model 787-8, 787-9, 787-10



NOTE:

1. EXAMPLE------SHOWS A 787 WEIGHING 220,445 KILOGRAMS BEING PUSHED UP A 2.5% SLOPE ON SANDED ICE AT -18°C BACKING AGAINST ONE ENGINE AT IDLE THRUST 17.411 KILOGRAMS OF DRAW BAR PUSH AND A WHEEL TRACTION LOAD OF 43,057 KILOGRAMS ARE REQUIRED FOR TOWING
2. UNUSUAL BREAKAWAY CONDITIONS NOT SHOWN
3. STRAIGHT-LINE TOW
4. COEFFICIENTS OF FRICTION (μ) ARE ESTIMATED FOR RUBBER-TIRED TOW VEHICLES

6.0 JET ENGINE WAKE AND NOISE DATA

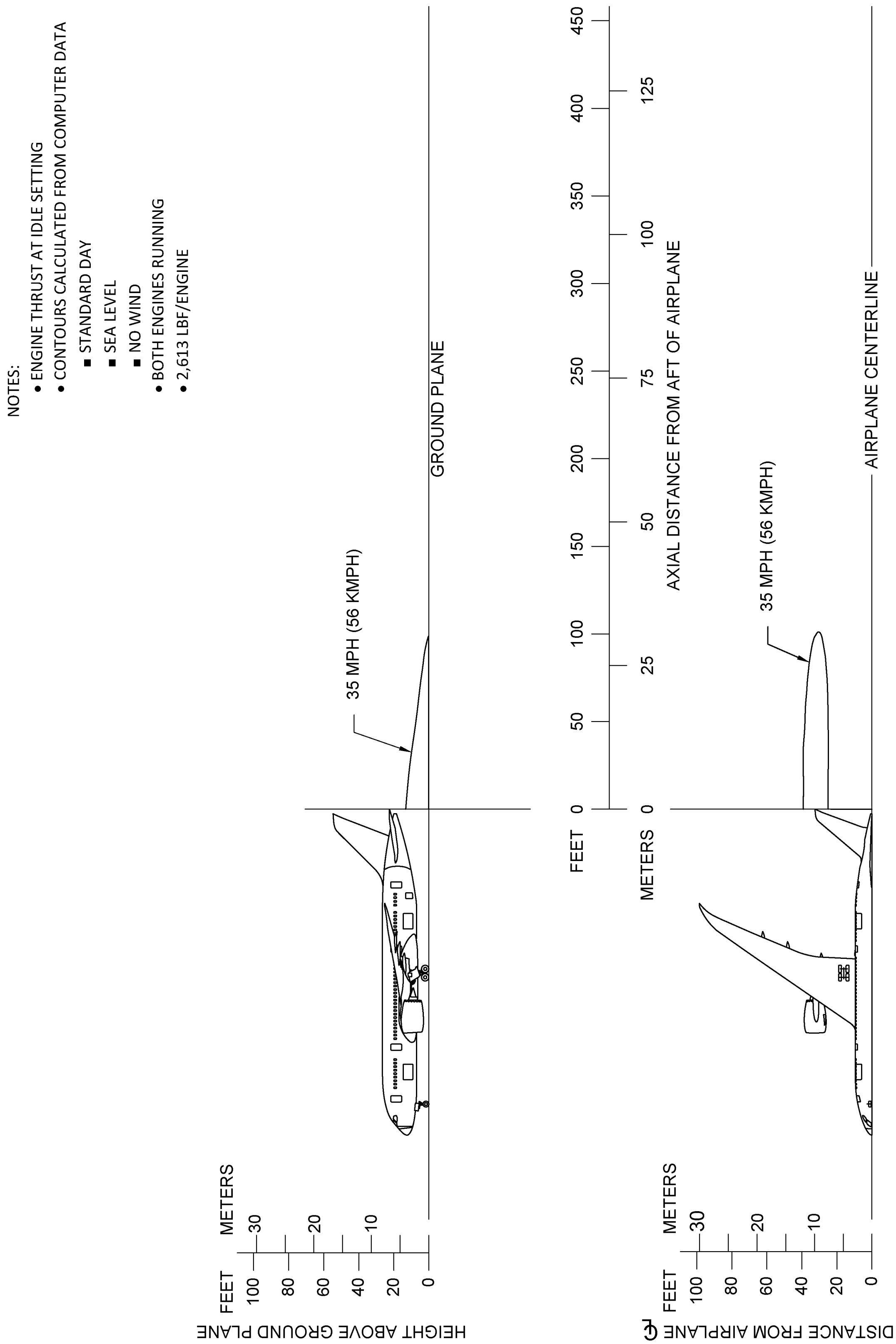
6.1 JET ENGINE EXHAUST VELOCITIES AND TEMPERATURE

This section shows exhaust velocity and temperature contours aft of the 787 airplane. The contours were calculated from a standard computer analysis using three-dimensional viscous flow equations with mixing of primary, fan, and free-stream flow. The presence of the ground plane is included in the calculations as well as engine tilt and toe-in. Mixing of flows from the engines is also calculated. The analysis does not include thermal buoyancy effects which tend to elevate the jet wake above the ground plane. The buoyancy effects are considered to be small relative to the exhaust velocity and therefore are not included.

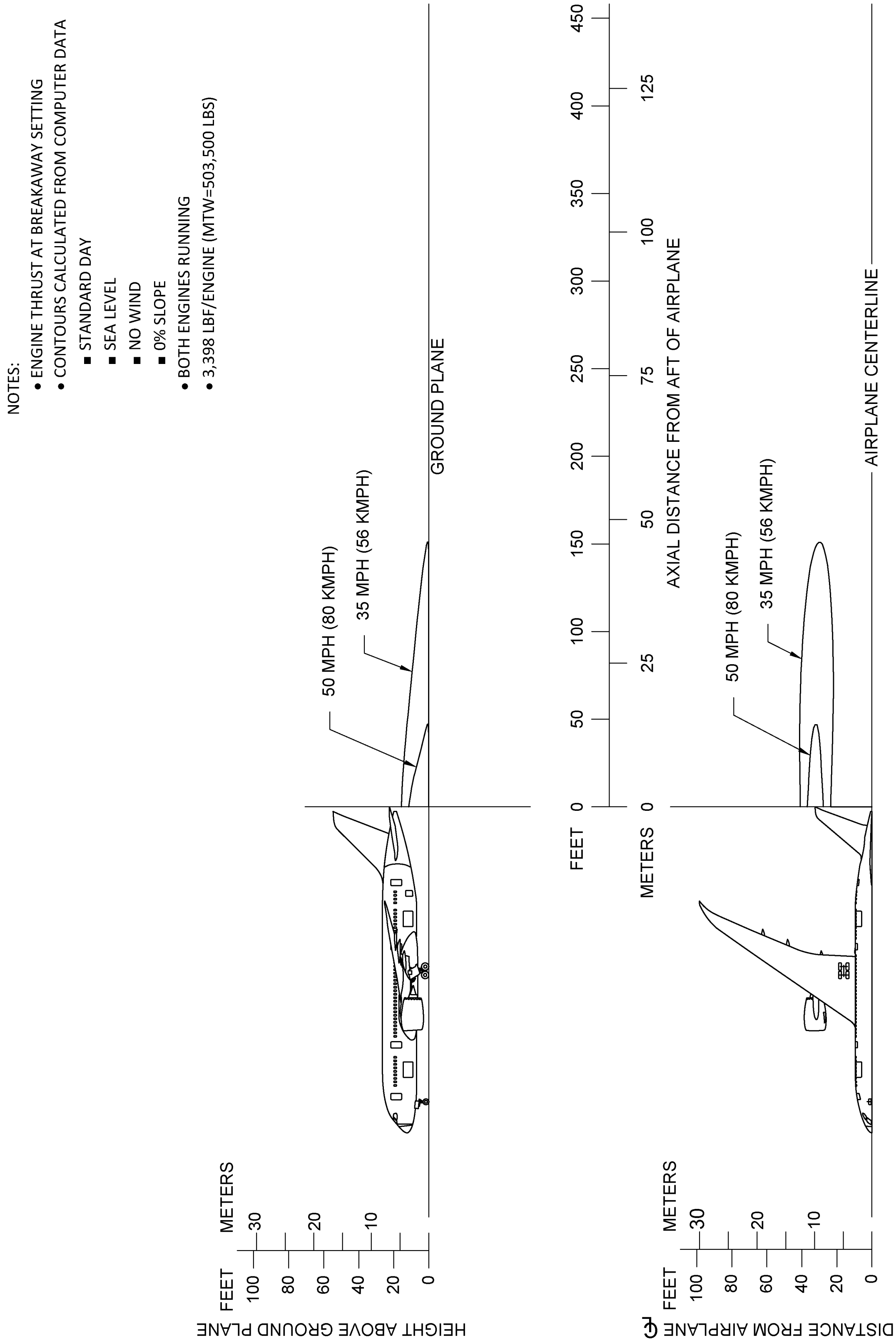
The graphs show jet wake velocity and temperature contours for representative engines. The results are valid for sea level, static, standard day conditions. The effect of wind on jet wakes is not included. There is evidence to show that a downwind or an upwind component does not simply add or subtract from the jet wake velocity, but rather carries the whole envelope in the direction of the wind. Crosswinds may carry the jet wake contour far to the side at large distances behind the airplane.

It should be understood, these exhaust velocity contours reflect steady-state, at maximum taxi weight, and not transient-state exhaust velocities. A steady-state is achieved with the aircraft in a fixed location, engine running at a given thrust level and measured when the contours stop expanding and stabilize in size, which could take several seconds. The steady-state condition, therefore, is conservative. Contours shown also do not account for performance variables such as ambient temperature or field elevation. For the terminal area environment, the transient-state is a more accurate representation of the actual exhaust contours when the aircraft is in motion and encountering static air with forward or turning movement, but it is very difficult to model on a consistent basis due to aircraft weight, weather conditions, the high degree of variability in terminal and apron configurations, and intensive numerical calculations. If the contours presented here are overly restrictive for terminal operations, The Boeing Company recommends conducting an analysis of the actual exhaust contours experienced by the using aircraft at the airport.

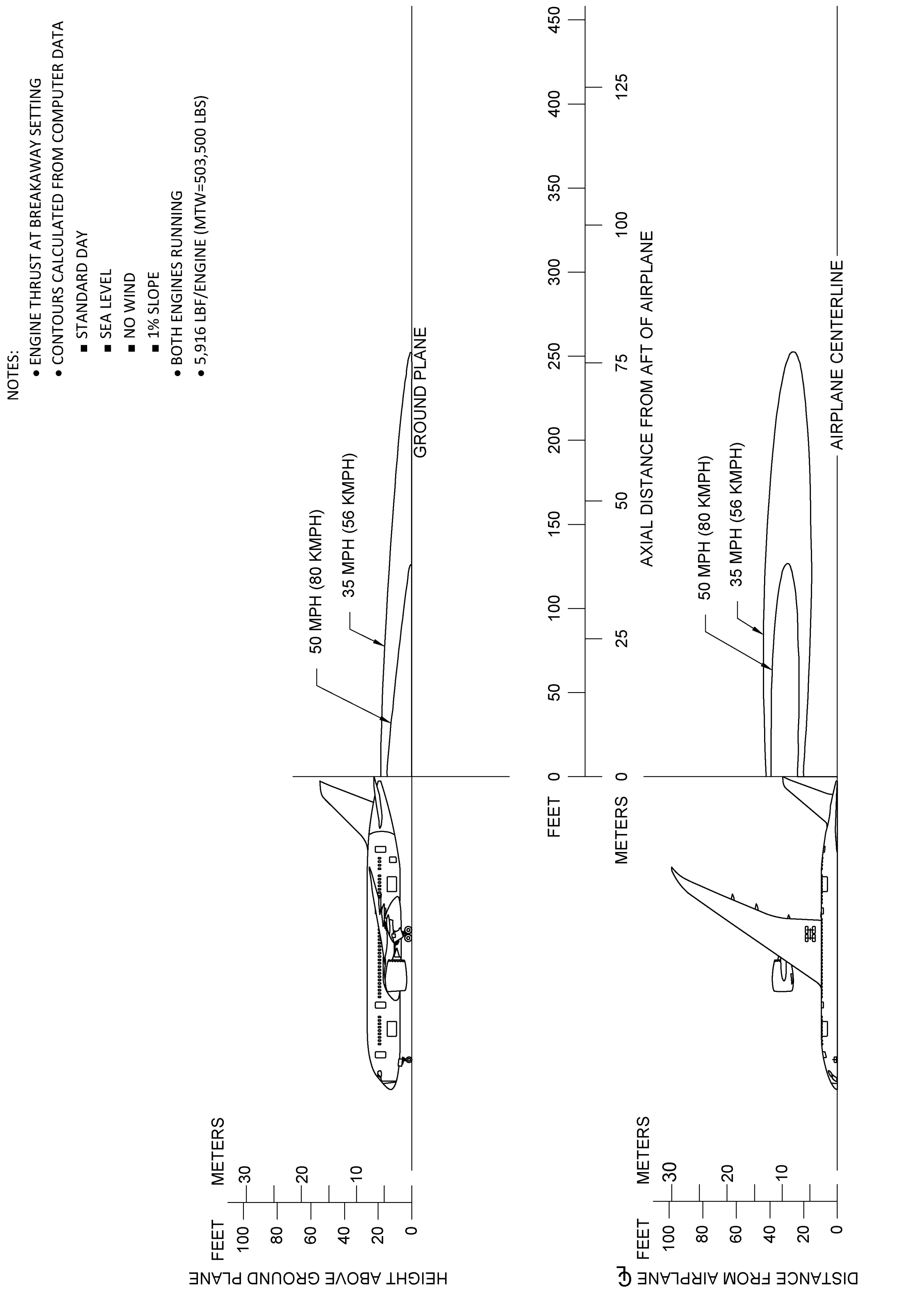
6.1.1 Jet Engine Exhaust Velocity Contours – Idle Thrust / Both Engines: Model 787-8



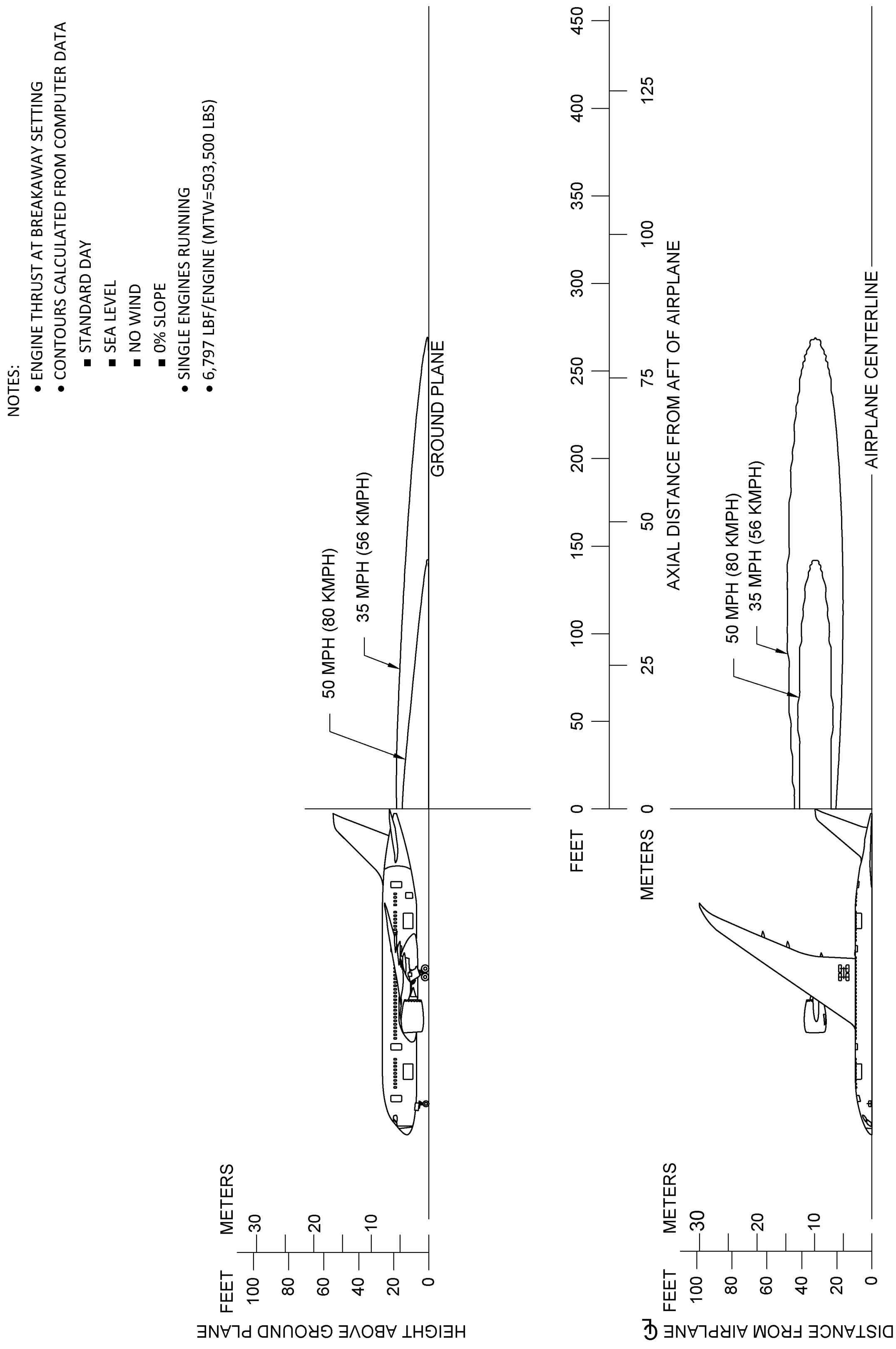
6.1.2 Jet Engine Exhaust Velocity Contours - Breakaway Thrust / 0% Slope / Both Engines / MTW: Model 787-8



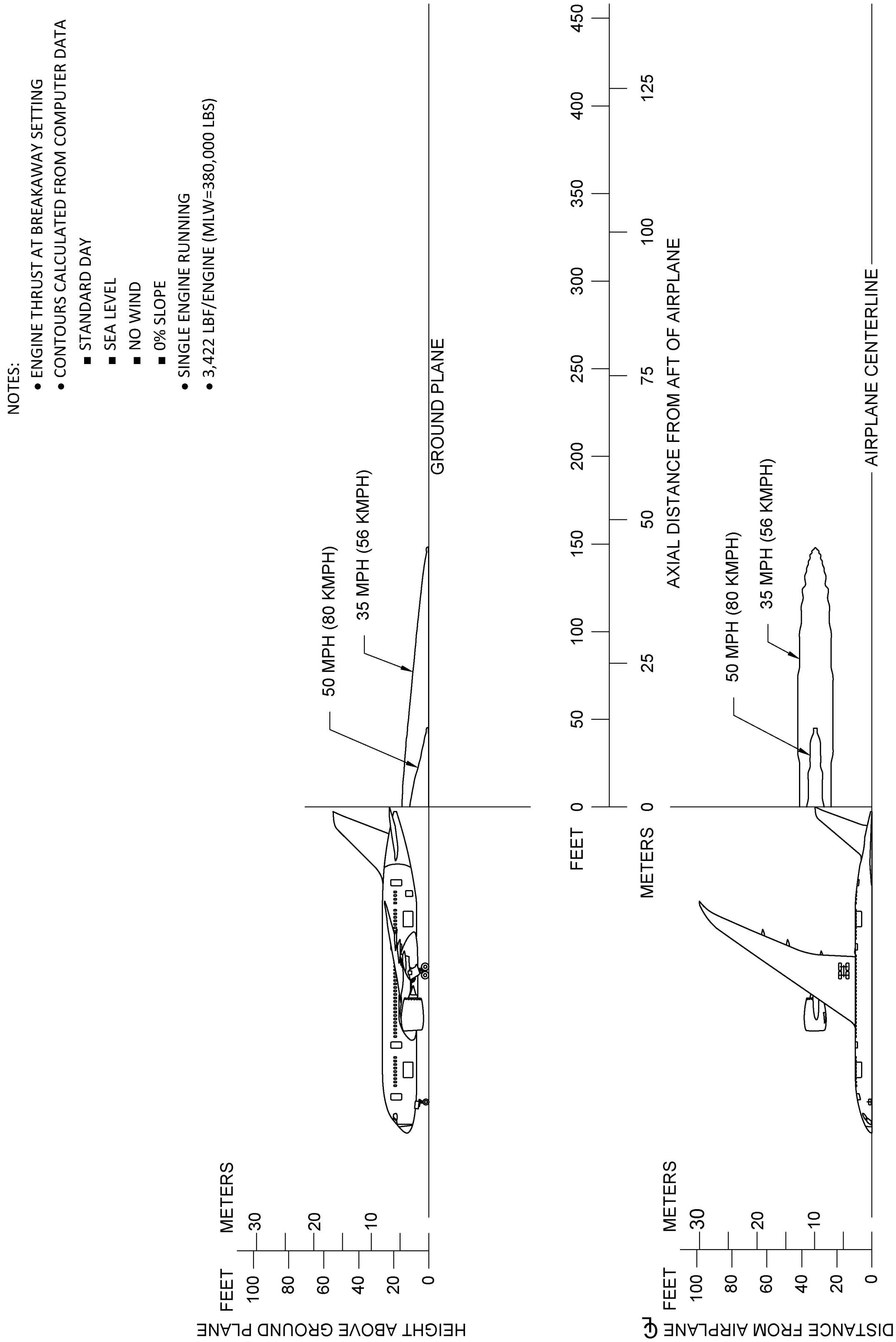
6.1.3 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 1% Slope / Both Engines / MTW: Model 787-8



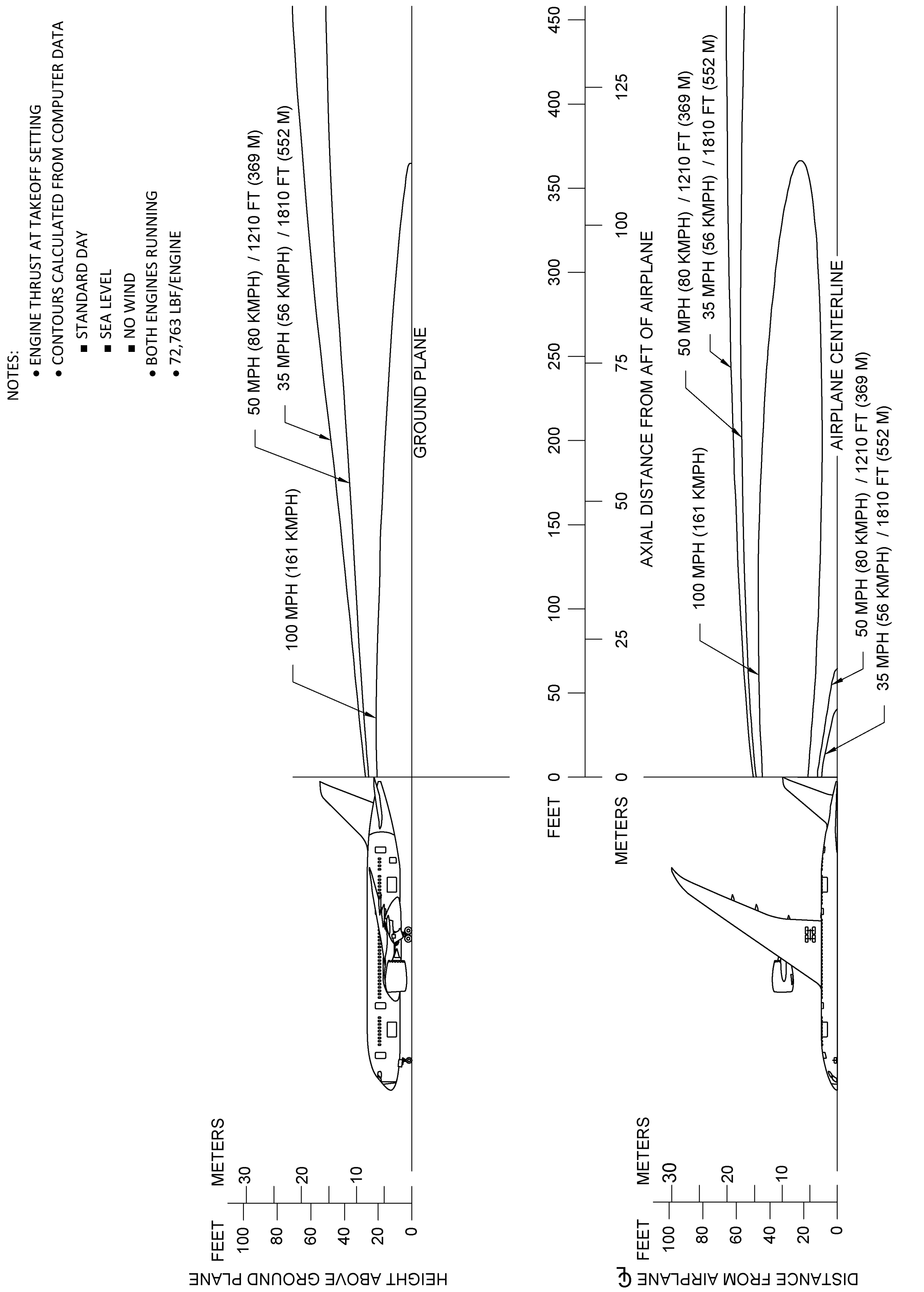
6.1.4 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 0% Slope / Single Engine / MTW: Model 787-8



6.1.5 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 0% Slope / Single Engine / MLW: Model 787-8



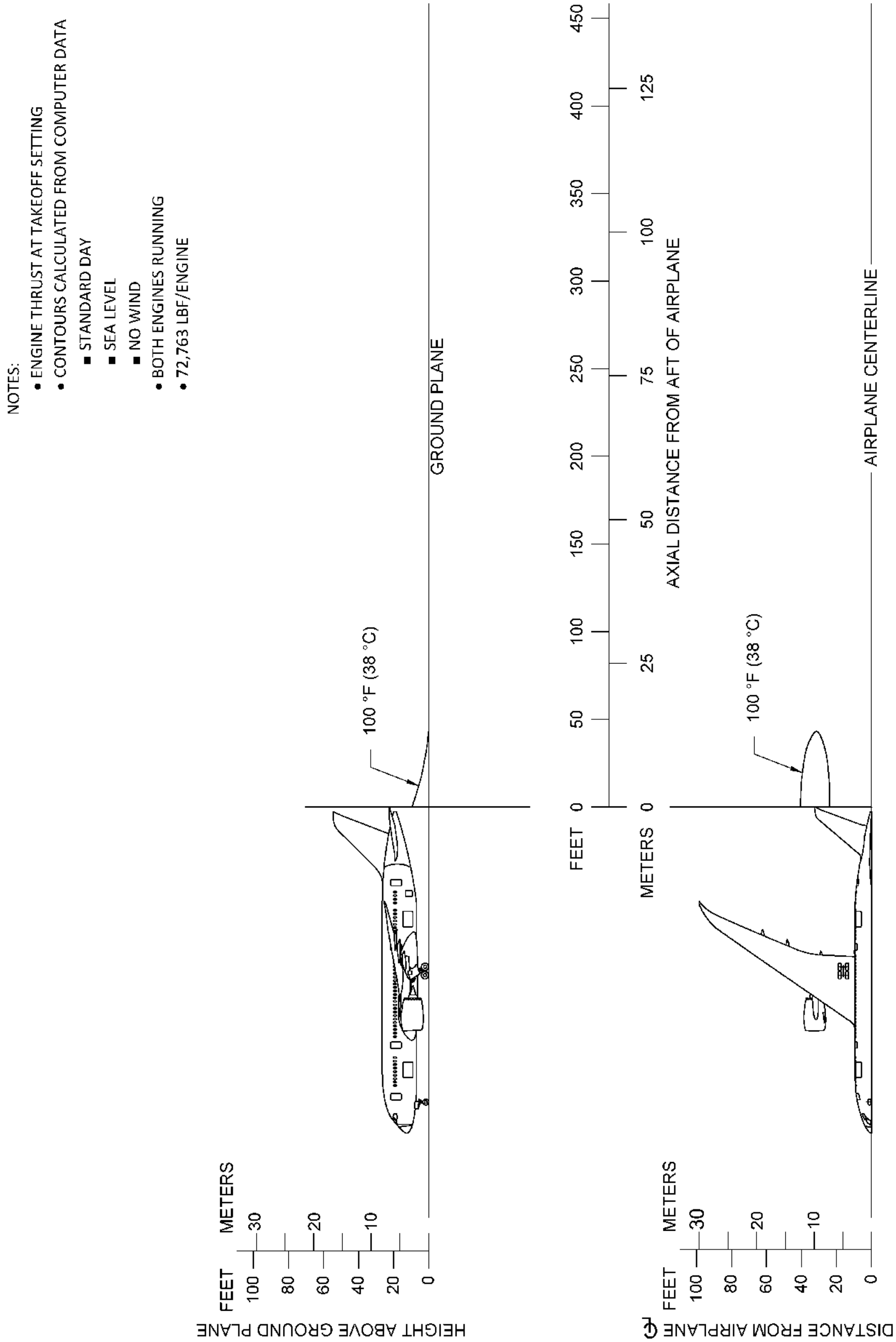
6.1.6 Jet Engine Exhaust Velocity Contours – Takeoff Thrust / Both Engines: Model 787-8



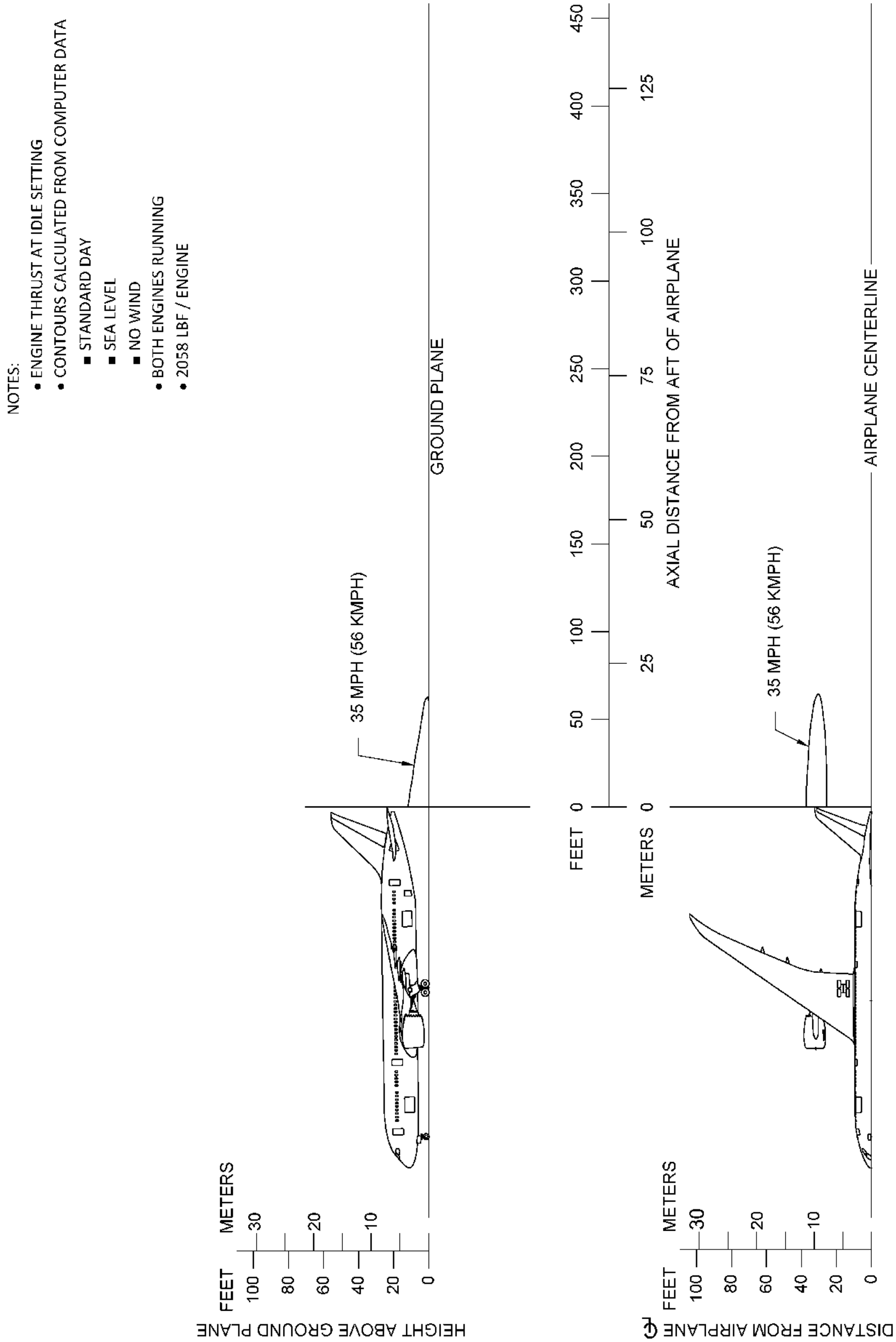
6.1.7 Jet Engine Exhaust Temperature Contours – Idle/Breakaway Thrust: Model 787-8

Temperature contours for idle/breakaway power conditions are not shown as the maximum temperature aft of the 787-8 is predicated to be less than 100° F (38° C) for standard day conditions of 59° F (15° C).

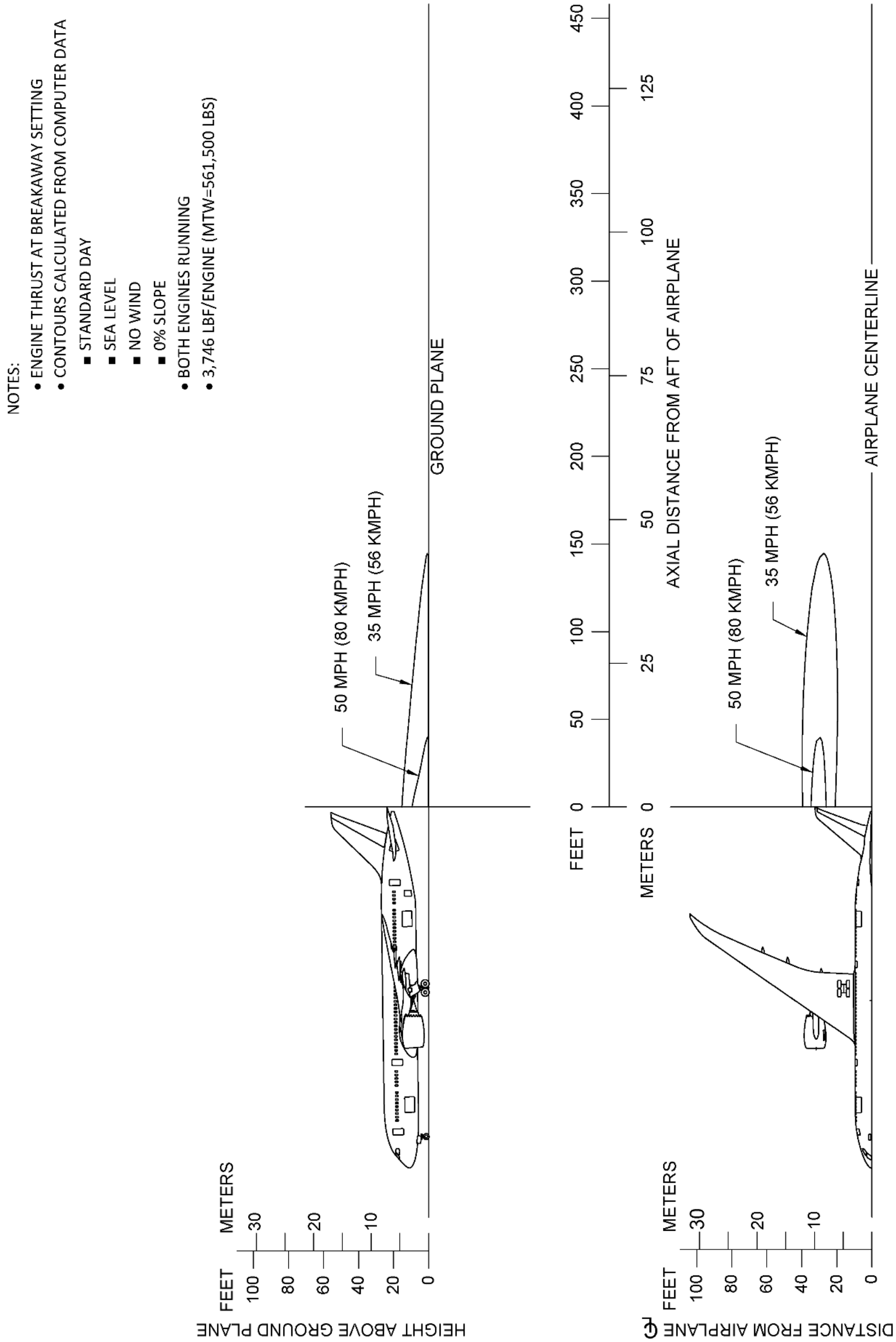
6.1.8 Jet Engine Exhaust Temperature Contours – Takeoff Thrust / Both Engines: Model 787-8



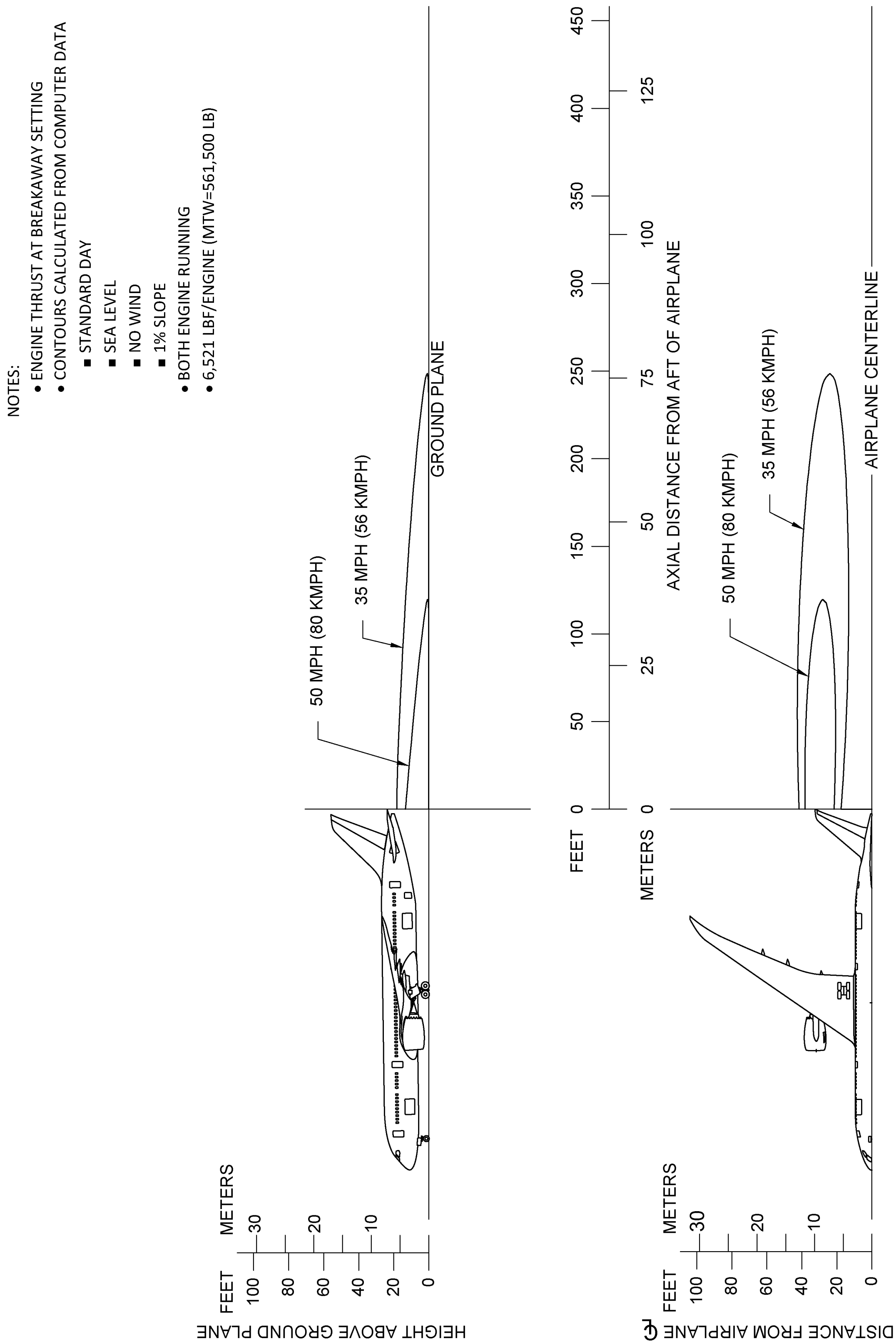
6.1.9 Jet Engine Exhaust Velocity Contours – Idle Thrust: Model 787-9



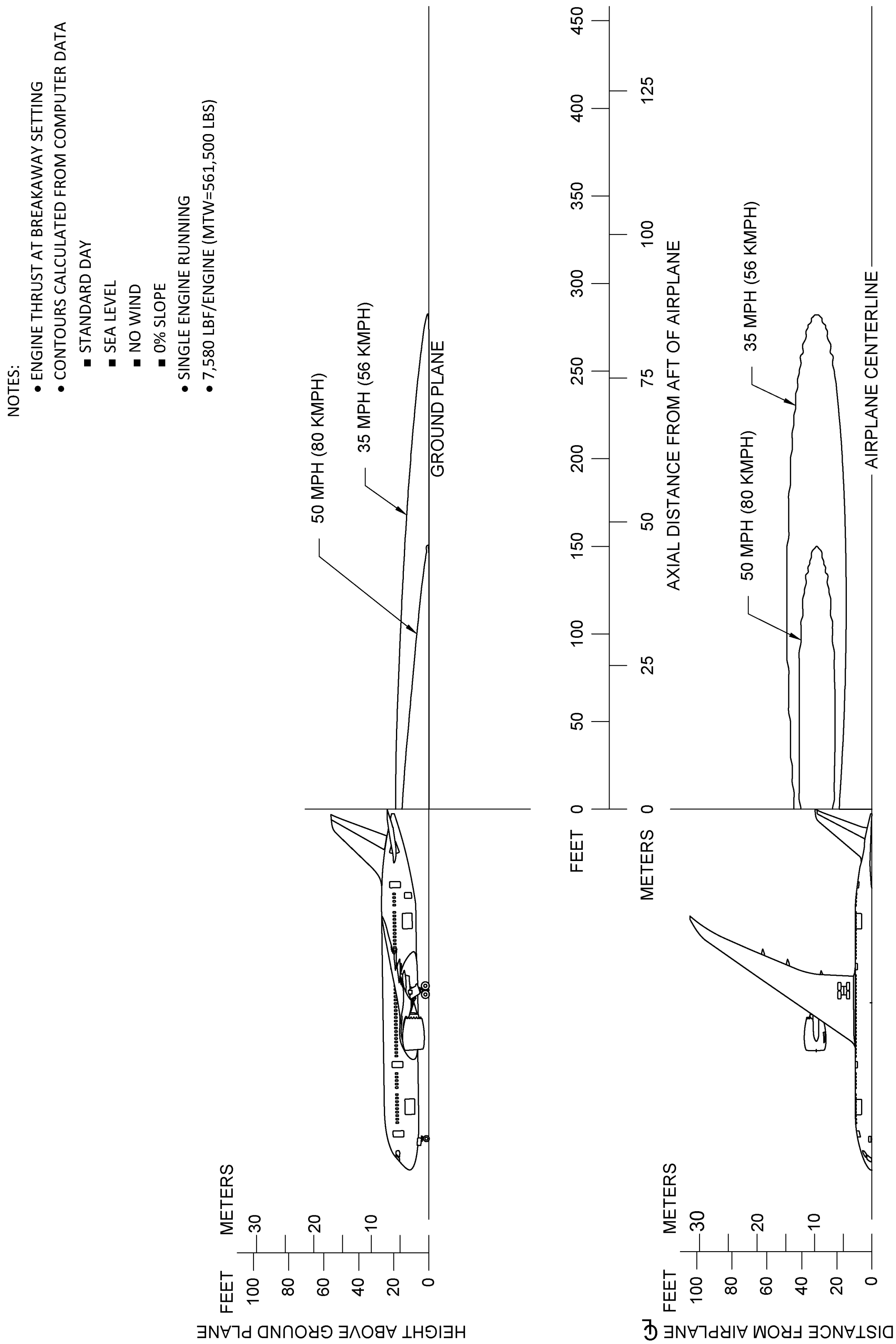
6.1.10 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 0% Slope / Both Engines / MTW: Model 787-9



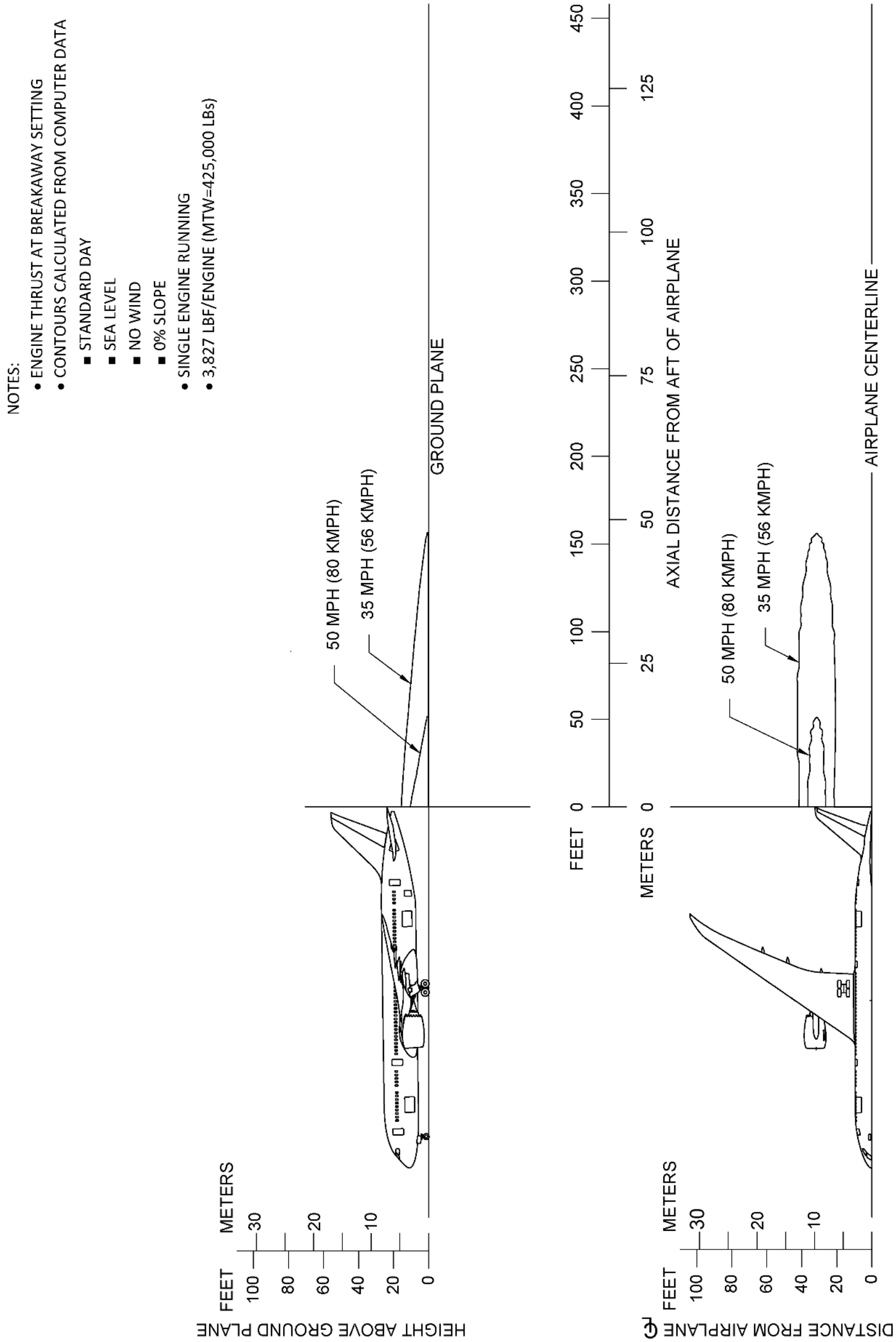
6.1.11 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 1% Slope / Both Engines / MTW: Model 787-9



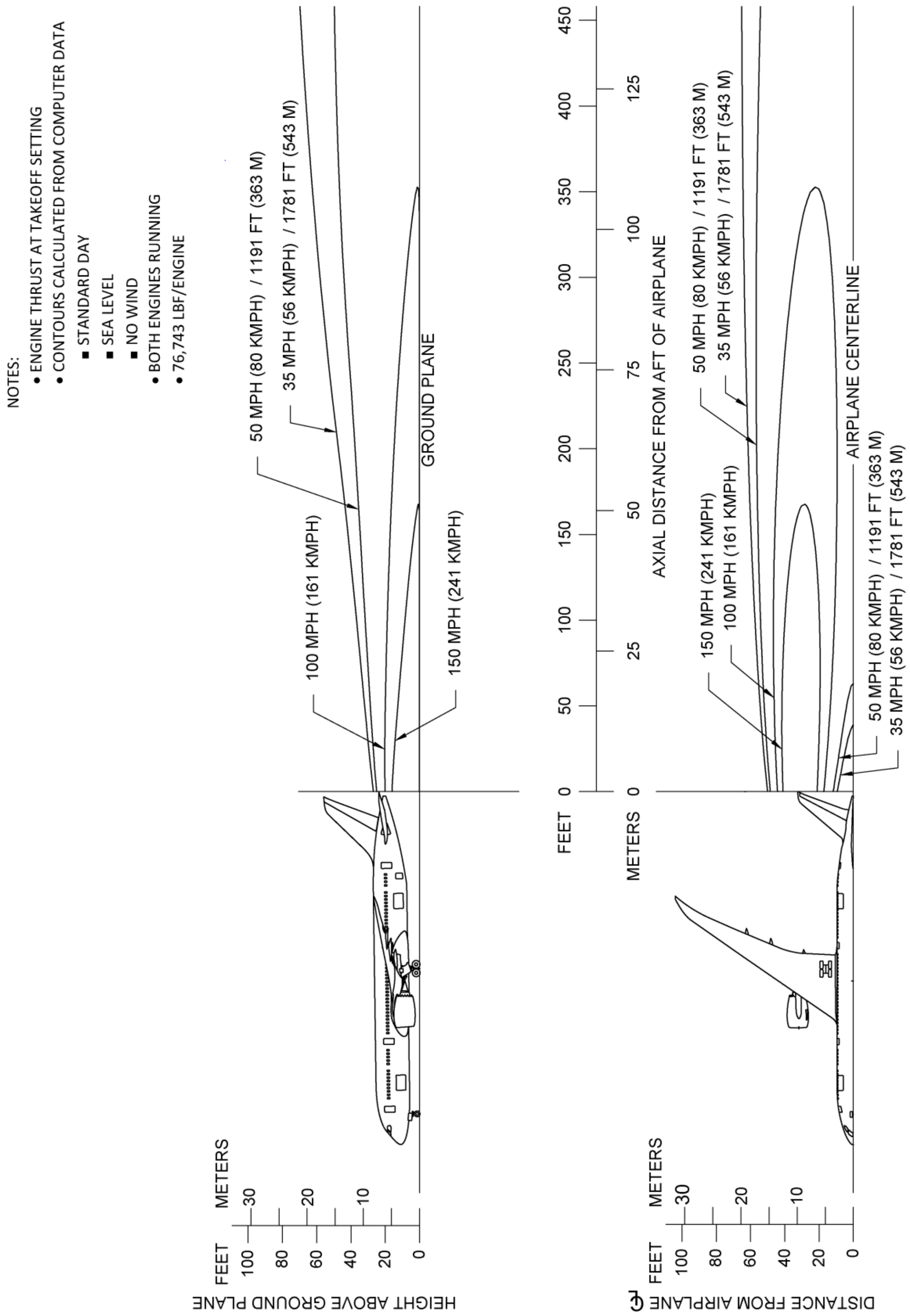
6.1.12 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 0% Slope / Single Engine / MTW: Model 787-9



6.1.13 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 0% Slope / Single Engine / MLW: Model 787-9



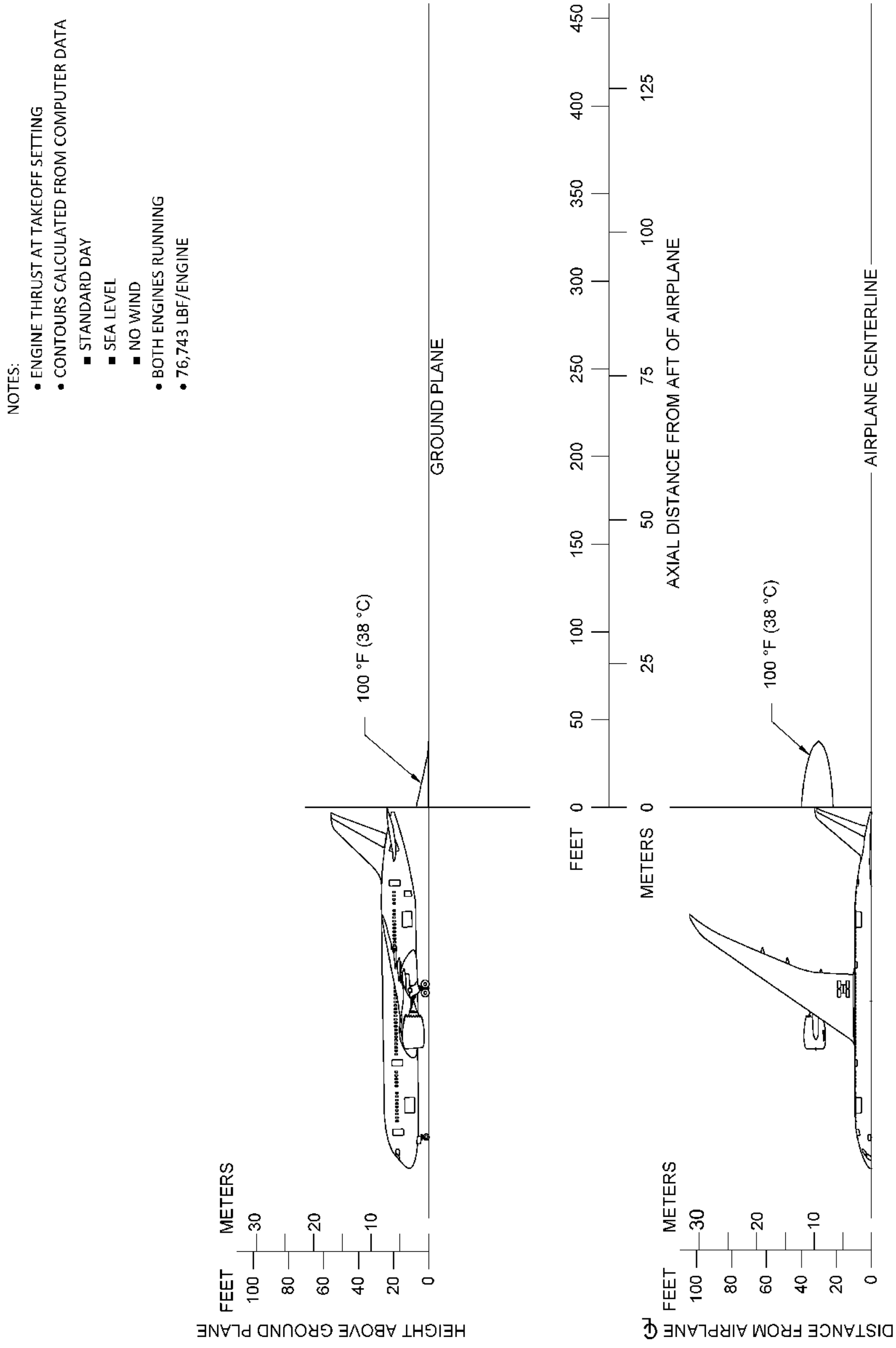
6.1.14 Jet Engine Exhaust Velocity Contours – Takeoff Thrust / Both Engines: Model 787-9



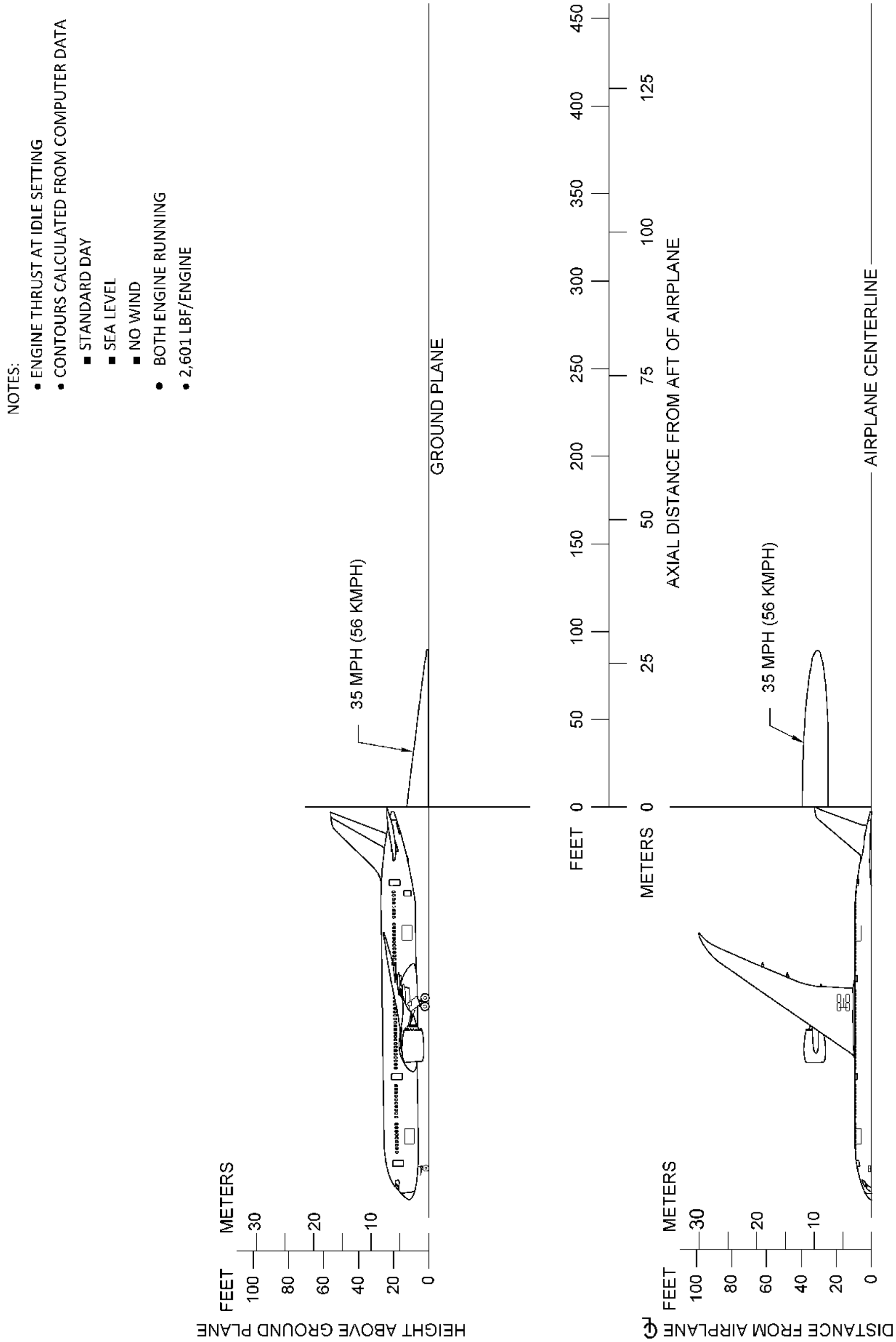
6.1.15 Jet Engine Exhaust Temperature Contours – Idle/Breakaway Thrust: Model 787-9

Temperature contours for idle/breakaway power conditions are not shown as the maximum temperature aft of the 787-9 is predicated to be less than 100° F (38° C) for standard day conditions of 59° F (15° C).

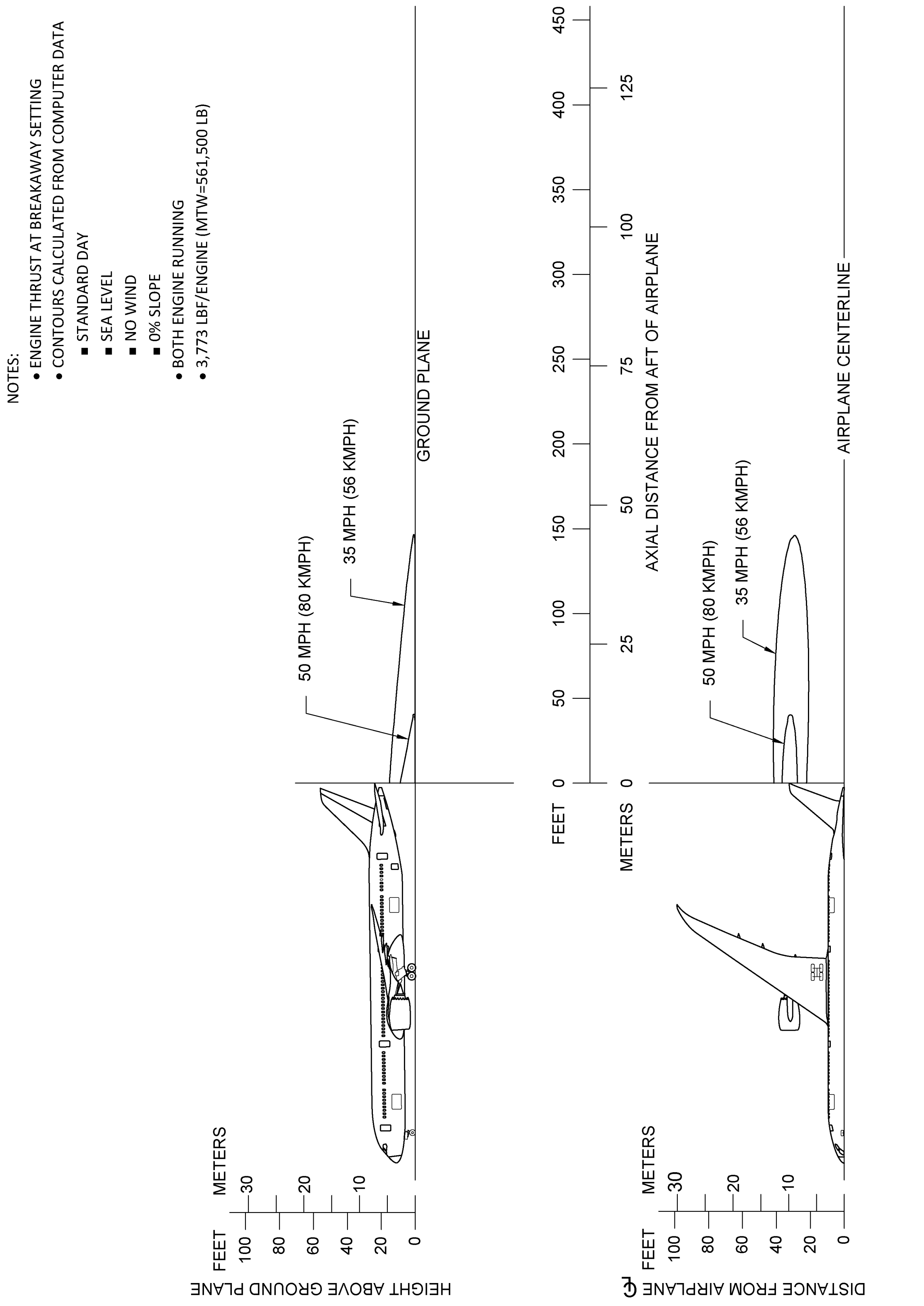
6.1.16 Jet Engine Exhaust Temperature Contours – Takeoff Thrust / Both Engines: Model 787-9



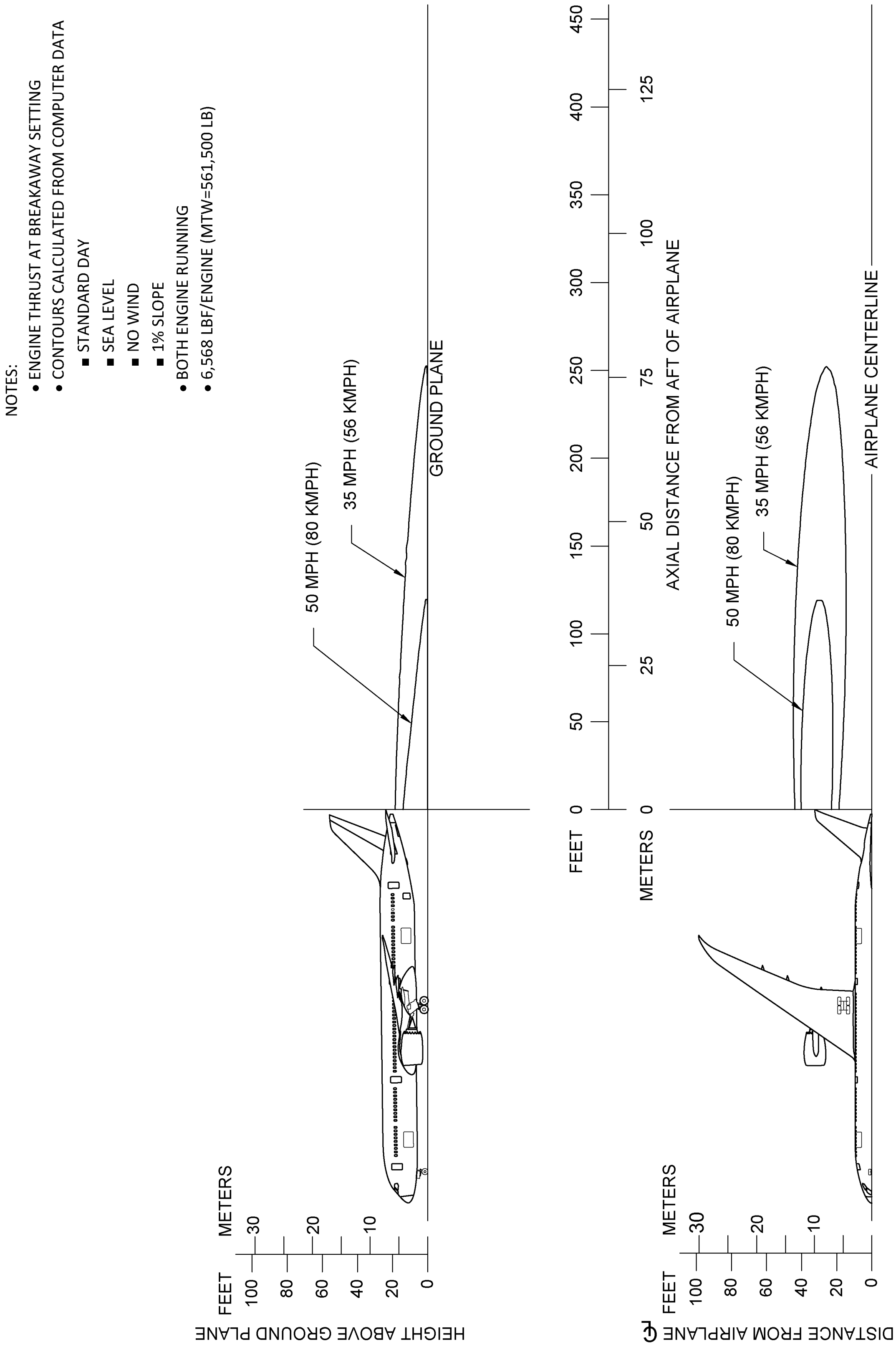
6.1.17 Jet Engine Exhaust Velocity Contours – Idle Thrust / Both Engines: Model 787-10



6.1.18 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 0% Slope / Both Engines: Model 787-10

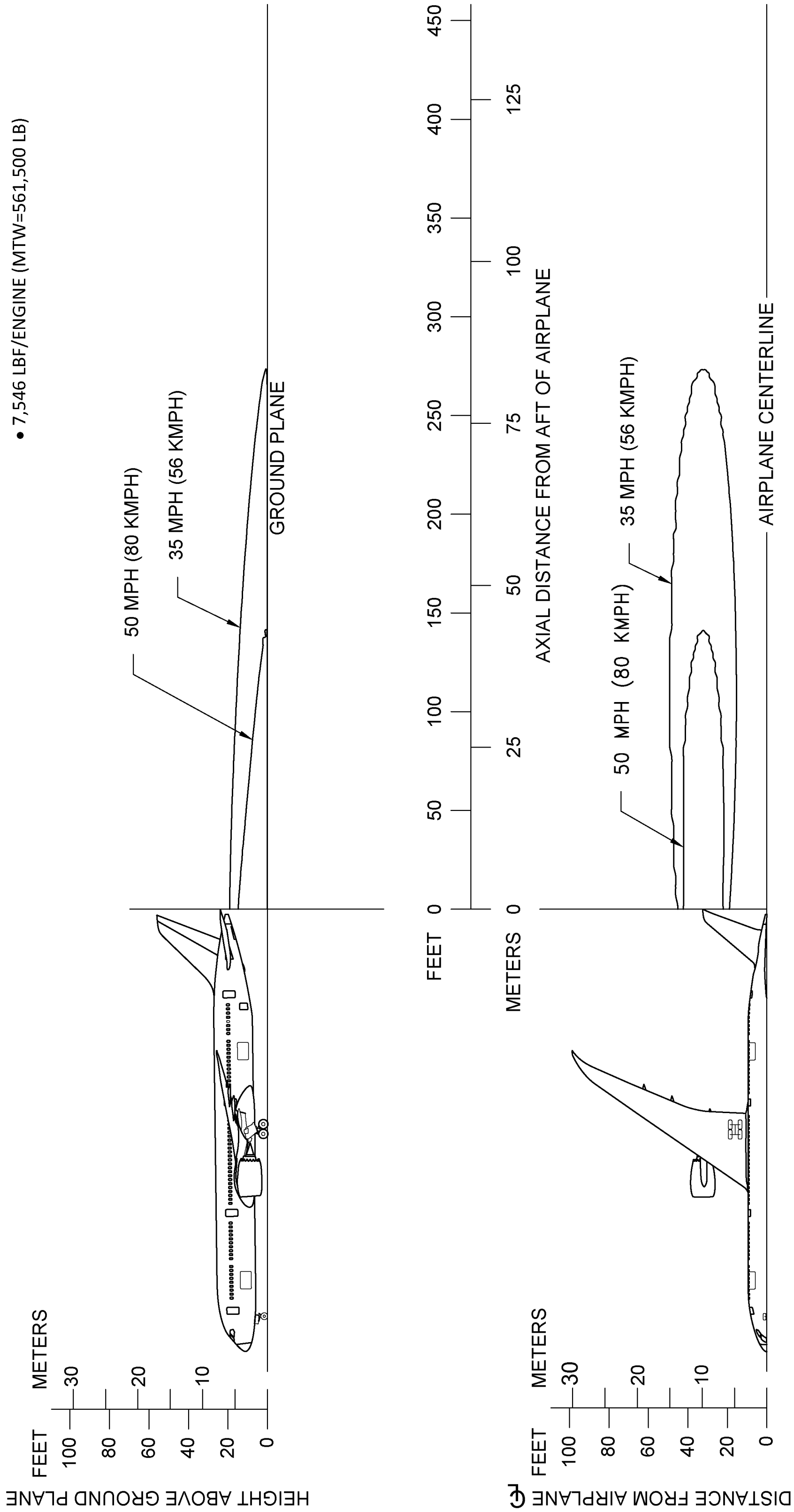


6.1.19 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 1% Slope / Both Engines / MTW: Model 787-10

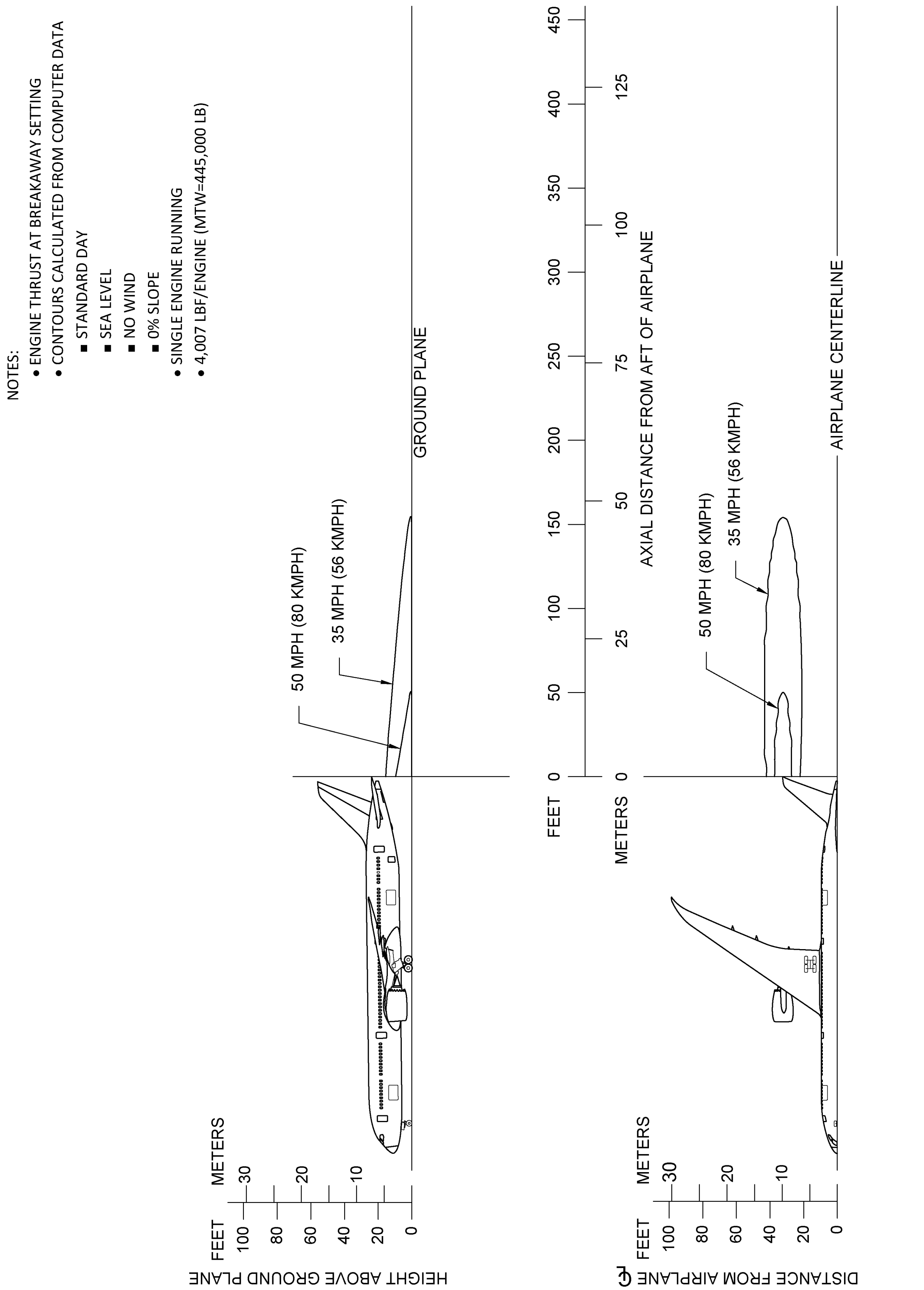


6.1.20 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 0% Slope / Single Engine / MTW: Model 787-10

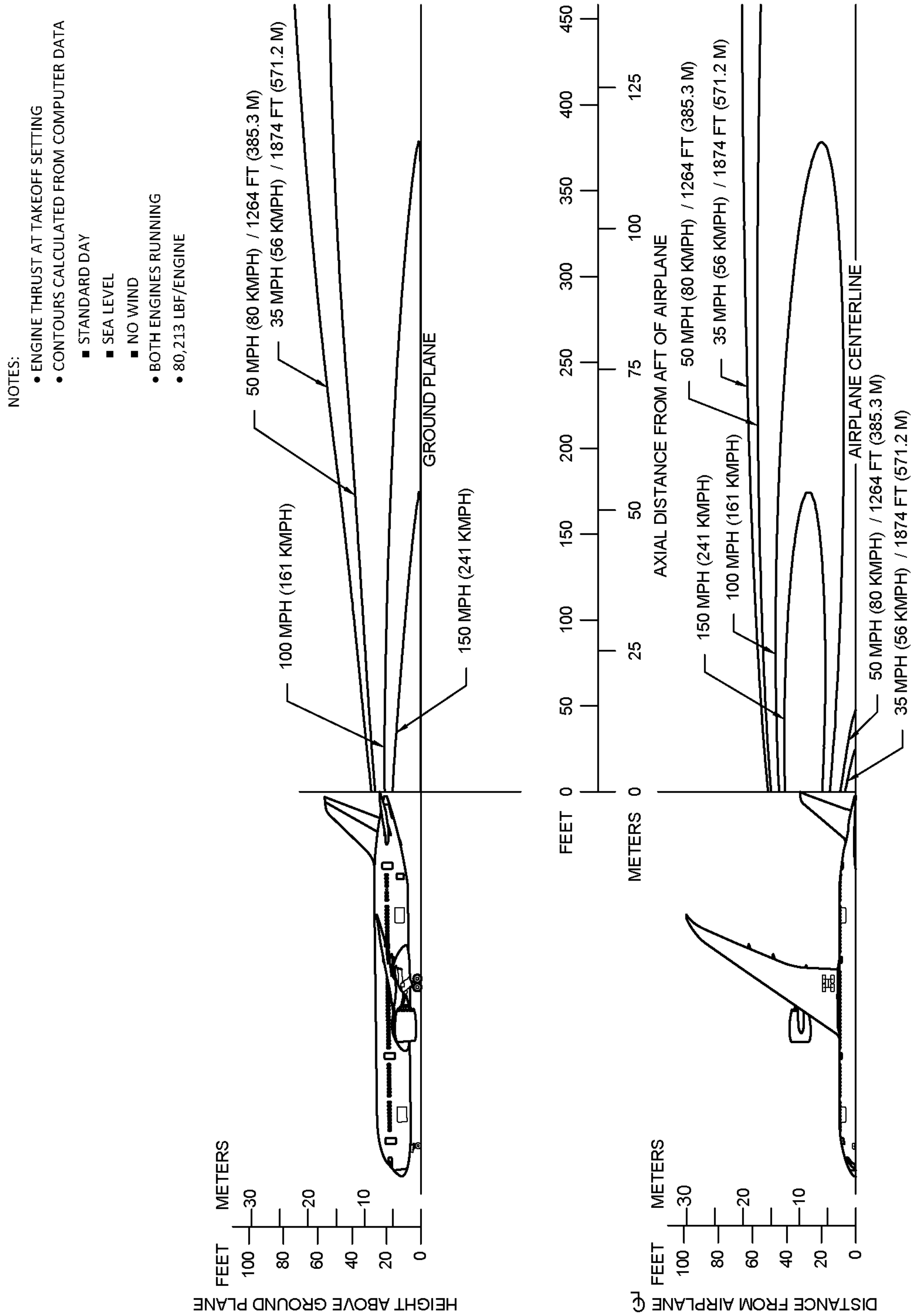
NOTES:
- ENGINE THRUST AT BREAKAWAY SETTING
- CONTOURS CALCULATED FROM COMPUTER DATA
  - STANDARD DAY
  - SEA LEVEL
  - NO WIND
  - 0% SLOPE
- SINGLE ENGINE RUNNING
- 7,546 LBF/ENGINE (MTW=561,500 LB)



6.1.21 Jet Engine Exhaust Velocity Contours – Breakaway Thrust / 0% Slope / Single Engine / MLW: Model 787-10



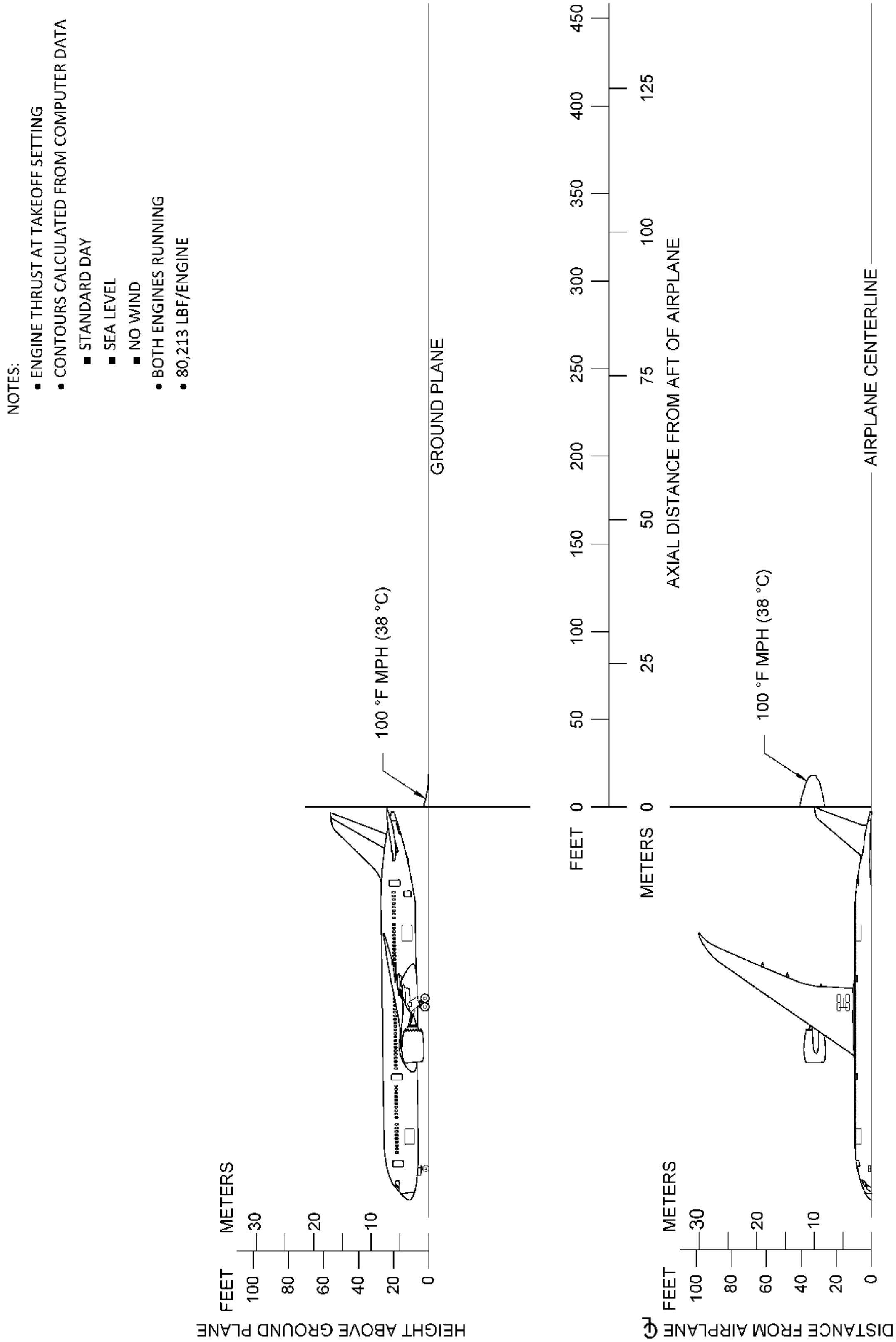
6.1.22 Jet Engine Exhaust Velocity Contours – Takeoff Thrust / Both Engines: Model 787-10



6.1.23 Jet Engine Exhaust Temperature Contours – Idle/Breakaway Thrust: Model 787-10

Temperature contours for idle/breakaway power conditions are not shown as the maximum temperature aft of the 787-10 is predicated to be less than 100° F (38° C) for standard day conditions of 59° F (15° C).

6.1.24 Jet Engine Exhaust Temperature Contours – Takeoff Thrust / Both Engines: Model 787-10



6.2 AIRPORT AND COMMUNITY NOISE

Airport noise is of major concern to the airport and community planner. The airport is a major element in the community's transportation system and, as such, is vital to its growth. However, the airport must also be a good neighbor, and this can be accomplished only with proper planning. Since aircraft noise extends beyond the boundaries of the airport, it is vital to consider the impact on surrounding communities. Many means have been devised to provide the planner with a tool to estimate the impact of airport operations. Too often they oversimplify noise to the point where the results become erroneous. Noise is not a simple subject; therefore, there are no simple answers.

The cumulative noise contour is an effective tool. However, care must be exercised to ensure that the contours, used correctly, estimate the noise resulting from aircraft operations conducted at an airport.

The size and shape of the single-event contours, which are inputs into the cumulative noise contours, are dependent upon numerous factors. They include the following:

1. Operational Factors

   a. Aircraft Weight - Aircraft weight is dependent on distance to be traveled, en route winds, payload, and anticipated aircraft delay upon reaching the destination.

   b. Engine Power Settings - The rates of ascent and descent and the noise levels emitted at the source are influenced by the power setting used.

   c. Airport Altitude - Higher airport altitude will affect engine performance and thus can influence noise.

2. Atmospheric Conditions-Sound Propagation

   a. Wind - With stronger headwinds, the aircraft can take off and climb more rapidly relative to the ground. Also, winds can influence the distribution of noise in surrounding communities.

   b. Temperature and Relative Humidity - The absorption of noise in the atmosphere along the transmission path between the aircraft and the ground observer varies with both temperature and relative humidity.

3. Surface Condition-Shielding, Extra Ground Attenuation (EGA)

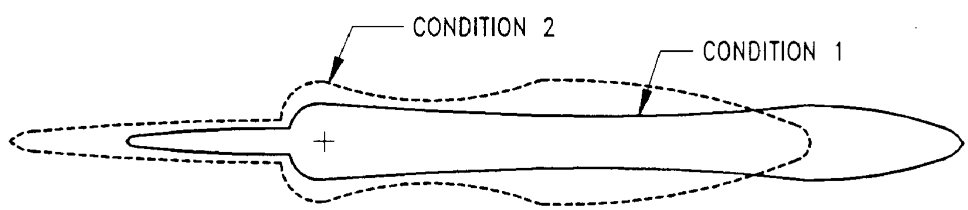
   a. Terrain - If the ground slopes down after takeoff or up before landing, noise will be reduced since the aircraft will be at a higher altitude above ground. Additionally, hills, shrubs, trees, and large buildings can act as sound buffers.

All these factors can alter the shape and size of the contours appreciably. To demonstrate the effect of some of these factors, estimated noise level contours for two different

operating conditions are shown below. These contours reflect a given noise level upon a ground level plane at runway elevation.

Condition 1

Landing	Takeoff
Maximum Structural Landing Weight	Maximum Gross Takeoff Weight
10-knot Headwind	Zero Wind
3° Approach	84 °F
84 °F	Humidity 15%
Humidity 15%	



Condition 2

Landing	Takeoff
85% of Maximum Structural Landing Weight	80% of Maximum Gross Takeoff Weight
10-knot Headwind	10-knot Headwind
3° Approach	59 °F
59 °F	Humidity 70%
Humidity 70%	

As indicated from these data, the contour size varies substantially with operating and atmospheric conditions. Most aircraft operations are, of course, conducted at less than maximum design weights because average flight distances are much shorter than maximum aircraft range capability and average load factors are less than 100%. Therefore, in developing cumulative contours for planning purposes, it is recommended that the airlines serving a particular city be contacted to provide operational information.

In addition, there are no universally accepted methods for developing aircraft noise contours or for relating the acceptability of specific zones to specific land uses. It is

therefore expected that noise contour data for particular aircraft and the impact assessment methodology will be changing. To ensure that the best currently available information of this type is used in any planning study, it is recommended that it be obtained directly from the Office of Environmental Quality in the Federal Aviation Administration in Washington, D.C.

It should be noted that the contours shown herein are only for illustrating the impact of operating and atmospheric conditions and do not represent the single-event contour of the family of aircraft described in this document. It is expected that the cumulative contours will be developed as required by planners using the data and methodology applicable to their specific study.

7.0 PAVEMENT DATA

7.1 GENERAL INFORMATION

A brief description of the pavement charts that follow will help in their use for airport planning. Each airplane configuration is depicted with a minimum range of five loads imposed on the main landing gear to aid in interpolation between the discrete values shown. All curves for any single chart represent data based on rated loads and tire pressures considered normal and acceptable by current aircraft tire manufacturer's standards. Tire pressures, where specifically designated on tables and charts, are at values obtained under loaded conditions as certificated for commercial use.

Section 7.2 presents basic data on the landing gear footprint configuration, maximum design taxi loads, and tire sizes and pressures.

Maximum pavement loads for certain critical conditions at the tire-to-ground interface are shown in Section 7.3, with the tires having equal loads on the struts.

Pavement requirements for commercial airplanes are customarily derived from the static analysis of loads imposed on the main landing gear struts. The charts in Section 7.4 are provided in order to determine these loads throughout the stability limits of the airplane at rest on the pavement. These main landing gear loads are used as the point of entry to the pavement design charts, interpolating load values where necessary.

The flexible pavement design curves (Section 7.5) are based on procedures set forth in Instruction Report No. S-77-1, "Procedures for Development of CBR Design Curves," dated June 1977, and as modified according to the methods described in ICAO Aerodrome Design Manual, Part 3, Pavements, 2nd Edition, 1983, Section 1.1 (The ACN-PCN Method), and utilizing the alpha factors approved by ICAO in October 2007. Instruction Report No. S-77-1 was prepared by the U.S. Army Corps of Engineers Waterways Experiment Station, Soils and Pavements Laboratory, Vicksburg, Mississippi. The line showing 10,000 coverages is used to calculate Aircraft Classification Number (ACN).

The following procedure is used to develop the curves, such as shown in Section 7.5:

1. Having established the scale for pavement depth at the bottom and the scale for CBR at the top, an arbitrary line is drawn representing 6,000 annual departures.

2. Values of the aircraft gross weight are then plotted.

3. Additional annual departure lines are drawn based on the load lines of the aircraft gross weights already established.

4. An additional line representing 10,000 coverages (used to calculate the flexible pavement Aircraft Classification Number) is also placed.

The Load Classification Number (LCN) curves are no longer provided in section 7.6 and 7.8 since the LCN system for reporting pavement strength is obsolete, being replaced by

the ICAO recommended ACN/PCN system in 1983. For questions regarding the LCN system contact Boeing Airport Compatibility Engineering:

AirportCompatibility@boeing.com

Rigid pavement design curves (Section 7.7) have been prepared with the Westergaard equation in general accordance with the procedures outlined in the Design of Concrete Airport Pavement (1995 edition) by Robert G. Packard, published by the Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077-1059. These curves are modified to the format described in the Portland Cement Association publication XP6705-2, Computer Program for Airport Pavement Design (Program PDILB), 1968, by Robert G. Packard.

The following procedure is used to develop the rigid pavement design curves shown in Section 7.7:

1. Having established the scale for pavement thickness to the left and the scale for allowable working stress to the right, an arbitrary load line is drawn representing the main landing gear maximum weight to be shown.

2. Values of the subgrade modulus (k) are then plotted.

3. Additional load lines for the incremental values of weight on the main landing gear are drawn on the basis of the curve for k = 300, already established.

For the rigid pavement design (Section 7.9) refer to the FAA website for the FAA design software (FAARFIELD):

http://www.faa.gov/airports/engineering/design_software/

The ACN/PCN system (Section 7.10) as referenced in ICAO Annex 14, "Aerodromes," Sixth Edition, July 2013, provides a standardized international airplane/pavement rating system replacing the various S, T, TT, LCN, AUW, ISWL, etc., rating systems used throughout the world. ACN is the Aircraft Classification Number and PCN is the Pavement Classification Number. An aircraft having an ACN equal to or less than the PCN can operate without restriction on the pavement subject to any limitation on the tire pressure. Numerically, the ACN is two times the derived single-wheel load expressed in thousands of kilograms, where the derived single wheel load is defined as the load on a single tire inflated to 181 psi (1.25 MPa) that would have the same pavement requirements as the aircraft. Computationally, the ACN/PCN system uses the PCA program PDILB for rigid pavements and S-77-1 for flexible pavements to calculate ACN values. The method of pavement evaluation is left up to the airport with the results of their evaluation presented as follows:

PCN	PAVEMENT TYPE	SUBGRADE CATEGORY	TIRE PRESSURE CATEGORY	EVALUATION METHOD
	R = Rigid	A = High	W = No Limit	T = Technical
	F = Flexible	B = Medium	X = To 254 psi (1.75 MPa)	U = Using Aircraft
		C = Low	Y = To 181 psi (1.25 MPa)	
		D = Ultra Low	Z = To 73 psi (0.5 MPa)	

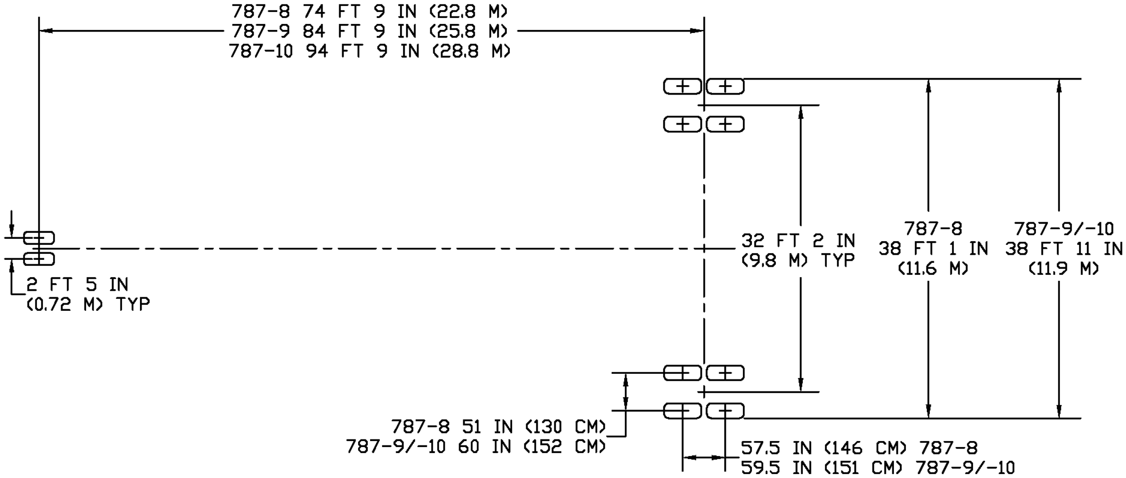
ACN values for flexible pavements are calculated for the following four subgrade categories:

- Code A - High Strength - CBR 15
- Code B - Medium Strength - CBR 10
- Code C - Low Strength - CBR 6
- Code D - Ultra Low Strength - CBR 3

ACN values for rigid pavements are calculated for the following four subgrade categories:

- Code A - High Strength, k = 550 pci (150 MN/m3)
- Code B - Medium Strength, k = 300 pci (80 MN/m3)
- Code C - Low Strength, k = 150 pci (40 MN/m3)
- Code D - Ultra Low Strength, k = 75 pci (20 MN/m3)

7.2 LANDING GEAR FOOTPRINT: MODEL 787-8, 787-9, 787-10



	UNITS	787-8	787-9	787-10
MAXIMUM DESIGN TAXI WEIGHT	LB	503,500	561,500	561,500
	KG	228,383	254,692	254,692
PERCENT OF WEIGHT ON MAIN GEAR	%	SEE SECTION 7.4		
NOSE GEAR TIRE SIZE	IN.	40 x 16.0 R16 26PR		
NOSE GEAR TIRE PRESSURE	PSI	187	182	182
	MPa	1.29	1.25	1.25
MAIN GEAR TIRE SIZE	IN.	50 x 20.0 R22 34 PR	54 x 21.0 R23 38 PR	
MAIN GEAR TIRE PRESSURE	PSI	228	226	226
	MPa	1.57	1.56	1.56

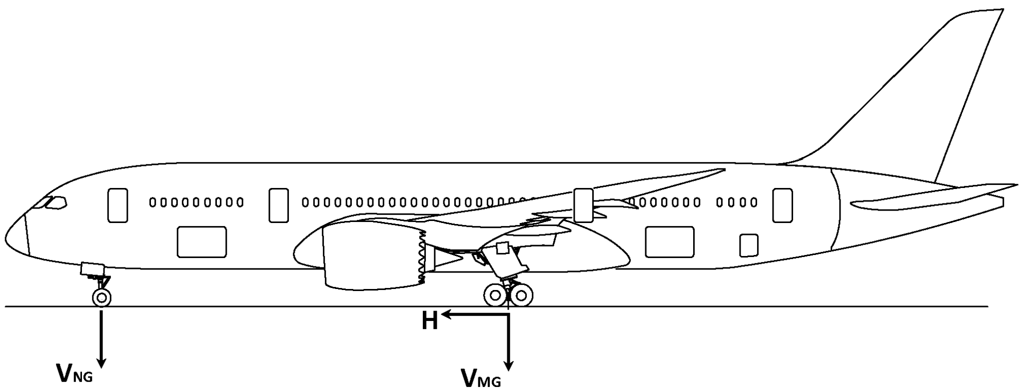
7.3 MAXIMUM PAVEMENT LOADS: MODEL 787-8, 787-9, 787-10

V_{NG} = MAXIMUM VERTICAL NOSE GEAR GROUND LOAD AT MOST FORWARD CENTER OF GRAVITY

V_{MG} = MAXIMUM VERTICAL MAIN GEAR GROUND LOAD AT MOST AFT CENTER OF GRAVITY

H = MAXIMUM HORIZONTAL GROUND LOAD FROM BRAKING

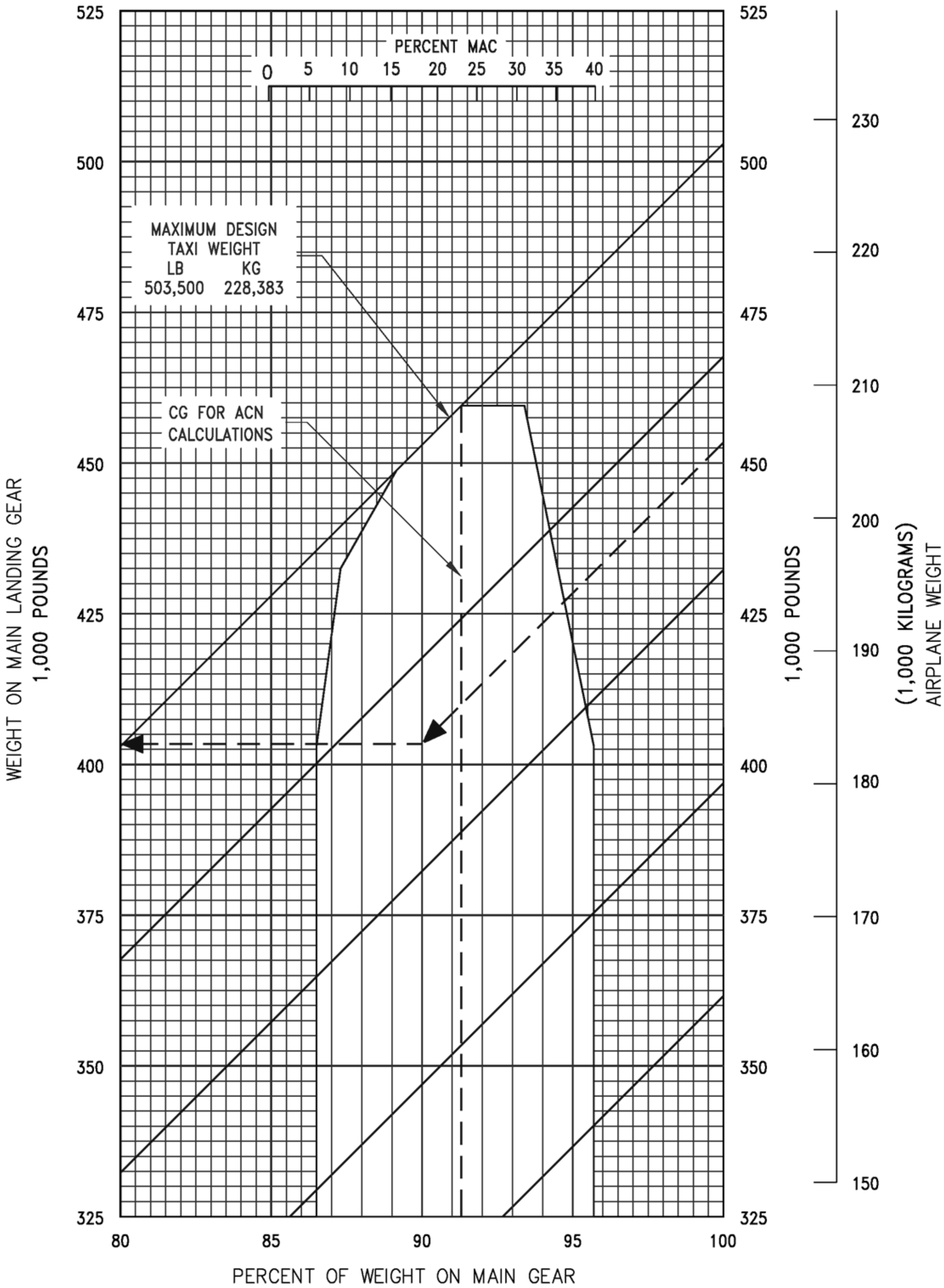
NOTE: ALL LOADS CALCULATED USING AIRPLANE MAXIMUM DESIGN TAXI WEIGHT



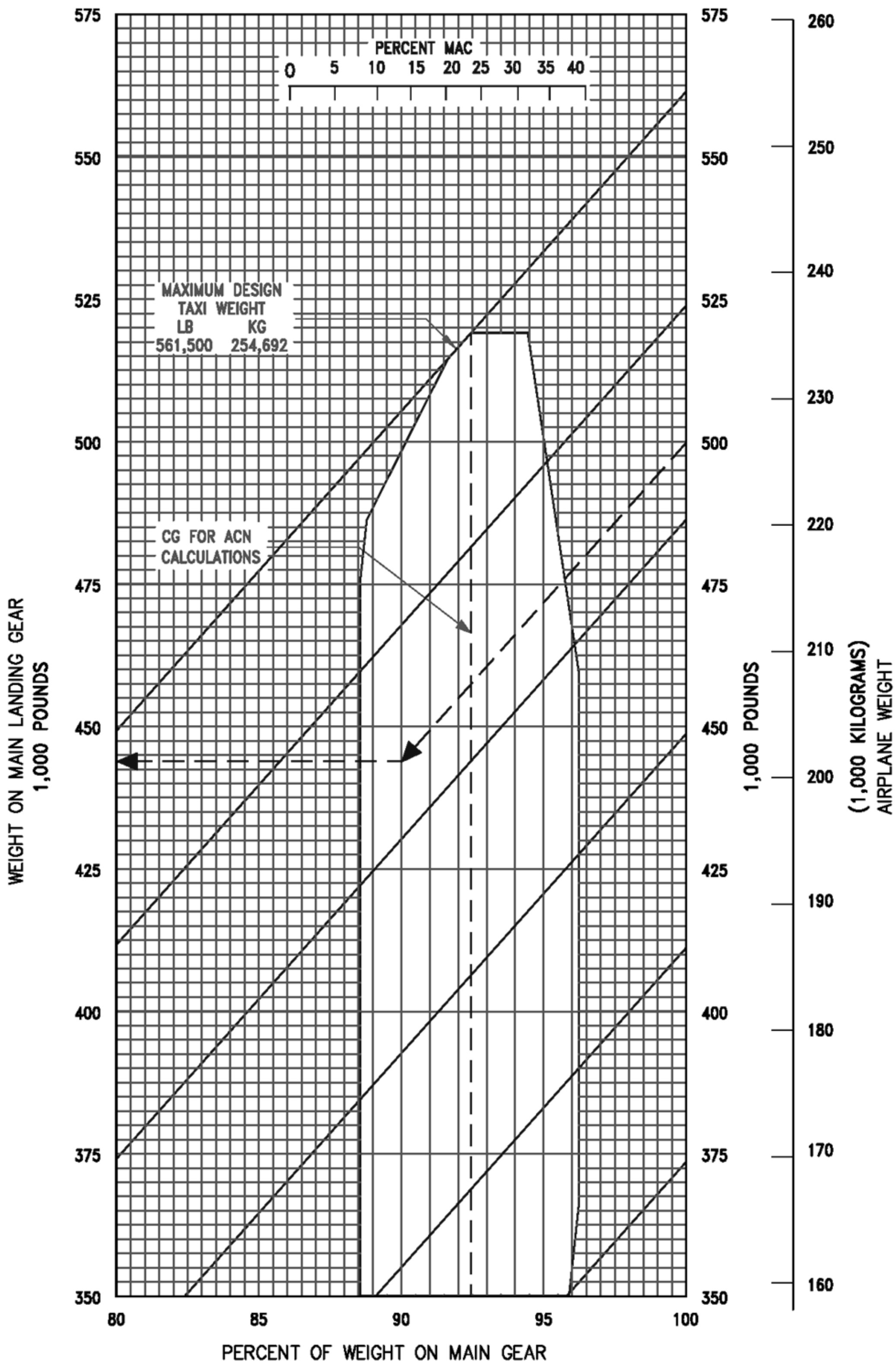
AIRPLANE MODEL	UNIT	MAX DESIGN TAXI WEIGHT	V_{NG}		V_{MG} PER STRUT AT MAX LOAD AT STATIC AFT C.G.	H PER STRUT	
			STATIC AT MOST FWD C.G.	STATIC + BRAKING 10 FT/SEC^2 DECEL		STEADY BRAKING 10 FT/SEC^2 DECEL	AT INSTANTANEOUS BRAKING (μ = 0.8)
787-8	LB	503,500	54,716	85,086	229,798	78,194	183,838
	KG	228,383	24,819	38,594	104,234	35,468	83,388
787-9	LB	561,500	47,006	76,161	259,564	87,201	207,651
	KG	254,692	21,322	34,546	117,736	39,554	94,189
787-10	LB	561,500	42,193	68,209	261,787	87,201	209,430
	KG	254,692	19,138	30,939	118,745	39,554	94,996

7.4 LANDING GEAR LOADING ON PAVEMENT

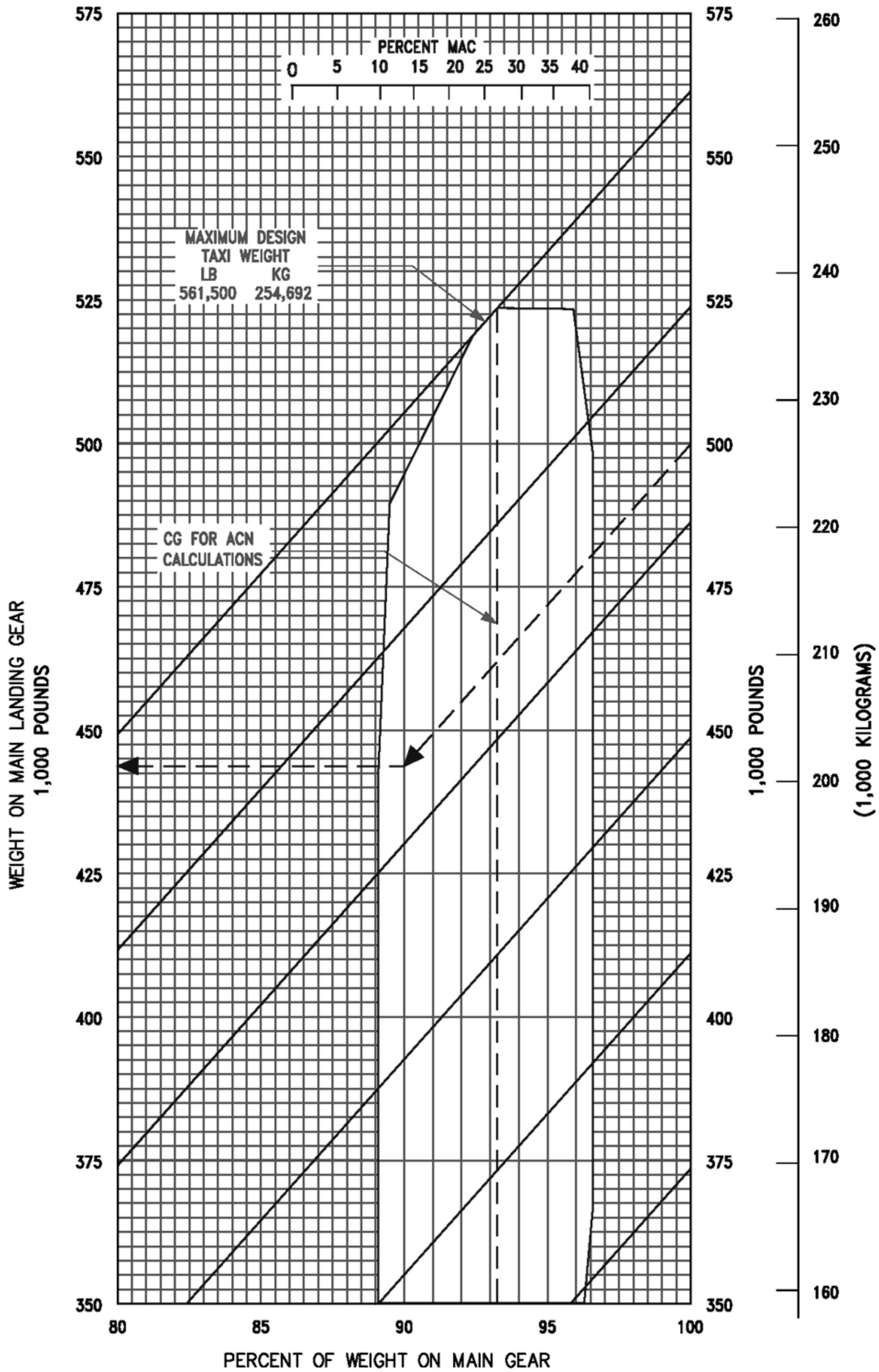
7.4.1 Landing Gear Loading on Pavement: Model 787-8



7.4.2 Landing Gear Loading on Pavement: Model 787-9



7.4.3 Landing Gear Loading on Pavement: Model 787-10



7.5 FLEXIBLE PAVEMENT REQUIREMENTS - U.S. ARMY CORPS OF ENGINEERS METHOD S-77-1

The following flexible-pavement design chart presents the data of five incremental main-gear loads at the minimum tire pressure required at the maximum design taxi weight.

In the example shown in 7.5.1, for a CBR of 25 and an annual departure level of 25,000, the required flexible pavement thickness for an airplane with a main gear loading of 300,000 pounds is 12.6 inches.

The line showing 10,000 coverages is used for ACN calculations (see Section 7.10).

The traditional FAA design method used a similar procedure using total airplane weight instead of weight on the main landing gears. The equivalent main gear loads for a given airplane weight could be calculated from Section 7.4.

7.5.1 Flexible Pavement Requirements - U.S. Army Corps of Engineers Design Method (S-77-1)

DATA TO BE PROVIDED AT A LATER DATE

7.6 FLEXIBLE PAVEMENT REQUIREMENTS - LCN METHOD

The Load Classification Number (LCN) curves are no longer provided in section 7.6 and 7.8 since the LCN system for reporting pavement strength is obsolete, being replaced by the ICAO recommended ACN/PCN system in 1983. For questions regarding the LCN system contact Boeing Airport Compatibility Engineering:

AirportCompatibility@boeing.com

7.7 RIGID PAVEMENT REQUIREMENTS - PORTLAND CEMENT ASSOCIATION DESIGN METHOD

The Portland Cement Association method of calculating rigid pavement requirements is based on the computerized version of "Design of Concrete Airport Pavement" (Portland Cement Association, 1973) as described in XP6705-2, "Computer Program for Airport Pavement Design" by Robert G. Packard, Portland Cement Association, 1968.

The following rigid pavement design chart presents the data for five incremental main gear loads at the minimum tire pressure required at the maximum design taxi weight.

In the example shown 7.7.1, for an allowable working stress of 550 psi, a main gear load of 459,594 lb, and a subgrade strength (k) of 300, the required rigid pavement thickness is 11.3 in.

7.7.1 Rigid Pavement Requirements - Portland Cement Association Design Method

DATA TO BE PROVIDED AT A LATER DATE

7.8 RIGID PAVEMENT REQUIREMENTS - LCN CONVERSION

The Load Classification Number (LCN) curves are no longer provided in section 7.6 and 7.8 since the LCN system for reporting pavement strength is obsolete, being replaced by the ICAO recommended ACN/PCN system in 1983. For questions regarding the LCN system contact Boeing Airport Compatibility Engineering:

AirportCompatibility@boeing.com

7.9 RIGID PAVEMENT REQUIREMENTS - FAA DESIGN METHOD

For the rigid pavement design refer to the FAA website for the FAA design software FAARFIELD:

http://www.faa.gov/airports/engineering/design_software/

7.10 ACN/PCN REPORTING SYSTEM - FLEXIBLE AND RIGID PAVEMENTS

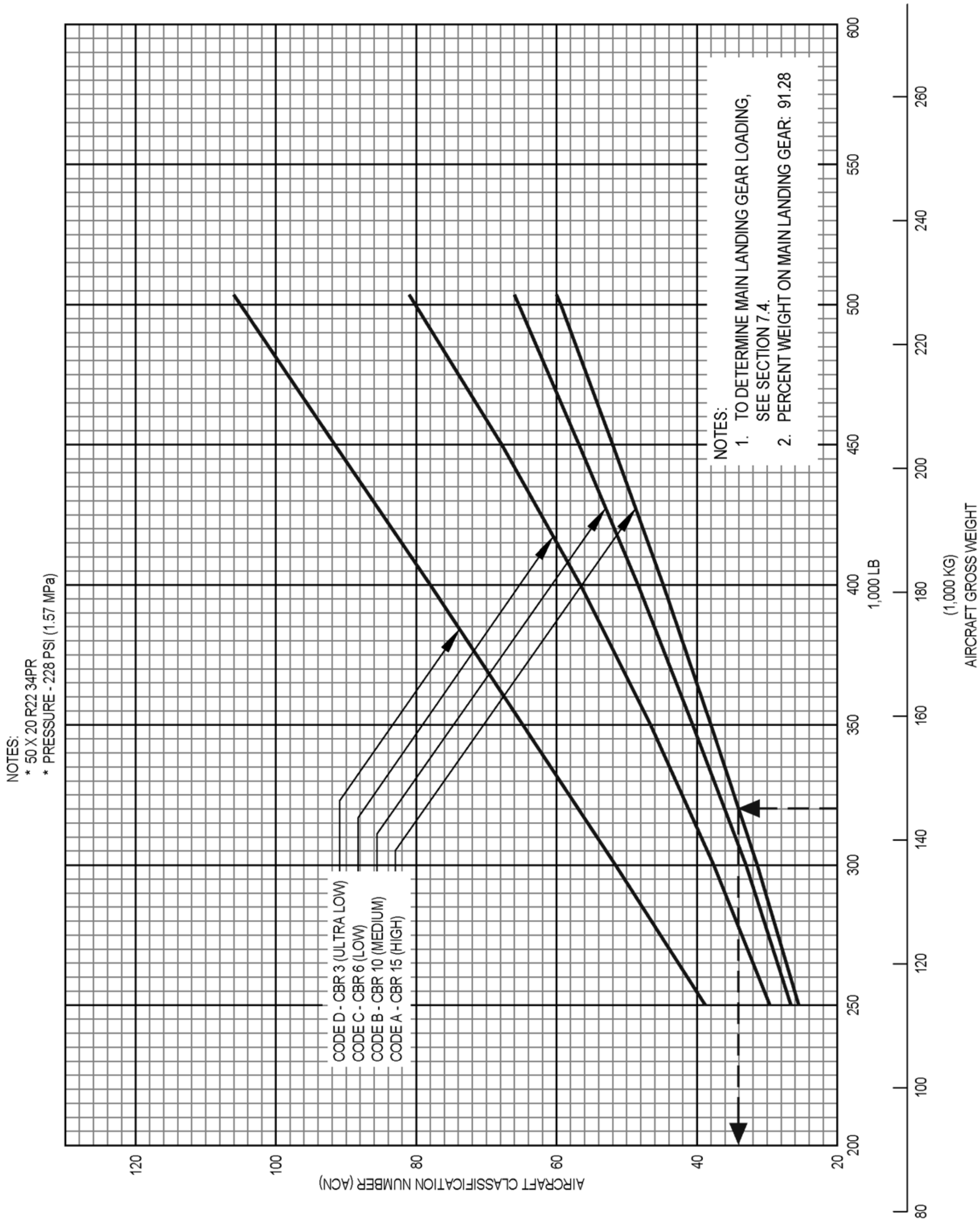
To determine the ACN of an aircraft on flexible or rigid pavement, both the aircraft gross weight and the subgrade strength category must be known. On the chart in section 7.10.1, for a 787-8 with gross weight of 320,000 lb on a (Code A), the flexible pavement ACN is 34. Referring to 7.10.4, the same aircraft on a high strength subgrade rigid pavement has an ACN of 34.

The following table provides ACN data in tabular format similar to the one used by ICAO in the “Aerodrome Design Manual Part 3, Pavements.” If the ACN for an intermediate weight between maximum taxi weight and minimum weight of the aircraft is required, Figures 7.10.1 through 7.10.6 should be consulted. Linear interpolation of the ACN values between two weight points will provide an approximate ACN value.

				ACN FOR RIGID PAVEMENT SUBGRADES - MN/m³				ACN FOR FLEXIBLE PAVEMENT SUBGRADES - CBR			
AIRCRAFT TYPE	MAXIMUM TAXI WEIGHT / MINIMUM WEIGHT *[1] LB (KG)	LOAD ON ONE MAIN GEAR LEG (%)	TIRE PRESSURE PSI (MPa)	HIGH 150	MEDIUM 80	LOW 40	ULTRA LOW 20	HIGH 15	MEDIUM 10	LOW 6	ULTRA LOW 3
787-8	503,500 (228,383)	45.64	228 (1.57)	61	71	84	96	60	66	81	106
	250,000 (113,398)			26	28	32	37	25	27	30	39
787-9	561,500 (254,692)	46.23	226 (1.56)	65	76	90	104	66	73	88	118
	250,000 (113,398)			25	27	30	35	25	26	28	35
787-10	561,500 (254,692)	46.63	226 (1.56)	66	77	91	105	67	74	89	119
	250,000 (113,398)			26	27	31	35	25	26	29	36

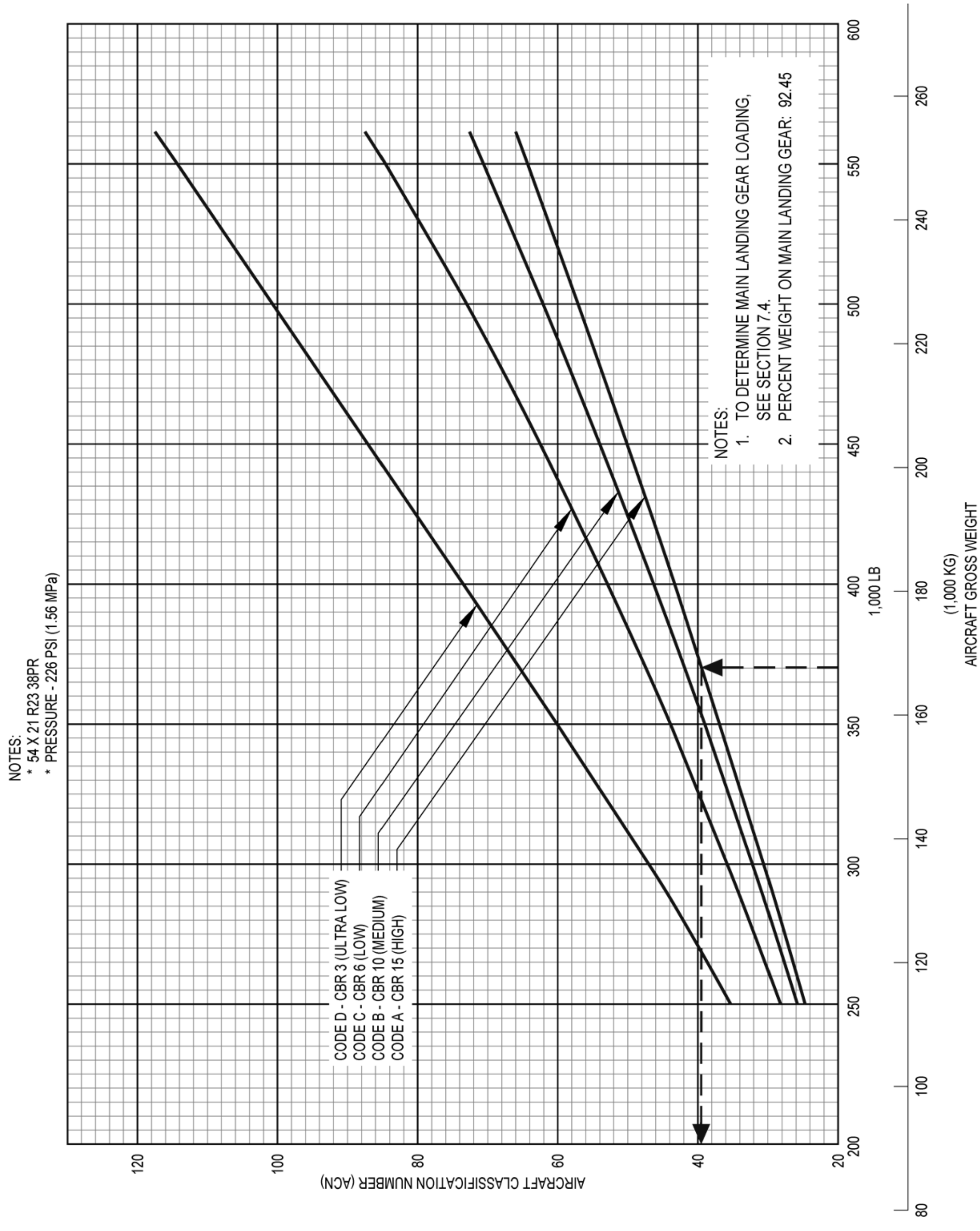
*[1] Minimum weight used solely as a baseline for ACN curve generation.

7.10.1 Aircraft Classification Number - Flexible Pavement: Model 787-8



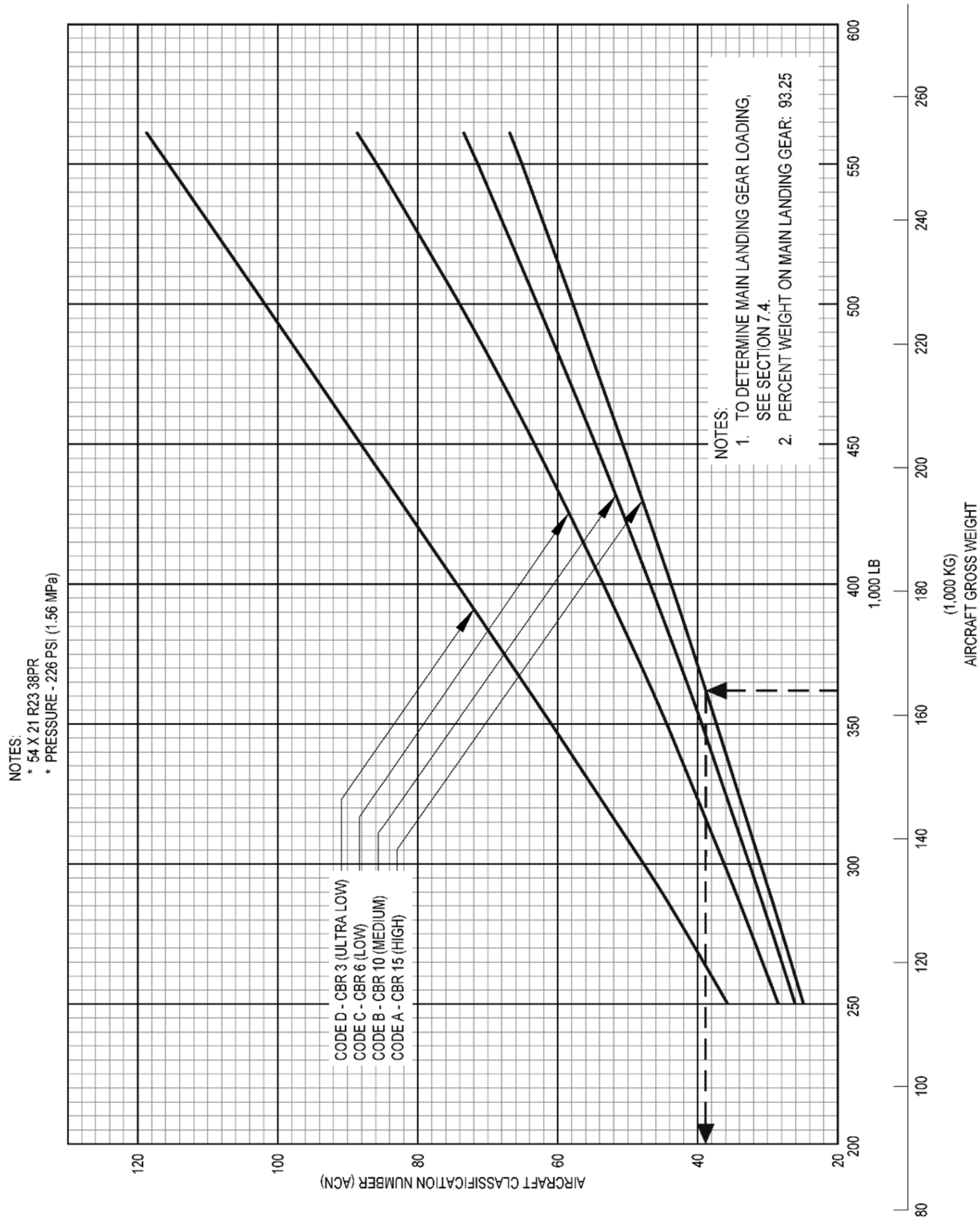
NOTE: The minimum weight shown on the chart is solely for the ACN curve generation.

7.10.2 Aircraft Classification Number - Flexible Pavement: Model 787-9



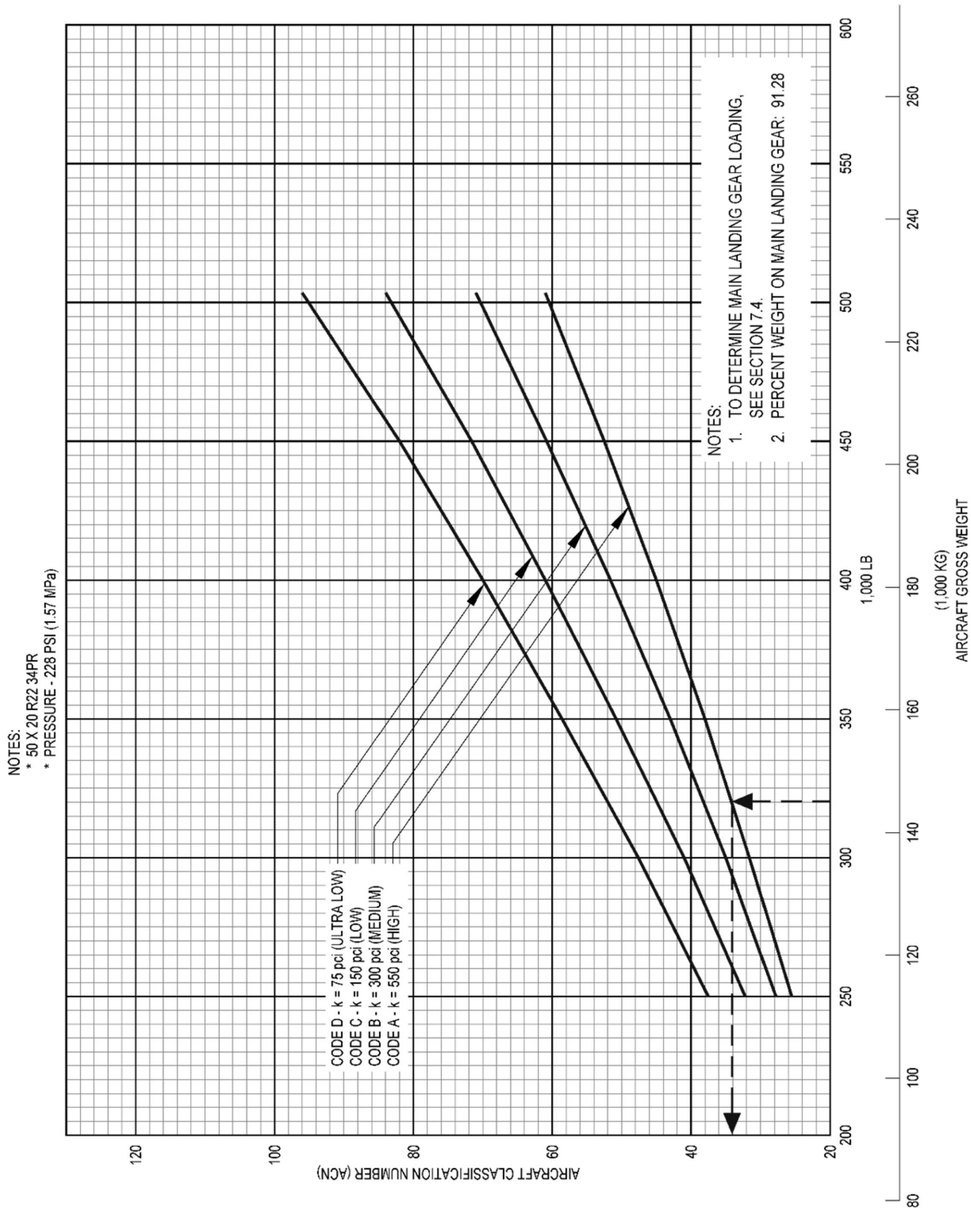
NOTE: The minimum weight shown on the chart is solely for the ACN curve generation.

7.10.3 Aircraft Classification Number - Flexible Pavement: Model 787-10



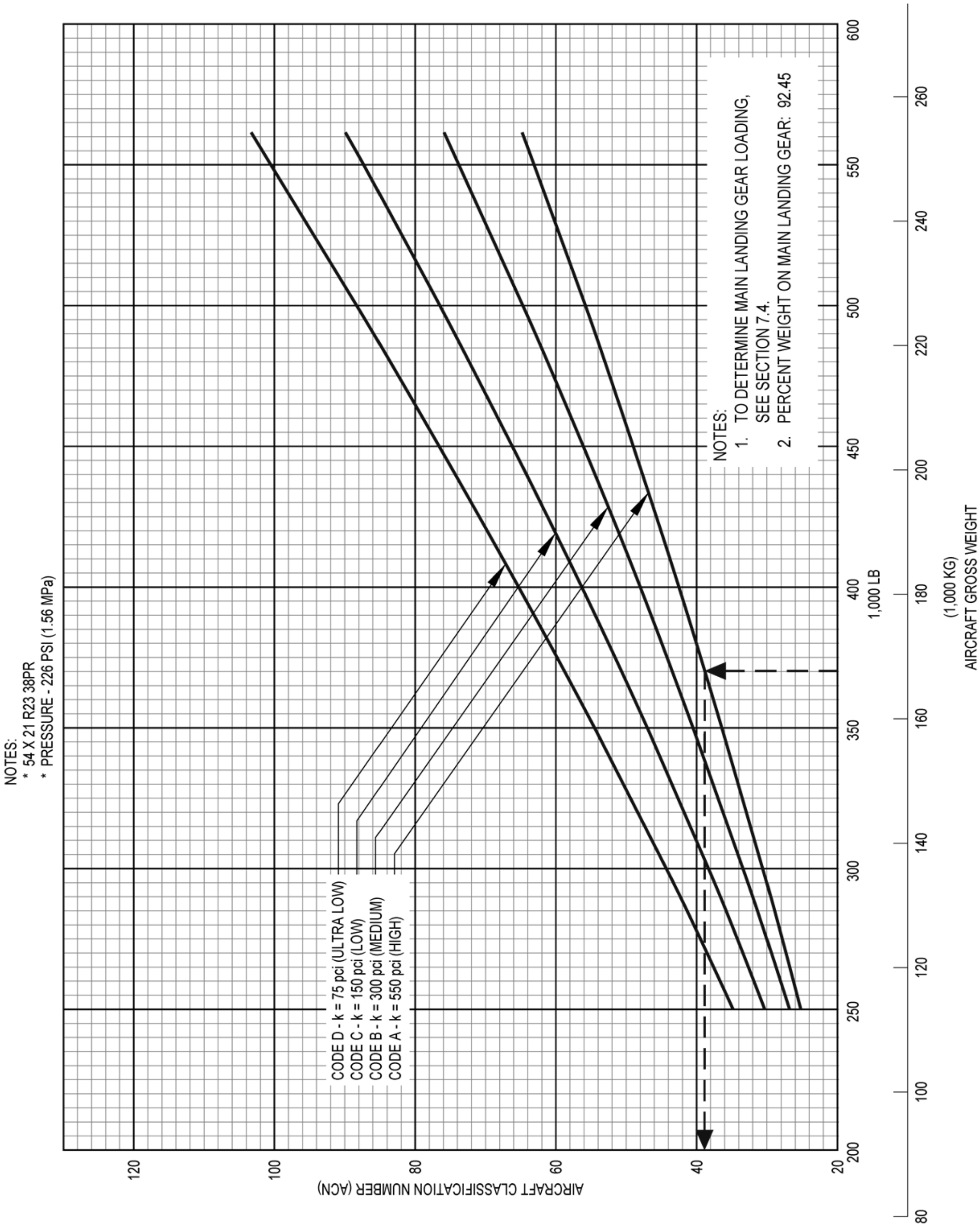
NOTE: The minimum weight shown on the chart is solely for the ACN curve generation.

7.10.4 Aircraft Classification Number - Rigid Pavement: Model 787-8



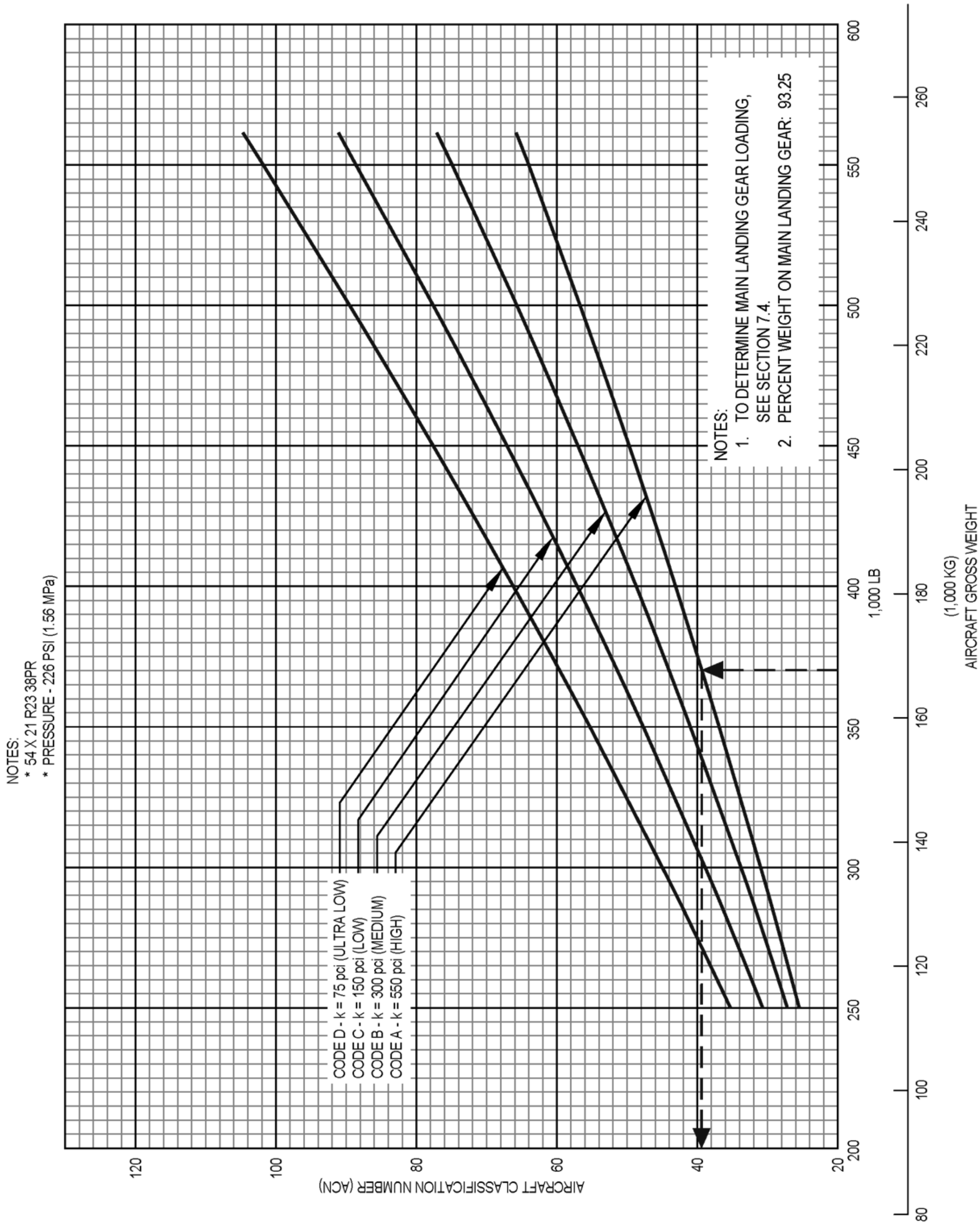
NOTE: The minimum weight shown on the chart is solely for the ACN curve generation.

7.10.5 Aircraft Classification Number – Rigid Pavement: Model 787-9



NOTE: The minimum weight shown on the chart is solely for the ACN curve generation.

7.10.6 Aircraft Classification Number – Rigid Pavement: Model 787-10



NOTE: The minimum weight shown on the chart is solely for the ACN curve generation.

8.0 FUTURE 787 DERIVATIVE AIRPLANES

Boeing's philosophy is to evaluate the derivative potential of its airplanes to provide capabilities that maximize value to our customers.

Decisions to design and manufacture future derivatives of an airplane depend on many considerations, including customer requirements. Along with many other parameters, airport facilities are considered during the development of any future airplane.

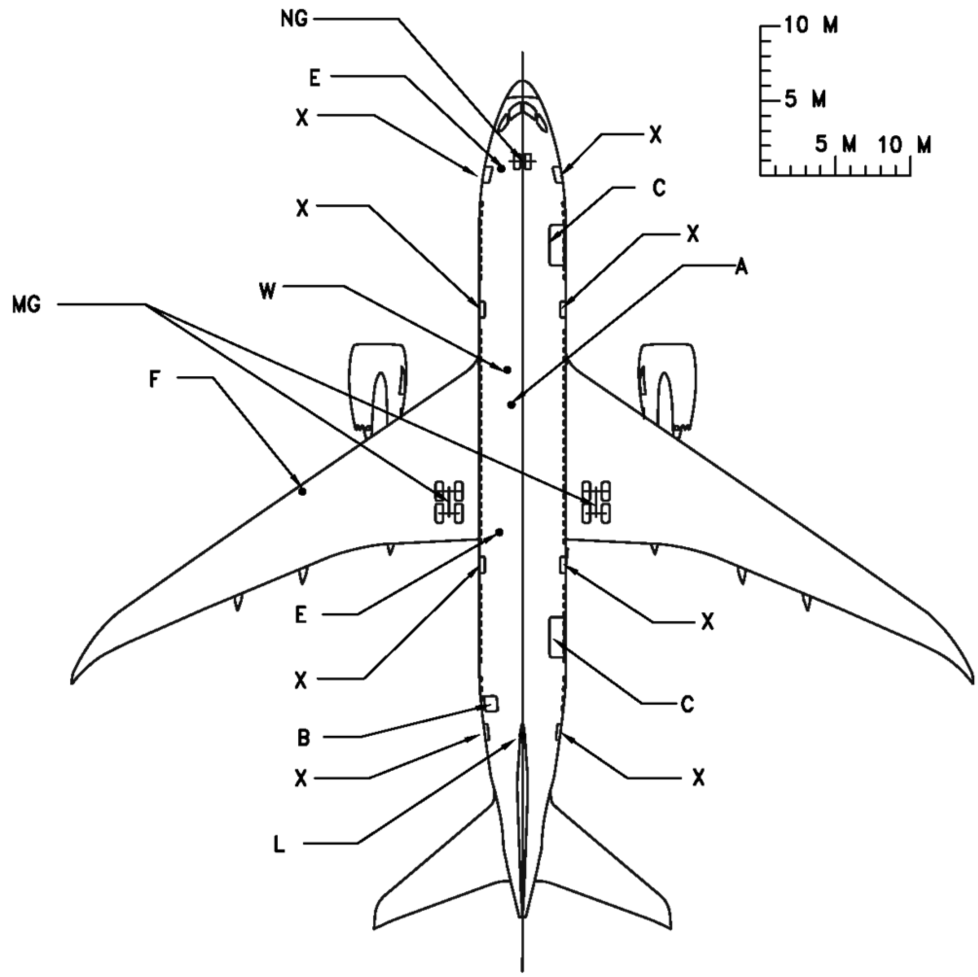
9.0 SCALED 787 DRAWINGS

The drawings in the following pages show airplane plan view drawings, drawn to approximate scale as noted. The drawings may not come out to exact scale when printed or copied from this document. Printing scale should be adjusted when attempting to reproduce these drawings. Three-view drawing files of the 787, along with other Boeing airplane models, can be downloaded from the following website:

http://www.boeing.com/airports

9.1 MODEL 787-8

9.1.1 Scaled Drawings – 1:500: Model 787-8

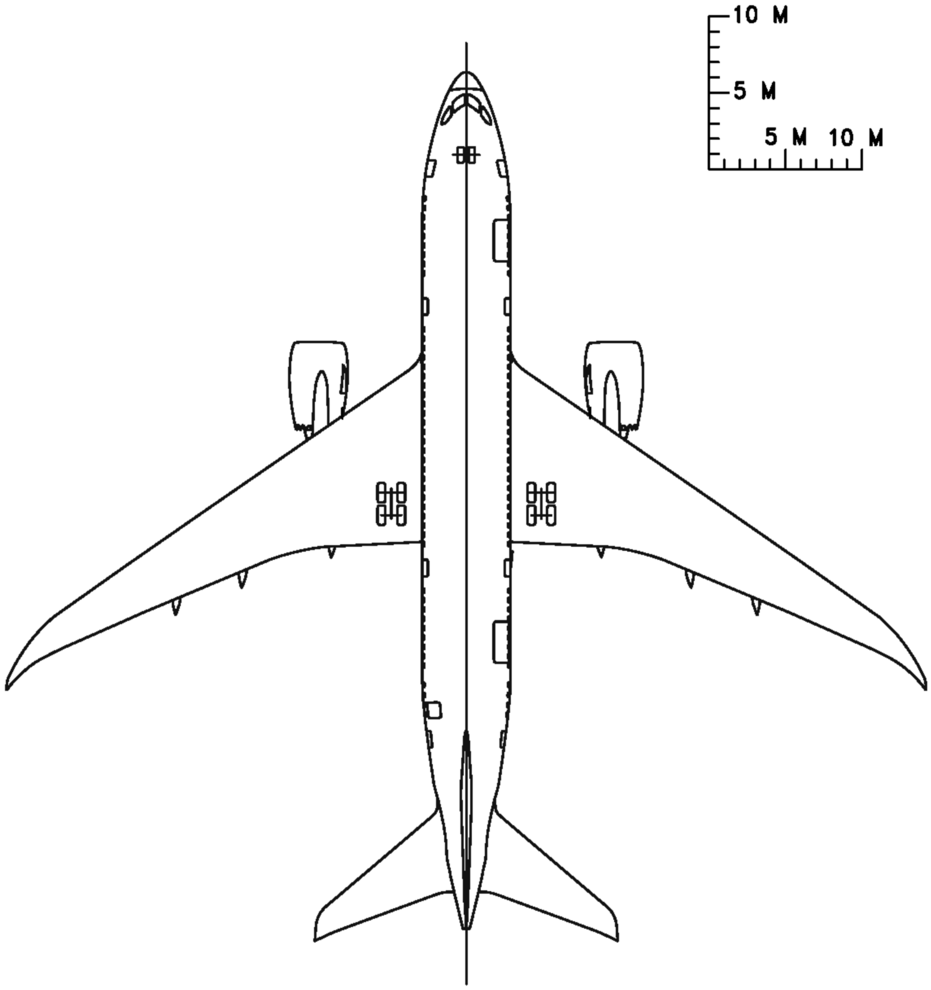


LEGEND

A	CONDITIONED AIR
B	BULK CARGO DOOR
C	CONTAINER CARGO DOOR
E	ELECTRICAL
F	FUEL
L	LAVATORY
MG	MAIN GEAR
NG	NOSE GEAR
W	POTABLE WATER
X	PASSENGER DOOR

NOTE: WHEN PRINTING THIS DRAWING, MAKE SURE TO ADJUST FOR PROPER SCALING

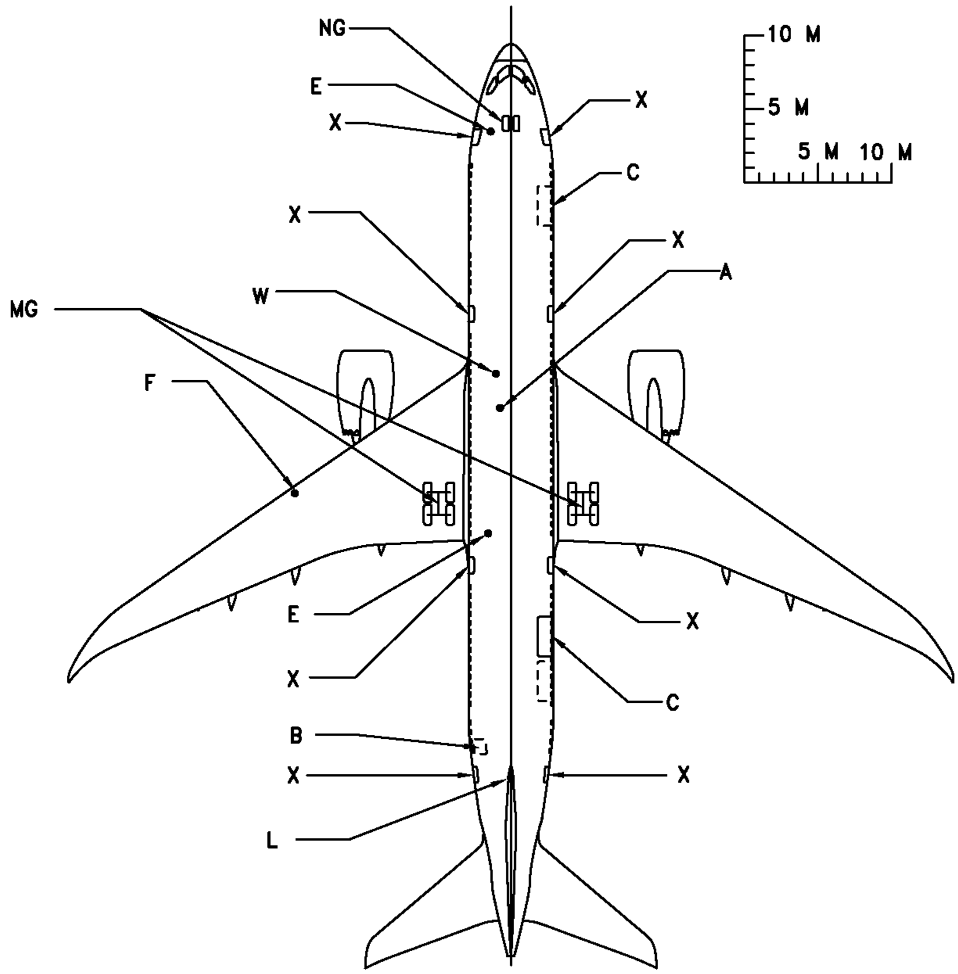
9.1.2 Scaled Drawings – 1:500: Model 787-8



NOTE: WHEN PRINTING THIS DRAWING, MAKE SURE TO ADJUST FOR PROPER SCALING

9.2 MODEL 787-9

9.2.1 Scaled Drawing – 1:500: Model 787-9

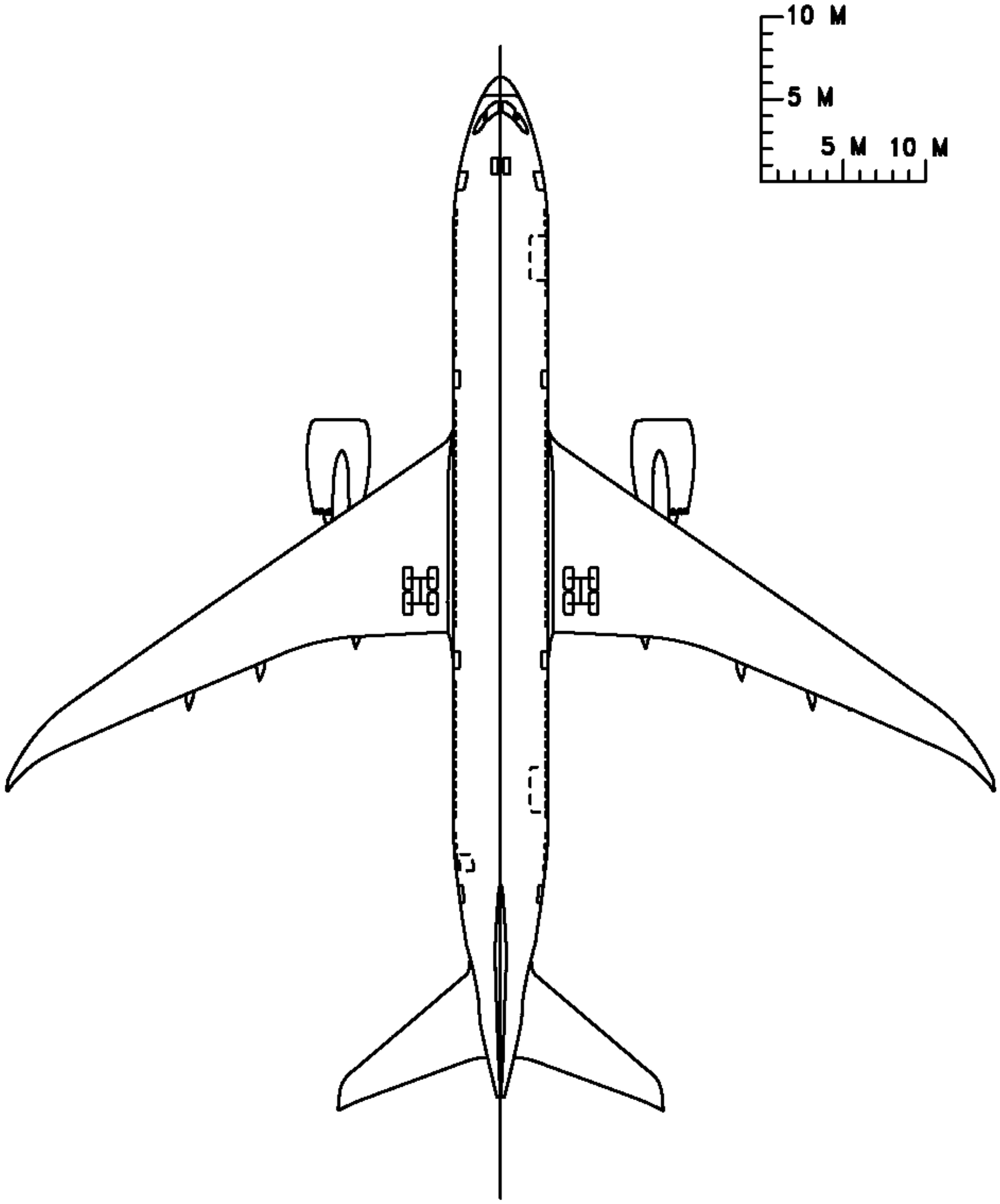


LEGEND

A	CONDITIONED AIR
B	BULK CARGO DOOR
C	CONTAINER CARGO DOOR
E	ELECTRICAL
F	FUEL
L	LAVATORY
MG	MAIN GEAR
NG	NOSE GEAR
W	POTABLE WATER
X	PASSENGER DOOR

NOTE: WHEN PRINTING THIS DRAWING, MAKE SURE TO ADJUST FOR PROPER SCALING

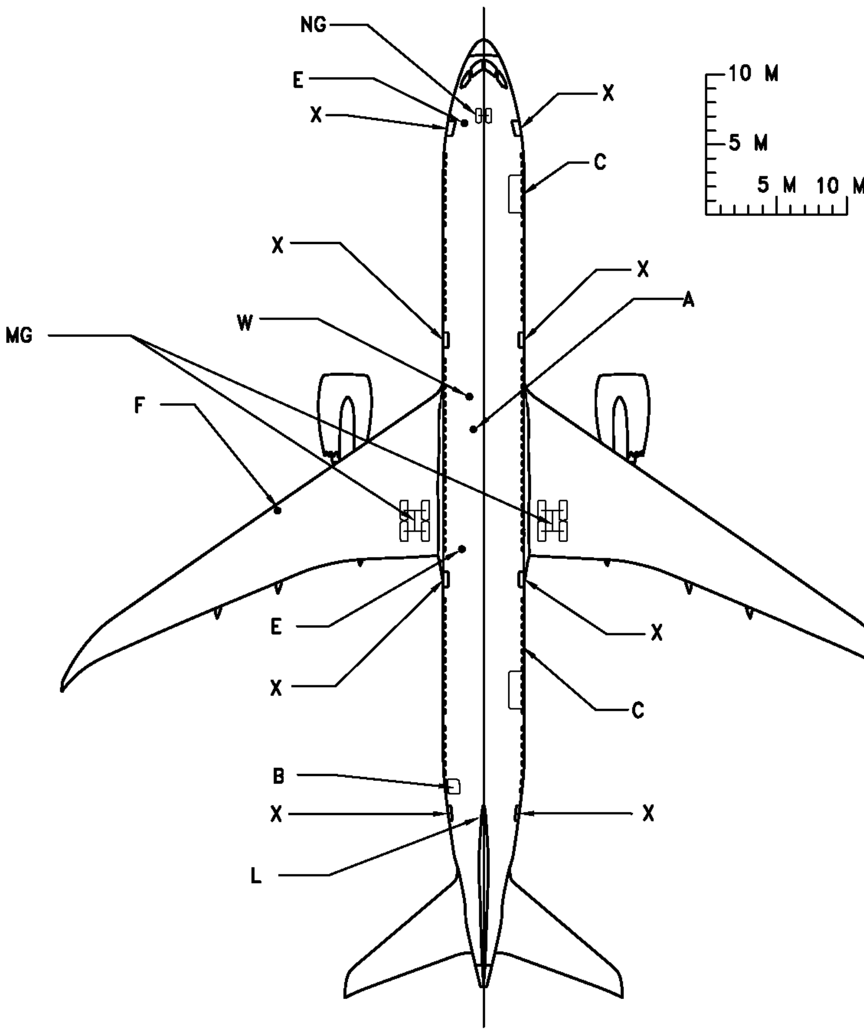
9.2.2 Scaled Drawing – 1:500: Model 787-9



NOTE: WHEN PRINTING THIS DRAWING, MAKE SURE TO ADJUST FOR PROPER SCALING

9.3 MODEL 787-10

9.3.1 Scaled Drawings – 1:500: Model 787-10

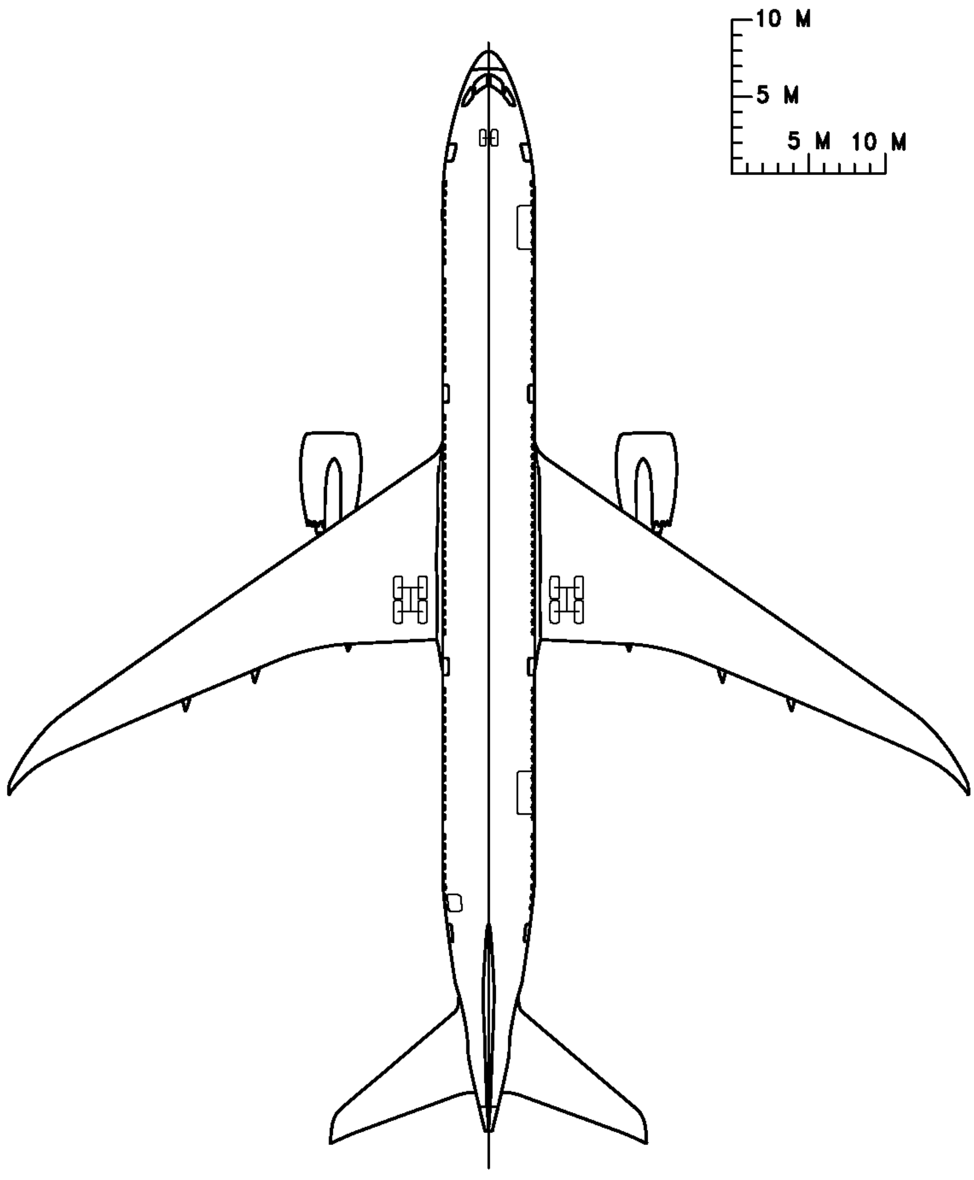


LEGEND

A	CONDITIONED AIR
B	BULK CARGO DOOR
C	CONTAINER CARGO DOOR
E	ELECTRICAL
F	FUEL
L	LAVATORY
MG	MAIN GEAR
NG	NOSE GEAR
W	POTABLE WATER
X	PASSENGER DOOR

NOTE: WHEN PRINTING THIS DRAWING, MAKE SURE TO ADJUST FOR PROPER SCALING

9.3.2 Scaled Drawings – 1:500: Model 787-10



NOTE: WHEN PRINTING THIS DRAWING, MAKE SURE TO ADJUST FOR PROPER SCALING