Alternative/Non-Standard Parking Information

(Source: American Airlines)

This document provides information for alternative parking arrangements to minimize spacing between aircraft. This is intended for specific scenarios such as emergency parking of aircraft in **non-standard, non-normal operational situations**, addressing close-proximity aircraft parking scenarios in areas other than standard aprons and terminal gates.

Information includes alternative arrangements including Nose-to-Tail (N2T), staggered, and angular parking options, a summary of the minimum parking distances based on idle engine run and APU run contours, additional parking clearance considerations, and references to pertinent regulatory standards.

Nose-to-Tail (N2T) parking information

For N2T parking of aircraft, typically the 35 mph and 50 mph jet blast velocity contours are used to determine the distance needed between nose and tail. Jet blast affects all operational areas of the airport. In terminal, maintenance, and cargo areas, personnel safety is the primary consideration. Jet blast velocities greater than 35 mph can cause loose objects on the pavement to become airborne with the capability of causing injury to personnel, structures and equipment at considerable distances behind the aircraft. If the aircraft are being parked N2T, on a pavement that is clean, with no ground-based FOD in the vicinity, the 35 mph-50 mph jet blast velocity contours should not impose undue threat of damage.

For N2T parking of aircraft, 150^{o} F is the allowable temperature for an aircraft parked behind an engine or APU run to avoid damage to structure, sealants, finishes, hydraulics, electrical. Please note that APU Exhaust Temperature Contour distances for 150^{o} F in Table 1 are estimates extrapolated from existing data.

These thresholds align with FAA standards and OSHA protection categories. Additionally please note, passage of personnel and other equipment between aircraft during engine and APU runs is NOT recommended. Consult the aircraft operator for additional information about engine exhaust hazard areas.

Parking Layout Considerations

To run airplanes while parked, engine and APU run exhaust contours need to be considered, but ***parking separations should not be determined solely by the engine and APU run envelopes. Additional considerations need to be made, such as, movement around the aircraft by emergency vehicles, access stairways, maintenance equipment, etc. Also, local environmental conditions should be taken into account to determine if any additional clearance may be required, due to wind strength and direction, contaminated pavement conditions, etc.***

(Source: American Airlines)

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The following drawings show examples of variations in parking layouts on a standard 75 FT runway. X indicates the minimum Nose-to-Tail parking distance for engine and/or APU runs. Again, please note that distance between aircraft will vary to accommodate engine and APU exhaust velocity and temperature contours ***as well as*** local environmental conditions and operational and safety requirements. N2T, staggered, and angled parking options can be considered depending on space available and minimum parking distances.

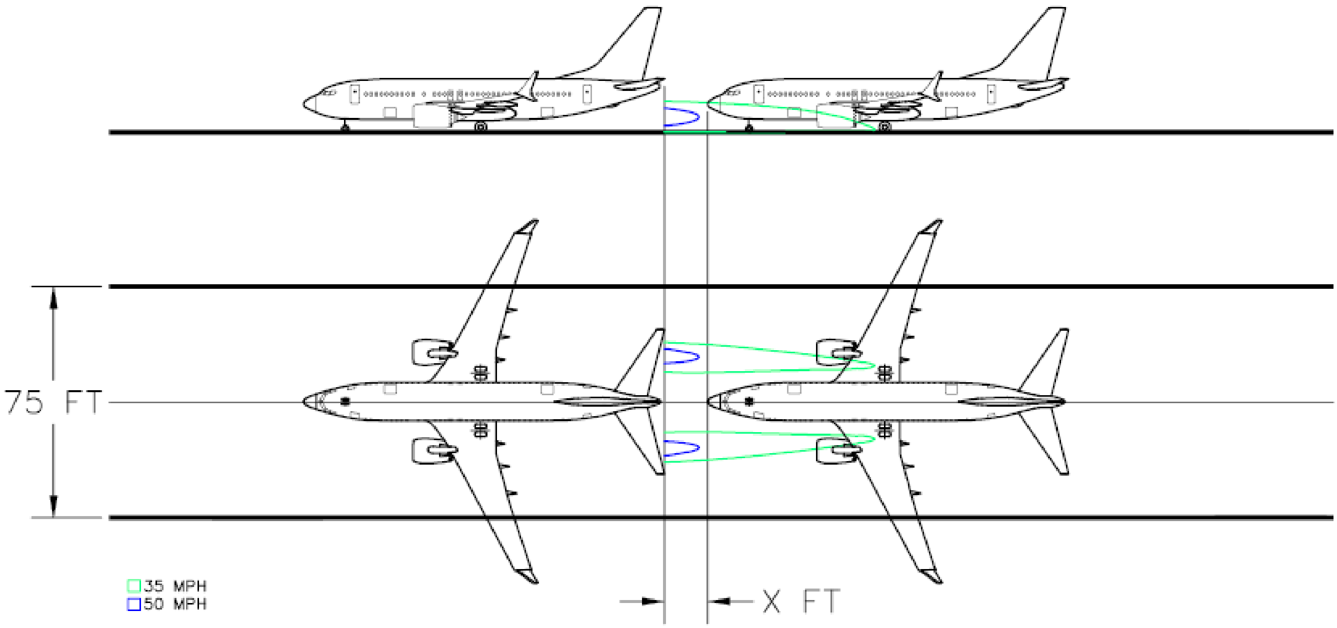


Figure 1. 737-7's parked Nose-To-Tail (N2T) with engine idle run exhaust velocity contours.

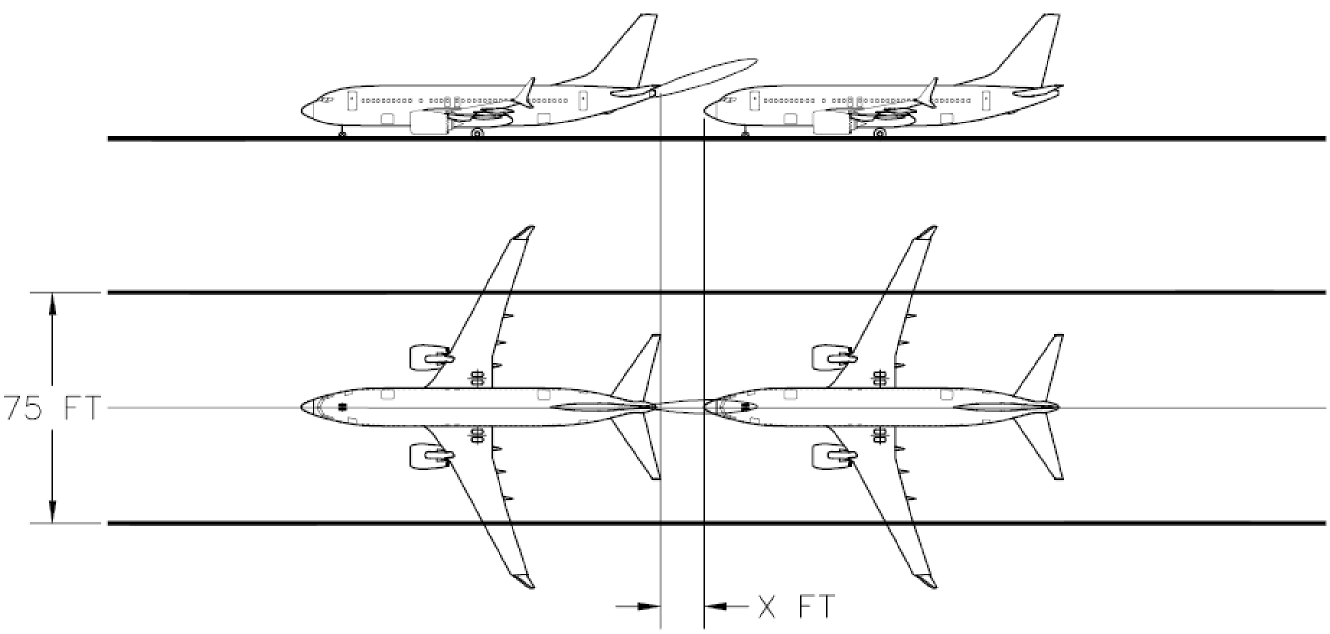


Figure 2. 737-7's parked Nose-To-Tail (N2T) with APU exhaust gas velocity contours.

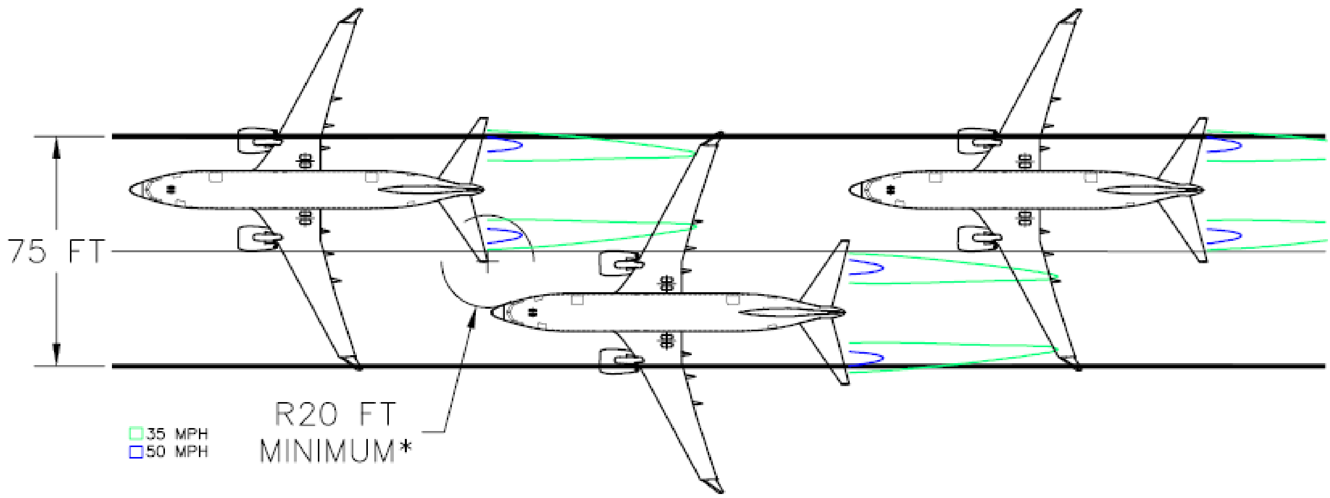


Figure 3. 737-7's staggered with engine idle run exhaust velocity contours. Offset distance varies case-by-case.
*Dimension varies by model and parking arrangement. Boeing does not recommend ***any*** aircraft-to-aircraft interface within a 20 FT clearance.

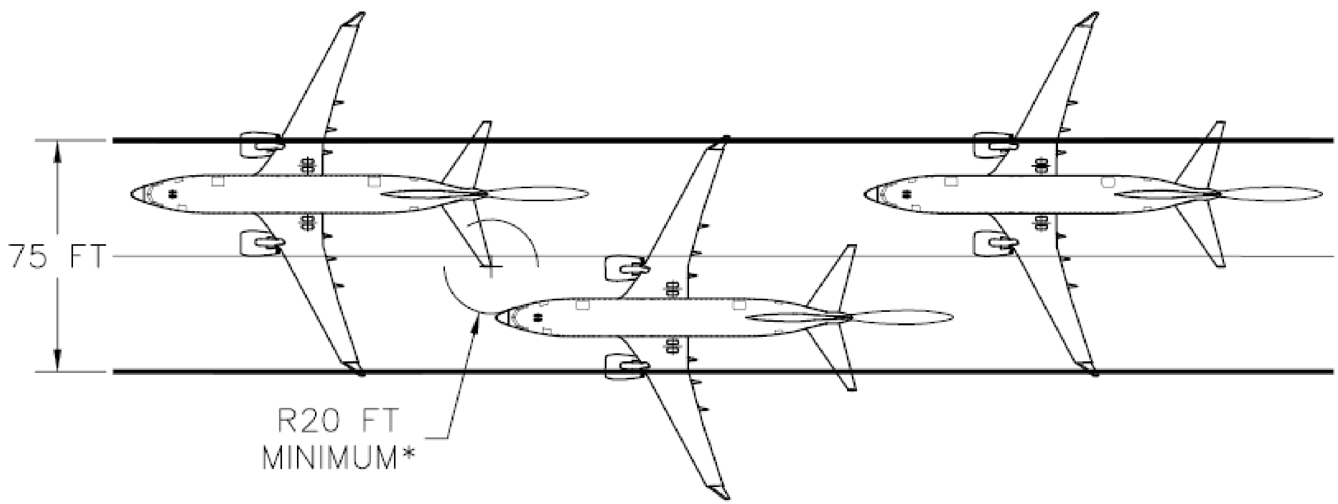


Figure 4. 737-7's staggered with APU exhaust gas velocity contours. Offset distance varies case-by-case.
*Dimension varies by model and parking arrangement. Boeing does not recommend ***any*** aircraft-to-aircraft interface within a 20 FT clearance.

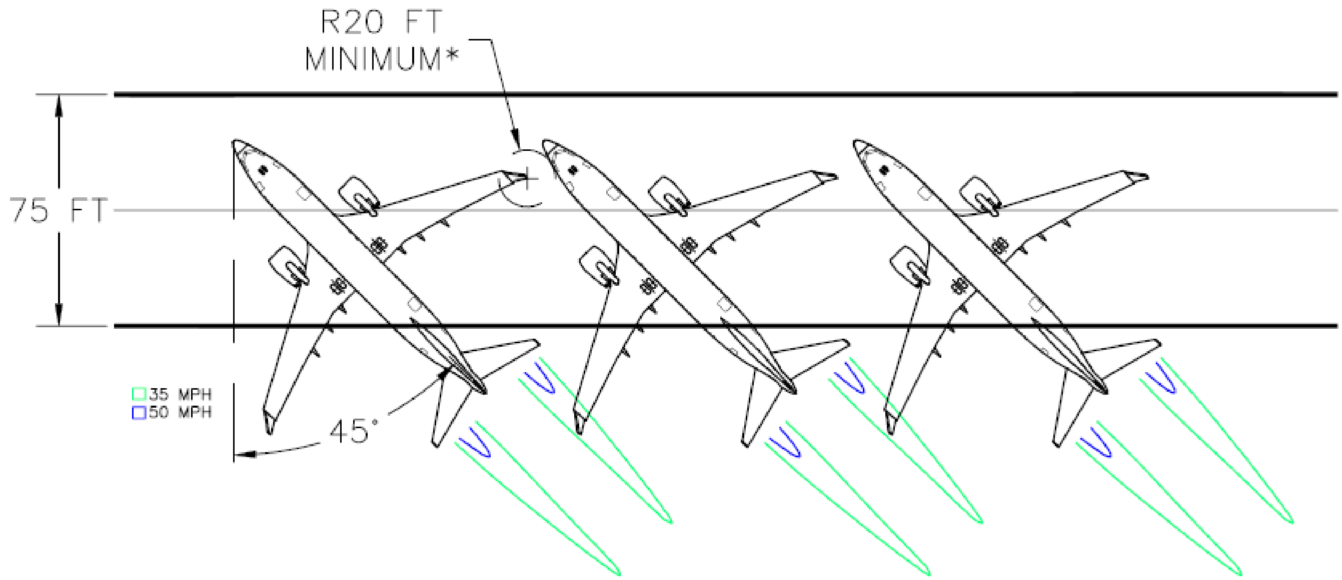


Figure 5. 737-7's angled with minimum engine idle run exhaust velocity envelopes.
Space consideration should be made for ground support equipment and relocation of aircraft.
*Dimension varies by model and parking arrangement. Boeing does not recommend ***any*** aircraft-to-aircraft interface within a 20 FT clearance.

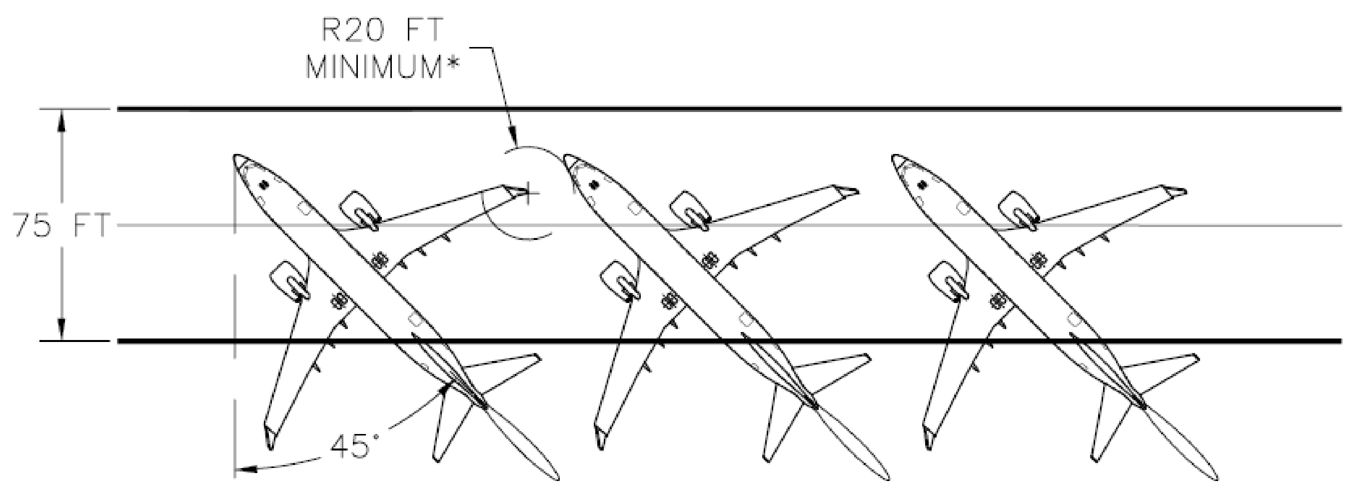


Figure 6. 737-7's angled with APU exhaust gas velocity contours.
Space consideration should be made for ground support equipment and relocation of aircraft.
*Dimension varies by model and parking arrangement. Boeing does not recommend ***any*** aircraft-to-aircraft interface within a 20 FT clearance.

Minimum Parking Distances

Table 1 provides minimum parking distances for N2T parking layouts based solely on the size and shape of the standard engine idle and APU exhaust velocity and temperature contours. These values assume steady-state conditions - the aircraft is sitting still, at idle thrust, for a long period of time, in standard day ambient conditions, with no other wind/weather conditions affecting the jet blast.

As mentioned previously, operational and safety considerations and clearances need to be accommodated ***in addition to*** the clearances for the engine idle and APU contours stated in Table 1.

These values are for use in non-typical parking scenarios. Detailed drawings of the jet blast contours and typical aircraft parking arrangements and separations are found in the Airport Characteristics for Airport Planning (ACAP) (http://www.boeing.com/commercial/airports/plan_manuals.page) and other Boeing documentation, as well as ICAO documentation.

APU exhaust is expelled angling up and in line (not angling left or right) from airplane centerline except where noted. Since APU exhaust angles upward it allows the nose of the second airplane in line N2T to pull forward slightly closer than the full length of the exhaust contour, as shown in the above drawings.

CAUTION: APU Exhaust Temperature Contour distances in Table 1 are estimates extrapolated from existing data.
CAUTION: Boeing does not recommend ***any*** aircraft-to-aircraft interface within a 20 FT clearance.
CAUTION: Passage of personnel and other equipment between aircraft during engine and APU runs is not recommended.
CAUTION: Considerations should be made for ground support equipment and relocation of aircraft.

MODEL	X DIMENSION			
	JET ENGINE EXHAUST VELOCITY CONTOURS 35 MPH	JET ENGINE EXHAUST TEMPERATURE CONTOURS 100º F	APU EXHAUST VELOCITY CONTOURS 35 MPH	APU EXHAUST TEMPERATURE CONTOURS 150º F
707				
-120B, -320B, -320C	20 FT (50 MPH)	20 FT (125º F)	Not available	Not available
-320	20 FT (50 MPH)	20 FT (125º F)	Not available	Not available
-420	20 FT (50 MPH)	20 FT (125º F)	Not available	Not available
717	55 FT	20 FT	Not available	Not available
727				
-100, -100C, -200				
JT8D-7 & -9 ENGINES	40 FT (50 MPH)	30 FT	Not available	Not available

-15, -17 & -17R ENGINES	50 FT (50 MPH)	50 FT	Not available	Not available
737				
-600, -700, -800, -900	35 FT	20 FT [2]	35 FT	45 FT [1]
-7, -8, -9, -10	50 FT	20 FT [2]	20 FT (40 MPH)	90 FT [1]
747				
-400	30 FT	20 FT [2]	35 FT	110 FT [1]
-8, -8F	20 FT	20 FT [2]	35 FT	110 FT [1]
757				
-200	90 FT	20 FT	20 FT (43 MPH)	60 FT [1]
-300	80 FT	20 FT	20 FT (43 MPH)	60 FT [1]
767				
-200, -200ER				
JT9D-7R4D, -7R4E ENGINES	75 FT	20 FT [2]	20 FT (43 MPH)	55 FT [1]
CF6-80A, -80A2 ENGINES	40 FT	20 FT [2]	20 FT (43 MPH)	55 FT [1]
-300				
JT9D-7R4D, -7R4E ENGINES	65 FT	20 FT [2]	20 FT (43 MPH)	55 FT [1]
CF6-80A, -80A2 ENGINES	30 FT	20 FT [2]	20 FT (43 MPH)	55 FT [1]
-300, -300ER, -300 FREIGHTER				
PW4000, CF6-80C2 SERIES ENGINES	80 FT	20 FT [2]	20 FT (43 MPH)	55 FT [1]
RB211-524 ENGINES	75 FT	20 FT [2]	20 FT (43 MPH)	55 FT [1]
-400ER	85 FT	20 FT [2]	20 FT (40 MPH)	100 FT [1]
777				
-200LR, -FREIGHTER	190 FT	20 FT [2]	Not available	20 FT (120º F) [3]
-300ER	175 FT	20 FT [2]	Not available	20 FT (120º F) [3]
-200, -200ER	90 FT	20 FT [2]	Not available	20 FT (120º F) [3]
-300	75 FT	20 FT [2]	Not available	20 FT (120º F) [3]
787				
-8	60 FT	20 FT [2]	25 FT	70 FT
-9	40 FT	20 FT [2]	25 FT	70 FT
-10	50 FT	20 FT [2]	25 FT	70 FT
DC-8				
-43, -55, -61, -61F, -62, -62F, -63, -63F	20 FT (50 MPH)	20 FT (125º F)	Not available	Not available
-71, -72, -73	20 FT (50 MPH)	20 FT (125º F)	Not available	Not available
DC-9 (SERIES 10 THROUGH 50)	115 FT	20 FT	Not available	Not available

DC/MD-10				
SERIES 10 AND 10CF	170 FT	20 FT [2]	Not available	Not available
SERIES 30 AND 30CF	185 FT	20 FT [2]	Not available	Not available
SERIES 40 AND 40CF				
-20 ENGINE	215 FT	20 FT [2]	Not available	Not available
-59A ENGINE	285 FT	20 FT [2]	Not available	Not available
MD-11				
GE ENGINE	225 FT	20 FT [2]	Not available	Not available
P&W ENGINE	165 FT	20 FT [2]	Not available	Not available
MD-80	105 FT	20 FT [2]	Not available	Not available
MD-90	65 FT	20 FT [2]	Not available	Not available

Table 1. Engine and APU run velocity and temperature contour distances.

[1] This APU Exhaust Temperature Contour distance for 150º F is an estimate extrapolated from existing data. 150º F is the allowable temperature for an aircraft parked behind an APU run to avoid damage to structure, sealants, finishes, hydraulics, electrical.

[2] Temperature contours for idle power conditions are not shown as the maximum temperature aft of the airplane is predicted to be less than 100º F (38º C). The adverse effects of exhaust temperature at any given position behind the aircraft are considerably less than the effects of exhaust velocity. 20 FT is the default minimum distance, we do not recommend any aircraft-to-aircraft interface within 20 FT.

[3] 777 APU exhaust is expelled angling up and to the left away from airplane CL.

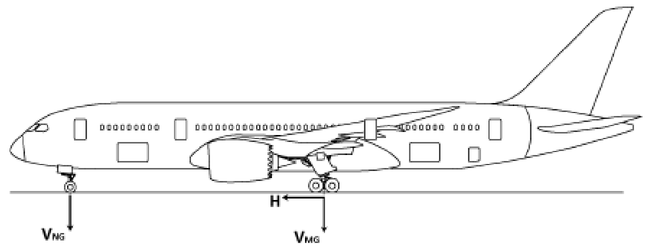
Pavement Considerations

For parking areas other than apron, it is important to ensure pavement strength is adequate to support the aircraft weight for long periods. Pavement overload of 10% is acceptable without appreciable impact on pavement life. However, our guidance is based on the pavement being in good condition, otherwise near-term deterioration may be initiated by the overload. Pavement analysis may be necessary to evaluate the feasibility of pavement overload.

The majority of airport apron pavement is constructed from concrete (Rigid Pavement) to withstand static loads. One primary concern is long-term static loads from airplanes being applied to flexible pavement with poor conditions and hot temperatures. These conditions, may lead to inability of the pavement to support the long-term airplane pavement loading. A second concern is, maintenance activity performed during long-term parking of aircraft can lead to spillage of fluids (oil, fuel, cleaners, etc). Due to the porous nature of asphalt pavement, these contaminants can be absorbed and deterioration of the pavement may be accelerated.

Before airplanes are parked on pavement surfaces that were not designed for prolonged parking, it is recommended to conduct pavement inspections. Frequent pavement inspections should be considered during prolonged parking periods to look for pavement distresses.

For information on the airplane's ACN, static loads for landing gear and other physical characteristics, reference the Airport Characteristics for Airport Planning (ACAP), Section 7 (http://www.boeing.com/commercial/airports/plan_manuals.page).



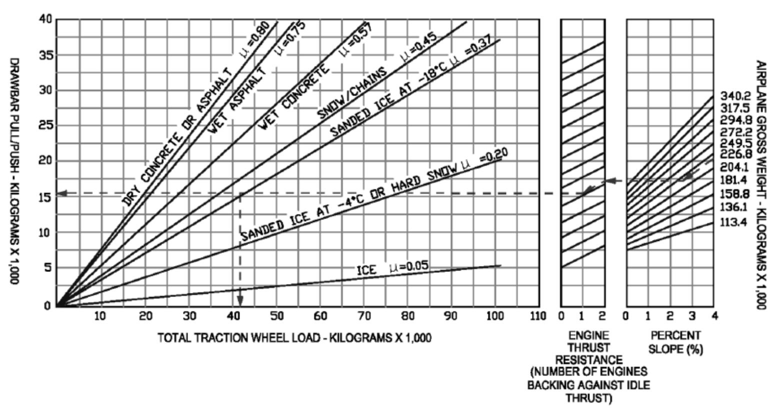
AIRPLANE MODEL	UNIT	MAX DESIGN TAXI WEIGHT	V_{NG}		V_{MG} PER STRUT AT MAX LOAD AT STATIC AFT C.G.	H PER STRUT	
			STATIC AT MOST FWD C.G.	STATIC + BRAKING 10 FT/SEC^2 DECEL		STEADY BRAKING 10 FT/SEC^2 DECEL	AT INSTANTANEOUS BRAKING (μ = 0.8)
787-8	LB	503,500	54,716	85,086	229,798	78,194	183,838
	KG	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

Figure 7. Maximum Pavement Loads: Models 787-8, 787-9, 787-10.
(Source: D6-58333 - 787 Airport Characteristics for Airport Planning (ACAP), Section 7.3, http://www.boeing.com/resources/boeingdotcom/commercial/airports/acaps/787.pdf)

Alternate weight and balance of the airplane can be used to reduce the pavement loading. For information on alternate weights please contact airplane operators for further details.

Aircraft Towing

Ground support may need to tow airplanes to temporary parking areas and information on towing requirements are available in the Airport Characteristics for Airport Planning (ACAP) (http://www.boeing.com/commercial/airports/plan_manuals.page).



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

Figure 8. Ground Towing Requirements - Metric Units: Model 787-8, 787-9, 787-10.
(Source: D6-58333 - 787 Airport Characteristics for Airport Planning (ACAP), Section 5.7.2, http://www.boeing.com/resources/boeingdotcom/commercial/airports/acaps/787.pdf)

For towing requirements for non-normal operations, contact the airplane operator.

Aircraft Mooring

Boeing airplanes are designed to withstand moderate ground winds from any angle without mooring. In areas subjected to high winds, additional considerations may be required, such as weigh limitations, CG, clearance from fixed structures or airplanes, direction of parking and the need for mooring provisions.

For additional mooring consideration, please contact the airplane operator.

Related Parking Guidance

IATA COVID-19 Guidance https://www.iata.org/en/programs/ops-infra/ground-operations/

ACI Advisory Bulletin – 200423 – Airfield – Parking – Advisory – Bulletin https://aci.aero/news/2020/04/24/new-guidance-for-mitigating-the-risks-created-by-aircraft-overflow-parking

FAA 150/5300-13A Appendix 3 – The Effects and Treatment of Jet Blast.

FAA Part 139 Cert Alert 20-02

For more information, please contact us at:

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