

CHAPTER

09

TOWING AND TAXIING



**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL**

**CHAPTER 09
TOWING AND TAXIING**

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TOWING - MAINTENANCE PRACTICES

1. General

- A. This procedure has instructions for towing an airplane.
- B. Be careful when you move the throttle in the flight deck. Throttle movement can activate the PWS radar. Do not operate the weather radar in the hangar. Make sure no personnel, fuel leaks, or open fuel cells are in the 50 ft (15 m) radius from the radar.

TASK 09-11-00-580-801

2. Towing

(Figure 201, Figure 202, Figure 204 or Figure 205, Figure 203, Figure 206, Figure 207 or Figure 208, Figure 209)

A. General

- (1) The design of the airplane will permit you to tow the airplane from the nose or main landing gear.
 - (a) The tow fitting on the nose gear can be used to tow the airplane with a tow bar (Figure 206).
 - (b) The maximum normal towing turning limits are indicated by the painted stripes on the nose gear doors.
- (2) You can tow the airplane on firm and level ground by the nose gear with one tire flat on each main landing gear if the starting loads are held to the minimum.

NOTE: With two flat tires on one main gear, if it is possible, you should replace one of the flat tires with a serviceable tire before towing to prevent damage to the tires and wheels. Refer to (Tow the Airplane with Flat Tire(s), TASK 09-11-04-580-801) .

- (a) For other unusual towing loads, such as towing with two flat tires on one main gear, towing on soft ground, or towing up inclines more than 5 degrees, you should tow the airplane from the main gear as the structural limitations of the nose gear can be exceeded.
- (3) You can tow the airplane with one or both engines removed if you make sure the center of gravity stays forward of the aft center of gravity limits (Figure 202).

NOTE: Refer to the Center of Gravity Calculations for Towing task, for center of gravity data.

- (4) Towing stability of a Towbarless Tow Vehicle (TLTV)/Airplane combination is dependent on many variables, two of these key variables being the characteristics of the tow vehicle tractive forces and the runway conditions. Maximum towing speeds shall be the responsibility of the airplane operator in conjunction with the airport authorities with consideration of recommendations from the TLTV manufacturer.

WARNING: DO NOT APPLY THE AIRPLANE BRAKES WHEN YOU TOW THE AIRPLANE WITH TOWBARLESS TOW VEHICLES. MOST TOWBARLESS TOW VEHICLES DO NOT HAVE A SHEAR PIN TO LIMIT THE LOADS IF THE AIRPLANE BRAKES ARE USED DURING TOWING. IF YOU APPLY THE BRAKES, YOU CAN APPLY LOADS TO THE NOSE LANDING GEAR THAT ARE MORE THAN THE DESIGN LOAD LIMITS. IF YOU DO NOT OBEY THIS WARNING, MAINTENANCE PERSONS CAN BE INJURED, AND DAMAGE WILL OCCUR TO THE NOSE LANDING GEAR, AND THE TOW VEHICLE.

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(WARNING PRECEDES)

CAUTION: DO NOT APPLY THE BRAKES OR OVERSTEER THE AIRPLANE WHEN YOU USE TOWBARLESS TOWING. IF YOU DO NOT OBEY THESE INSTRUCTIONS, YOU CAN CAUSE DAMAGE TO THE NOSE GEAR STRUCTURE AND THE HYDRAULIC SYSTEMS.

(5) You can use towbarless equipment to push or pull the airplane.

NOTE: This procedure is for towing or pushing the airplane with a tow bar. However, most of the steps in this procedure will apply if you use towbarless equipment. Refer to the equipment manufacturer's data for procedures that are specific to their equipment.

(a) Make sure the maximum permitted loads on the nose landing gear are not more than the maximum towing loads as shown in (Figure 203).

(6) Boeing recommends towbarless tow vehicles be designed, tested, operated, and maintained per the following Society of Automotive Engineers (SAE) Aerospace Recommended Practices (ARP), and applicable Boeing documentation:

NOTE: Airlines must insure the latest revisions of the standards and documents are applied.

(a) SAE ARP 4852: Specification for Towbarless Push-Back Tow Vehicles.

(b) SAE ARP 4853: Specification for Towbarless Tow Vehicles (TLTV).

(c) SAE ARP 5283: Towbarless Tow Vehicles - Aircraft Nose Landing Gear Steering and Tractive Force Protection Systems or Alerting Devices - Inspection, Maintenance, and Calibration Requirements.

(d) SAE ARP 5285: Towbarless Towing Vehicle Operating Procedure.

(e) Boeing document D6-56872: Towbarless Towing Vehicle Assessment Criteria.

(f) Boeing Service Letter 737-SL-09-002: Towbarless Towing Evaluation.

NOTE: The service letter provides additional guidance and information regarding towbarless towing recommendations and regulatory requirements.

(7) When it is necessary to tilt the airplane for tail clearance in hangars and storage areas, do this task: Tilt the Airplane For the Tail Clearance, TASK 07-11-06-580-801.

(8) During all phases of ground handling and maintenance, the center of gravity (CG) of the airplane must be forward of the aft CG limit (Figure 201).

(a) This CG limit provides a margin of safety to allow for grade, winds, and acceleration forces as noted.

(b) The configuration to be towed should be carefully checked to make sure that the CG is forward of the towing limit.

(c) If the aft towing limit CG is more than the center of gravity limits, the recommended procedure is to add ballast or fuel, to move the CG forward.

1) The Table in (Figure 202) gives the incremental CG shift for some of the items that you need to consider.

a) A forward CG shift is (-) and an aft CG shift is (+).

b) All of the data is for a level airplane.

B. References

Reference	Title
05-51-01-210-801	Phase I Inspection (P/B 201)
05-51-01-210-802	Phase II Inspection (P/B 201)
05-51-29-200-801	Phase I Inspection (P/B 201)

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Reference	Title
05-51-29-200-802	Phase II Inspection (P/B 201)
07-11-06-580-801	Tilt the Airplane For the Tail Clearance (P/B 201)
09-11-04-580-801	Tow the Airplane with Flat Tire(s) (P/B 201)
12-15-31-610-802	Main Landing Gear Shock Strut Servicing (P/B 301)
12-15-41-610-802	Nose Landing Gear Shock Strut Servicing (P/B 301)
12-15-51-610-802	Add Nitrogen or Air to the Tire (P/B 301)
24-22-00-860-812	Remove Electrical Power (P/B 201)
24-22-00-860-813	Supply External Power (P/B 201)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)
29-11-00-860-801	Hydraulic System A or B Pressurization (P/B 201)
29-11-01-860-802	Hydraulic Reservoirs Depressurization (P/B 201)
32-00-01-480-801	Landing Gear Downlock Pins Installation (P/B 201)
32-21-00-700-801	Nose Landing Gear Torsional Freeplay Inspection (P/B 601)
49-11-00-860-801	APU Starting and Operation (P/B 201)
49-11-00-860-802	APU Usual Shutdown (P/B 201)
71-11-02 P/B 201	FAN COWL PANELS - MAINTENANCE PRACTICES
78-31-00 P/B 201	THRUST REVERSER SYSTEM - MAINTENANCE PRACTICES

C. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-1498	Eyebolt - Towing, Main Gear (737 Classic and NG) (Part #: F72719-500, Supplier: 81205, A/P Effectivity: 737-ALL)
SPL-1499	Pin - Lock, NLG Towing Lever (Part #: A09003-2, Supplier: 81205, A/P Effectivity: 737-600, -700, -700C, -700ER, -700QC, -800, -900, -900ER, -BBJ) (Opt Part #: A09003-1, Supplier: 81205, A/P Effectivity: 737-600, -700, -700C, -700ER, -700QC, -800, -900, -900ER, -BBJ)

D. Location Zones

Zone	Area
700	Landing Gear and Landing Gear Doors

E. Prepare To Tow the Airplane

SUBTASK 09-11-00-580-001

WARNING: ALL WORK AROUND THE AIRPLANE MUST STOP WHEN LIGHTNING OCCURS AT A DISTANCE OF 6 MILES OR LESS. ALL PERSONNEL MUST GO IN A BUILDING OR THE AIRPLANE. LIGHTNING CAN KILL PERSONNEL OR CAUSE INJURY.

WARNING: WHEN YOU PUSH OR TOW THE AIRPLANE, YOU MUST MAKE SURE THE TOW TRACTOR HEAD SET CORD IS CONNECTED TO THE AIRPLANE. CONNECT THE HEAD SET CORD HOOK TO THE LOWER FORWARD CORNER OF THE ELECTRICAL POWER ACCESS COMPARTMENT.

- (1) Do the steps that follow to prepare to tow the airplane:

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HAP 031-054, 101-999; AIRPLANES WITH THE INTEGRATED STANDBY FLIGHT DISPLAY

CAUTION: DO NOT TOW OR MOVE THE AIRPLANE DURING THE ISFD POWER-ON INITIALIZATION. FAILURE TO FOLLOW THIS CAUTION MAY RESULT IN FLIGHT CREWS HAVING INCORRECT ATTITUDE INFORMATION DISPLAYED BY THE ISFD FOLLOWING TAKE-OFF.

- (a) Do not tow or move the airplane within 90 seconds of power on for the Integrated Standby Flight Display (ISFD).

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- (b) Close the Fan Cowl Panels, do this task: FAN COWL PANELS - MAINTENANCE PRACTICES, PAGEBLOCK 71-11-02/201.
- (c) Close the Thrust Reversers, do this task: THRUST REVERSER SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 78-31-00/201.
- (d) Make sure that the airplane is within the center of gravity towing limitations and that the fuel load is balanced.
 - 1) Adjust the fuel load as appropriate.
 - a) The fuel imbalance between the main wing tanks must not exceed 1000 lb (454 kg).

WARNING: ONLY USE THE CORRECT PIN FOR THE AIRPLANE MODEL. IF YOU USE AN INCORRECT PIN, THE HYDRAULIC STEERING CAN OPERATE. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

- (e) Make sure that all the landing gear ground lockpins are installed, do this task: Landing Gear Downlock Pins Installation, TASK 32-00-01-480-801.

NOTE: Towing and pushing with the landing gear ground lockpins removed is optional.

- (f) Make sure the electronic compartment access door is closed.
- (g) Make sure that the tires are correctly inflated, do this task: Add Nitrogen or Air to the Tire, TASK 12-15-51-610-802.

CAUTION: DO NOT TOW THE AIRPLANE WITH THE NOSE GEAR FULLY COMPRESSED OR EXTENDED MORE THAN 23.5 INCHES (59.7 CENTIMETERS) FROM THE BOTTOM OF THE INNER CYLINDER TO THE BOTTOM OF THE STEERING PLATE. YOU CAN DAMAGE THE NOSE GEAR STRUT INTERNALLY.

- (h) Make sure that the shock strut of the nose landing gear correctly serviced, do this task: Nose Landing Gear Shock Strut Servicing, TASK 12-15-41-610-802.
- (i) Make sure that the shock struts of the main landing gear are correctly serviced, do this task: Main Landing Gear Shock Strut Servicing, TASK 12-15-31-610-802.

SUBTASK 09-11-00-860-008

- (2) Prevent the pitot probe from heating up.
 - (a) Put the BAT switch on the P5 panel to the ON position.
 - (b) Turn the STBY power switch on the P5 panel to the AUTO position.

SUBTASK 09-11-00-860-002

- (3) Supply the external electrical power to the airplane, do this task: Supply External Power, TASK 24-22-00-860-813.
 - (a) You can start and operate the APU if it is necessary, do this task: APU Starting and Operation, TASK 49-11-00-860-801.

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SUBTASK 09-11-00-860-003

(4) Pressurize the system B hydraulic system, do this task: Hydraulic System A or B Pressurization, TASK 29-11-00-860-801.

(a) Make sure that the brake hydraulic pressure is normal, approximately 3000 psi.

(b) Remove the external electrical power, do this task: Remove Electrical Power, TASK 24-22-00-860-812

or:

(c) Shut down the APU, do this task: APU Usual Shutdown, TASK 49-11-00-860-802.

WARNING: IF THE NOSE GEAR STEERING LOCKOUT PIN IS NOT INSTALLED, MAKE SURE THAT THE PRESSURE IN HYDRAULIC SYSTEM A IS COMPLETELY REMOVED BEFORE TOWING THE AIRPLANE. IF YOU DO NOT OBEY THIS WARNING, YOU CAN CAUSE INJURY TO PERSONS AND DAMAGE TO THE STEERING COMPONENTS.

WARNING: ONLY USE THE CORRECT PIN FOR THE AIRPLANE MODEL. IF YOU USE AN INCORRECT PIN, THE HYDRAULIC STEERING CAN OPERATE. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

(d) If you have not yet installed the NLG towing lever pin, SPL-1499, do one of the steps that follow:

WARNING: WHEN YOU WILL USE A TOWBAR TO MOVE THE AIRPLANE IN HIGH WINDS, CONNECT THE TOW BAR BEFORE YOU INSERT THE STEERING LOCKOUT PIN (TOWPIN). THE AIRPLANE COULD MOVE AND CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

WARNING: ONLY USE THE CORRECT PIN FOR THE AIRPLANE MODEL. IF YOU USE AN INCORRECT PIN, THE HYDRAULIC STEERING CAN OPERATE. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

1) Move the towing lever to "Tow" position and install the Nose Gear Steering Lockout pin with a streamer attached to it NLG towing lever pin, SPL-1499.

NOTE: The towing lever is located at the left forward side of the steering metering valve.

2) Remove the pressure of the hydraulic system A, do this task: Hydraulic Reservoirs Depressurization, TASK 29-11-01-860-802 or Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.

WARNING: DO NOT CONNECT A HEADSET AND DO NOT TOUCH CONNECTIONS TO THE AIRPLANE DURING ATMOSPHERIC ELECTRICAL ACTIVITY OR STRONG RADIATIVE FIELDS. LIGHTNING STRIKE AND HIGH DISCHARGE CURRENTS CAN CAUSE SEVERE INJURY.

WARNING: MAKE SURE THAT THE TOW TRACTOR OPERATOR, THE GROUND CREW, AND THE FLIGHT COMPARTMENT CREW CAN SPEAK TO THE OTHERS. IF THEY CAN NOT SPEAK TO THE OTHERS, AIRPLANE MOVEMENTS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

(e) Connect the interphone system or equivalent between the control cabin, the tow tractor operator, and the towing ground crew.

NOTE: Wireless handsets may be used in place of an interphone system.

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- (f) Make sure you have an approved brake operator in the flight compartment.
- (g) Make sure that the ramp area is clear of all stands and equipment in the towing path.
- (h) Connect the tow bar to the tow tractor and to the airplane, if it is necessary.
- (i) Remove the airplane static ground wires.

F. Tow the Airplane from the Nose Landing Gear

SUBTASK 09-11-00-580-002

- (1) Do the steps that follow to tow the airplane:

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CAUTION: DO NOT TOW OR MOVE THE AIRPLANE DURING THE ISFD POWER-ON INITIALIZATION. FAILURE TO FOLLOW THIS CAUTION MAY RESULT IN FLIGHT CREWS HAVING INCORRECT ATTITUDE INFORMATION DISPLAYED BY THE ISFD FOLLOWING TAKE-OFF.

- (a) Do not tow or move the airplane within 90 seconds of power on for the Integrated Standby Flight Display (ISFD).

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- (b) Put into position the control cabin crew, the tow tractor operator, and the ground crew so all are in visual contact.

WARNING: MAKE SURE THAT THE TOW TRACTOR OPERATOR, THE GROUND CREW, AND THE FLIGHT COMPARTMENT CREW CAN SPEAK TO THE OTHERS. IF THEY CAN NOT SPEAK TO THE OTHERS, AIRPLANE MOVEMENTS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

- (c) Make sure that the control cabin crew has intercom or wireless communication with the ground crew and the tow tractor operator.
- (d) Make sure that the wheel chocks are removed.
- (e) Make sure that the hydraulic brakes are released.

CAUTION: MOVE THE AIRPLANE FORWARD BEFORE YOU START SHARP TURNS. MAKE SURE THERE ARE NO SUDDEN STARTS AND STOPS. IF YOU TOW THE PLANE UNDER HIGH LOAD CONDITIONS, SUCH AS TOWING WITH BOTH TIRES FLAT ON ONE MAIN GEAR, TOWING ON SOFT TERRAIN, TOWING UP INCLINES GREATER THAN 5 DEGREES, OR OTHER ABNORMAL LOADS, REFER TO THE TOW AIRPLANE UNDER ABNORMAL LOADS TASK. IF YOU DO NOT OBEY THIS CAUTION, THE NOSE GEAR TOWING STRESS CAN BE MORE THAN THE SPECIFICATIONS PERMIT.

- (f) Tow the airplane.

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WARNING: WHEN YOU TOW THE AIRPLANE, ALL PERSONS MUST STAY OUT OF THE DANGEROUS AREAS AROUND THE TOW VEHICLE, TOW BAR, NOSE WHEELS, AND MAIN WHEELS. PERSONS ON THE GROUND MUST KNOW IT IS POSSIBLE TO BE RUN OVER BY THE NOSE WHEELS, MAIN WHEELS, AND THE TOW VEHICLE. THIS IS BECAUSE THE AIRPLANE WILL CHANGE POSITION DURING PUSHBACK AND TOWING. MAKE SURE YOU KEEP A MINIMUM OF 10 FEET SEPARATION BETWEEN PERSONS ON THE GROUND AND THE EQUIPMENT THAT MOVES. IF YOU DO NOT KEEP THE MINIMUM DISTANCE, A FATAL INJURY CAN OCCUR.

- (g) Make sure the persons that work near the areas that follow know the pushback hazard zones as shown in (Figure 209).
 - 1) tow vehicle
 - 2) towbar
 - 3) nose wheels
 - 4) main wheels.
- (h) It is optional to tow the airplane with the entry or lower cargo doors open.
- (i) Tow the airplane slowly straight ahead before you try to turn.

CAUTION: IF YOU USE A TOW BAR, YOU CAN CAUSE THE SHEAR PINS TO SHEAR IF YOU USE THE AIRPLANE BRAKES WHILE YOU TOW THE AIRPLANE. MOST TOWBARLESS TOW VEHICLES DO NOT HAVE A SHEAR PIN TO LIMIT THE LOADS IF AIRPLANE BRAKES ARE USED DURING TOWING. IF AIRPLANE BRAKES ARE USED WHILE TOWING WITH A TOWBARLESS TOW VEHICLE ATTACHED TO THE NOSE LANDING GEAR, DO THE "HARD LANDING OR HIGH DRAG/SIDE LOAD LANDING" INSPECTION FOR THE NOSE LANDING GEAR AREAS.

- (j) Keep brake applications to minimum use within safety limitations. If airplane brakes are used while towing with a towbarless tow vehicle attached to the nose landing gear, do this task: Phase I Inspection, TASK 05-51-01-210-801.

NOTE: Fully charged accumulators are capable of approximately six brake applications.

- (k) Maximum normal turning angle is 78 degrees and as indicated by red stripes on nose gear doors (Figure 203).
 - 1) The theoretical (No slip angle) airplanes turning radii VS nose gear steering angle is shown in the referenced figure (Figure 204 or Figure 205).
 - 2) If the maximum turning angle is exceeded and oversteer occurs:
 - a) Do this task: Phase I Inspection, TASK 05-51-29-200-801 and, do this task: Phase II Inspection, TASK 05-51-29-200-802.
 - b) Do this task: Nose Landing Gear Torsional Freeplay Inspection, TASK 32-21-00-700-801.
 - c) Do this task: Phase I Inspection, TASK 05-51-01-210-801.
Nose Landing Gear Area, subtask 210-002.
 - d) Do this task: Phase II Inspection, TASK 05-51-01-210-802.
Nose Landing Gear Area, subtask 710-001.
- (l) Disconnect the torsion links on the nose gear, if a turning angle more than 78 degrees is necessary.

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- 1) To prevent damage to the lubrication fittings when disconnected, support the lower torsion link so it wont drag.
- (m) Disconnect the nose gear taxi light wire, if a towing angle will be more than 90 degrees.
- (n) Complete the airplane tow in a straight line for a minimum of 10 feet (3 meters).

NOTE: This procedure will make sure that the torsional loads (side load pressures) are released before it is parked.

- (o) At the end of towing, put the wheel chocks fore and aft of the main landing gear (MLG) tires and the nose landing gear (NLG) tires.

NOTE: If the ramp does not slope: Move the aft NLG chocks away from the tires. During the refuel, the NLG tires roll aft as the MLG shock strut compresses. Make sure that the chocks do not touch the MLG tires. The weight of the fuel can lower the aircraft and cause the tires to catch the chocks.

NOTE: If the ramp slopes: Make sure that the chocks down from the tires touch the NLG and MLG tires. Make sure that the chocks up from the tires do not touch the NLG and MLG tires.

- (p) Make sure the parking brake is released.
- (q) Disconnect the tow bar (if it was installed).

WARNING: IF HYDRAULIC SYSTEM A IS PRESSURIZED, STAY CLEAR OF THE NOSE LANDING GEAR. DO THIS WHEN THE STEERING LOCKOUT PIN IS REMOVED FROM THE STEERING TOW LEVER. IF YOU DO NOT OBEY THIS WARNING, INJURY TO PERSONS CAN OCCUR.

- (r) Remove the NLG towing lever pin, SPL-1499, with streamer from the towing lever.

G. Tow the Airplane Under Abnormal Loads (Main Gear Towing)

SUBTASK 09-11-00-580-003

- (1) Preparation for towing and towing airplane under abnormal loads is the same as towing airplane from nose gear except for the steps that follow:

NOTE: The nose gear tow bar is not used.

- (a) Put eyebolt assemblies eyebolt, SPL-1498 in the position of the jacking cone on each main gear.
- (b) Locally fabricate cables and attach them to each main gear and to the tow tractors.
- (c) Fabricate the wire cable (3/4 inch) with end fittings to match F72719 eyebolt, SPL-1498.
- (d) Pressurize Hydraulic System A.

NOTE: The airplane is steered during the towing by the nose wheel steering system and from the directions of the ground crew.

- (e) Airplane motion is interrupted by the application of the airplane brakes.

NOTE: The number of applications is not limited when the hydraulic systems are operational.

H. Tow the Airplane in High Wind

SUBTASK 09-11-00-580-004

- (1) You can tow the airplane in high winds, but you must obey the conditions described in (Figure 207 or Figure 208).

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I. Put the Airplane to its Usual Condition

SUBTASK 09-11-00-860-004

- (1) Do the steps that follow to put the airplane back to its usual condition:
 - (a) Attach the static ground wires.
 - (b) Disconnect and stow the intercommunication set.
 - (c) If it is on, remove the APU power, do this task: APU Usual Shutdown, TASK 49-11-00-860-802.
 - (d) If the landing gear downlock pins were installed, remove the pins before taxi and takeoff.

————— **END OF TASK** —————

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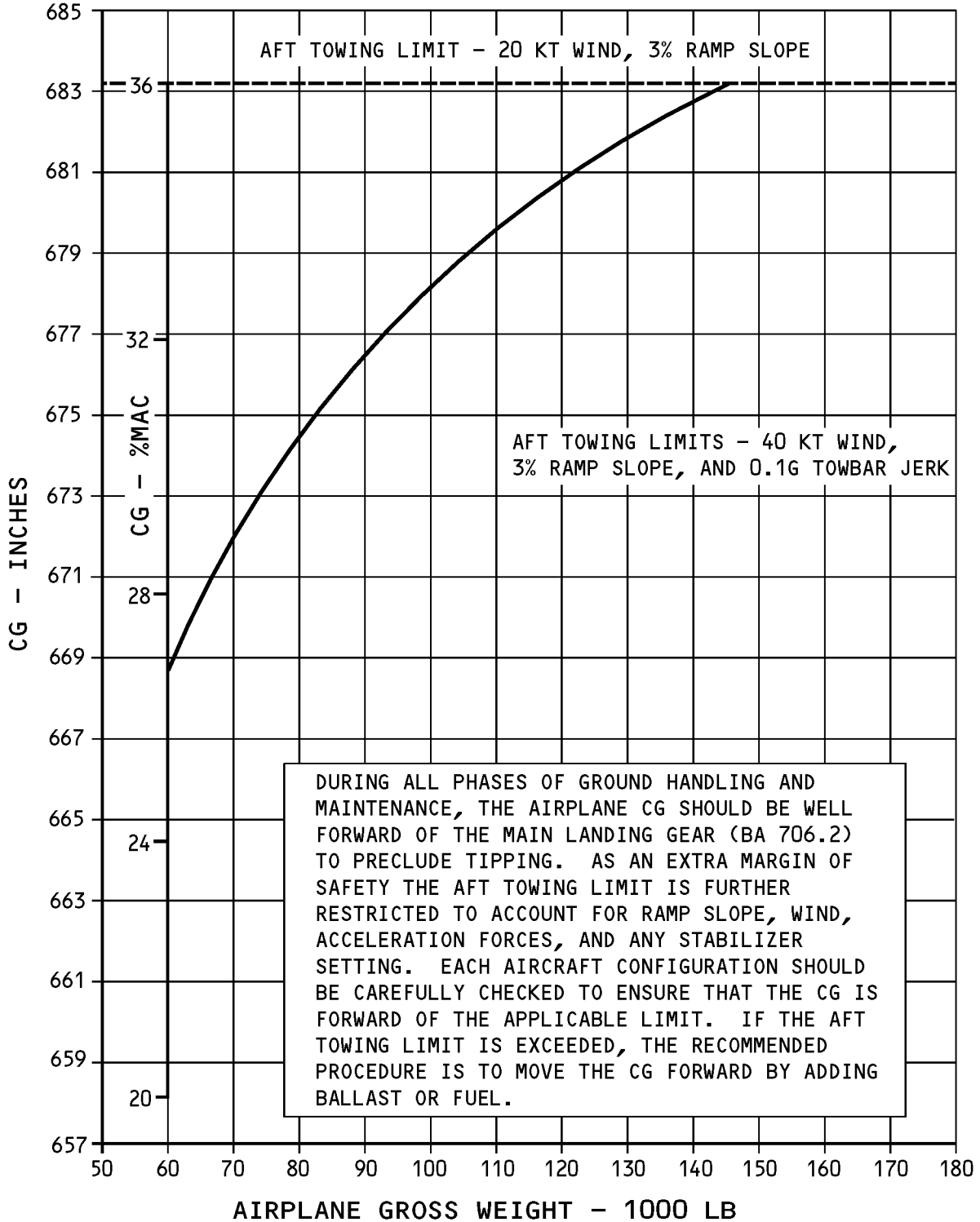
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Aft CG Limits for Towing (Airplane CG versus Gross Weight) Figure 201 (Sheet 1 of 2)/09-11-00-990-801

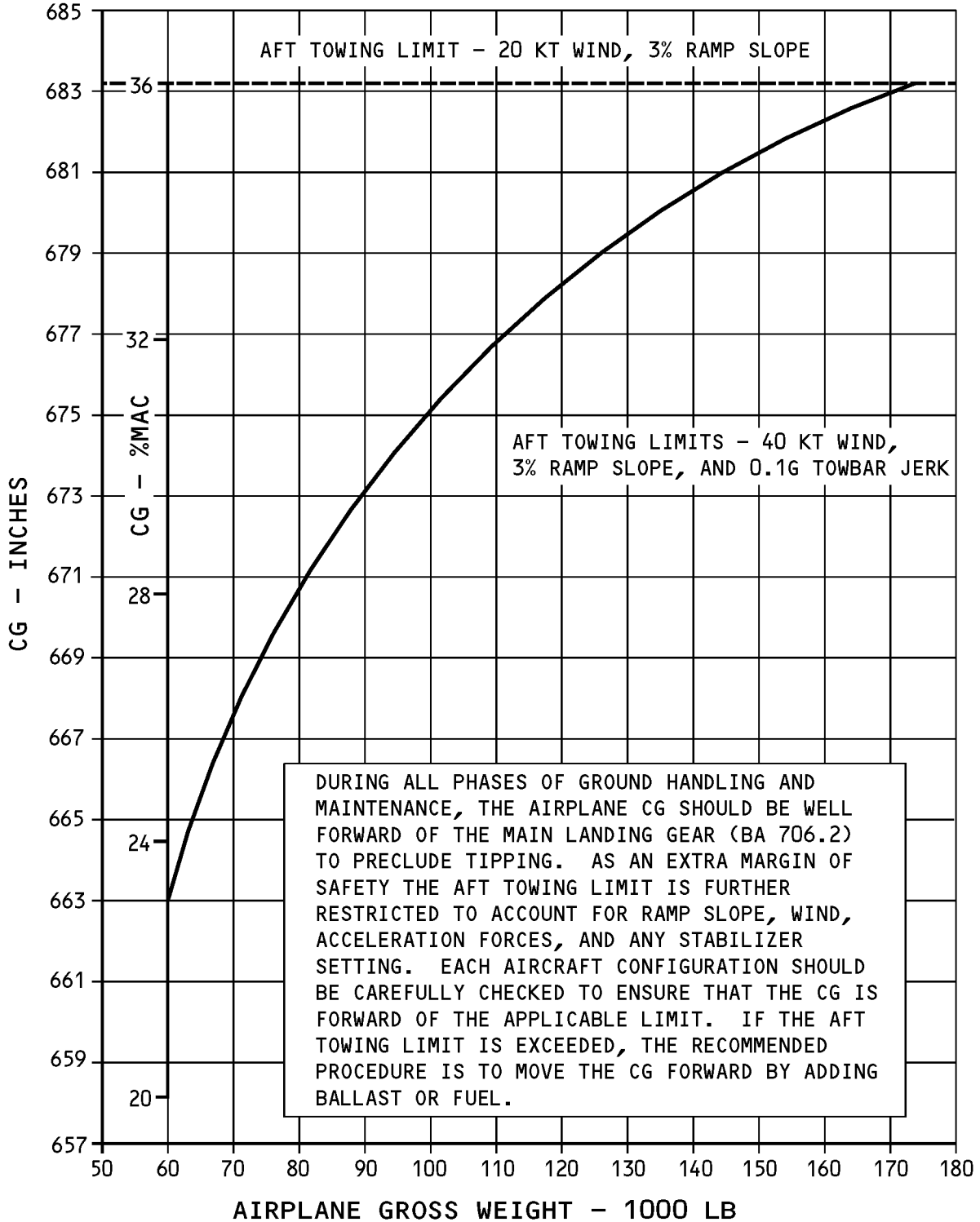
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Aft CG Limits for Towing (Airplane CG versus Gross Weight)
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SHIFTS	WEIGHT		CENTER OF GRAVITY (CG)	737-700 1 Moment Weight X B.A.	
	POUNDS	KILOGRAMS		(LB.)	(B.A.)
			B.A.	(INCHES)	(%MAC)
ONE MAN IN PILOT'S SEAT	200	90.7	150	-1.4	-0.9
ONE MAN IN CABIN AT BS 990	200	90.7	1090	1.1	0.7
1000 LB ATTACHED TO THE NOSE GEAR	1000	453.6	211	-6.1	-3.9
1000 LB LOADED IN THE FWD CARGO HOLD AT (CENTROID)	1000	453.6	414	-3.5	-2.2
ONE ENGINE REMOVED	-7500	-3401.9	551.5	14.1	9.0
TWO ENGINES REMOVED	-15000	-6803.9	551.2	31.7	20.3
FUEL IN THE WING TANKS - (7.1 LB/GAL.)	2500	1134.0	657.3	-0.7	-0.4
	5000	2268.0	660.24	-1.1	-0.7
	7500	3401.9	663.49	-1.3	-0.8
	10000	4535.9	668.58	-1.1	-0.7
	12500	5669.9	675.88	-0.3	-0.2
	15000	6803.9	684.93	1.2	0.7
	17500	7937.9	696.06	3.4	2.2
	18289	8295.8	700.71	4.5	2.9
FUEL IN THE CENTER TANK - (7.1 LB/GAL.)	2500	1134.0	607.95	-2.3	-1.5
	5000	2268.0	605.22	-4.5	-2.9
	7500	3401.9	604.75	-6.7	-4.3
	10000	4535.9	604.85	-8.6	-5.5
	12500	5669.9	605.22	-10.4	-6.7
	15000	6803.9	605.71	-12.0	-7.7
	17500	7937.9	606.13	-13.6	-8.7
	20000	9071.8	606.46	-15.1	-9.7
	22500	10205.8	606.69	-16.5	-10.6
	25000	11339.8	606.74	-17.8	-11.4
	27500	12473.8	606.38	-19.2	-12.3
	30000	13607.8	605.59	-20.7	-13.3
	30523	13845.0	605.39	-21.0	-13.5

Shifts Based on Weight and Center of Gravity
Figure 202 (Sheet 1 of 3)/09-11-00-990-802

EFFECTIVITY
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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL**

SHIFTS	WEIGHT		CENTER OF GRAVITY (CG)	737-800 1 Moment Weight X B.A.	
	POUNDS	KILOGRAMS		(LB.)	(B.A.)
			B.A.	(INCHES)	(%MAC)
ONE MAN IN PILOT'S SEAT	200	90.7	32	-1.6	-1.0
ONE MAN IN CABIN AT BS 990	200	90.7	1202	1.3	0.8
1000 LB ATTACHED TO THE NOSE GEAR	1000	453.6	93	-7.3	-4.7
1000 LB LOADED IN THE FWD CARGO HOLD AT (CENTROID)	1000	453.6	360.7	-4.0	-2.6
ONE ENGINE REMOVED	-7500	-3401.9	551.5	13.6	8.7
TWO ENGINES REMOVED	-15000	-6803.9	551.2	30.4	19.5
FUEL IN THE WING TANKS - (7.1 LB/GAL.)	2500	1134.0	657.3	-0.8	-0.5
	5000	2268.0	660.24	-1.3	-0.9
	7500	3401.9	663.49	-1.7	-1.1
	10000	4535.9	668.58	-1.6	-1.0
	12500	5669.9	675.88	-1.0	-0.6
	15000	6803.9	684.93	0.3	0.2
	17500	7937.9	696.06	2.3	1.5
	18289	8295.8	700.71	3.3	2.1
FUEL IN THE CENTER TANK - (7.1 LB/GAL.)	2500	1134.0	607.95	-2.3	-1.5
	5000	2268.0	605.22	-4.6	-2.9
	7500	3401.9	604.75	-6.7	-4.3
	10000	4535.9	604.85	-8.7	-5.6
	12500	5669.9	605.22	-10.5	-6.7
	15000	6803.9	605.71	-12.2	-7.8
	17500	7937.9	606.13	-13.8	-8.9
	20000	9071.8	606.46	-15.3	-9.8
	22500	10205.8	606.69	-16.8	-10.8
	25000	11339.8	606.74	-18.2	-11.7
	27500	12473.8	606.38	-19.6	-12.6
	30000	13607.8	605.59	-21.1	-13.5
	30523	13845.0	605.39	-21.4	-13.8

**Shifts Based on Weight and Center of Gravity
Figure 202 (Sheet 2 of 3)/09-11-00-990-802**

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AIRCRAFT MAINTENANCE MANUAL

1 EACH AIRPLANE CONFIGURATION SHOULD BE CAREFULLY CHECKED TO MAKE SURE THAT THE CENTER OF GRAVITY (CG) IS FORWARD OF THE APPLICABLE LIMIT. IF THE AFT TOWING LIMIT IS EXCEEDED, THE RECOMMENDED PROCEDURE IS TO MOVE THE CENTER OF GRAVITY FORWARD BY ADDING BALLAST OR FUEL (B. A. = BALANCE ARM). THE TABLE ABOVE SHOWS THE EFFECT THAT VARIOUS ITEMS HAVE ON THE CENTER OF GRAVITY LOCATION OF THE AIRPLANE. A FORWARD CG SHIFT IS INDICATED BY A MINUS (-) SIGN.

WEIGHTS AND BALANCE ARMS (B.A.) GIVEN ON FIGURE 202 ARE BASED ON THE AS MANUFACTURED OPERATIONAL EMPTY WEIGHT (OEW). POST DELIVERY MODIFICATIONS CHANGE WEIGHT AND BALANCE.

Shifts Based on Weight and Center of Gravity
Figure 202 (Sheet 3 of 3)/09-11-00-990-802

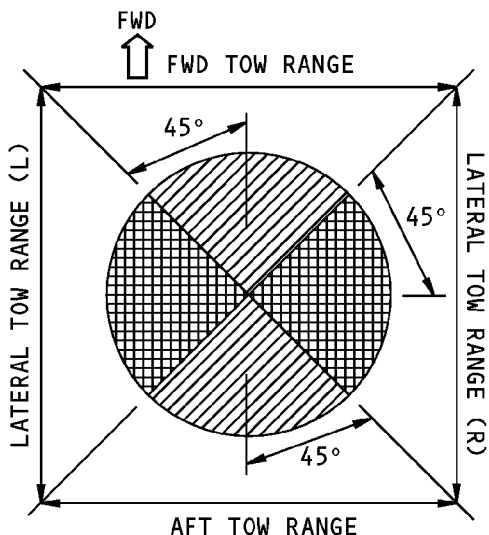
EFFECTIVITY
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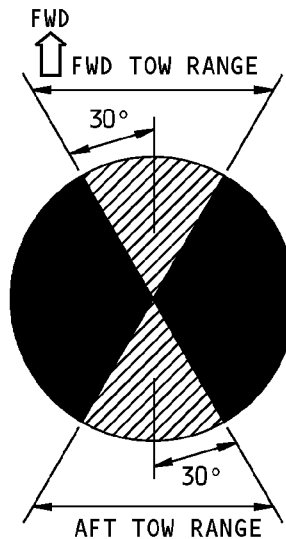
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AIRCRAFT MAINTENANCE MANUAL



NOSE GEAR TOWING ANGLES
(PLAN VIEW)



MAIN GEAR TOWING ANGLES
(PLAN VIEW)

MODEL	MAXIMUM TAXI GROSS WEIGHT LB (kg)	NOSE LANDING GEAR LOAD LB (kg)			MAIN LANDING GEAR LOAD LB (kg)(EACH)	
		FWD (±45°)	AFT (180 ±45°)	LATERAL (±90° ±45°)	FWD (±30°)	AFT (180 ±30°)
737-700	153,500 (69,628)	23,020 (10,442)	23,020 (10,442)	11,510 (5,221)	17,260 (7,829)	17,260 (7,829)

NOTE: 0° = AIRPLANE FORWARD (FWD) DIRECTION.

MAXIMUM TOWING LOADS

NOTE:

- THE MAXIMUM STEERING/TOWING ANGLE FOR PUSH BACK IS 75 DEGREES.
- FOR NOSE GEAR TOW ANGLES GREATER THAN 78 DEGREES, THE TORSION LINKS MUST BE DISCONNECTED.
- WITH TORSION LINK DISCONNECTED, NOSE GEAR TOWING ANGLE IS LIMITED TO APPROXIMATELY 90 DEGREES UNLESS NOSE GEAR TAXI LIGHT CABLE IS DISCONNECTED.
- TOWBARLESS TOWLOADS ARE 80% OF ABOVE VALUES. SEE SERVICE LETTER 737-SL-09-002 FOR DETAILS.

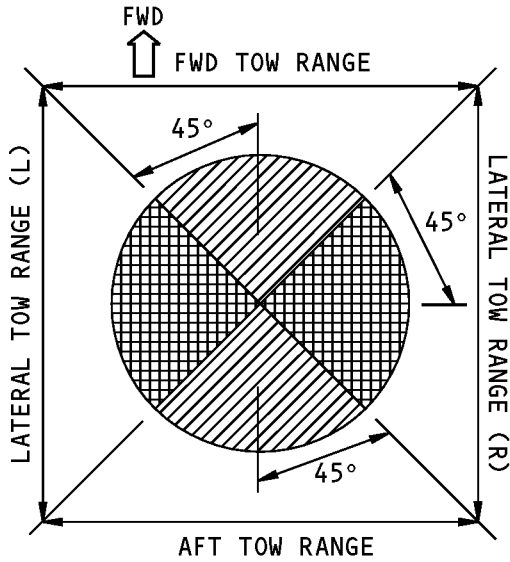
CAUTION: DEPRESSURIZE NOSE GEAR STEERING BEFORE TOWING AIRPLANE. FAILURE TO COMPLY COULD RESULT IN DAMAGE TO NOSE GEAR STEERING ACTUATOR.

Towing Loads and Turning Radius
Figure 203 (Sheet 1 of 3)/09-11-00-990-803

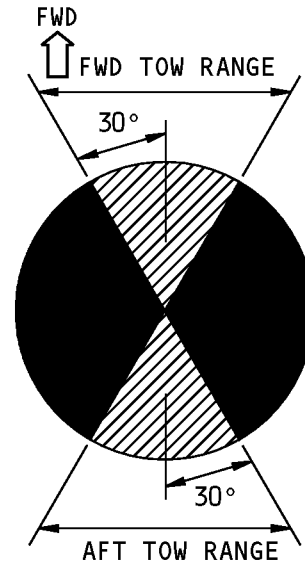
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AIRCRAFT MAINTENANCE MANUAL



**NOSE GEAR TOWING ANGLES
(PLAN VIEW)**



**MAIN GEAR TOWING ANGLES
(PLAN VIEW)**

MODEL	MAXIMUM TAXI GROSS WEIGHT LB (kg)	NOSE LANDING GEAR LOAD LB (kg)			MAIN LANDING GEAR LOAD LB (kg)(EACH)	
		FWD (±45°)	AFT (180 ±45°)	LATERAL (±90° ±45°)	FWD (±30°)	AFT (180 ±30°)
737-800	174,700 (79,244)	25,950 (11,771)	25,950 (11,771)	12,975 (5,885)	19,460 (8,827)	19,460 (8,827)

NOTE: 0° = AIRPLANE FORWARD (FWD) DIRECTION.

MAXIMUM TOWING LOADS

NOTE:

- THE MAXIMUM STEERING/TOWING ANGLE FOR PUSH BACK IS 75 DEGREES.
- FOR NOSE GEAR TOW ANGLES GREATER THAN 78 DEGREES, THE TORSION LINKS MUST BE DISCONNECTED.
- WITH TORSION LINK DISCONNECTED, NOSE GEAR TOWING ANGLE IS LIMITED TO APPROXIMATELY 90 DEGREES UNLESS NOSE GEAR TAXI LIGHT CABLE IS DISCONNECTED.
- TOWBARLESS TOWLOADS ARE 80% OF ABOVE VALUES. SEE SERVICE LETTER 737-SL-09-002 FOR DETAILS.

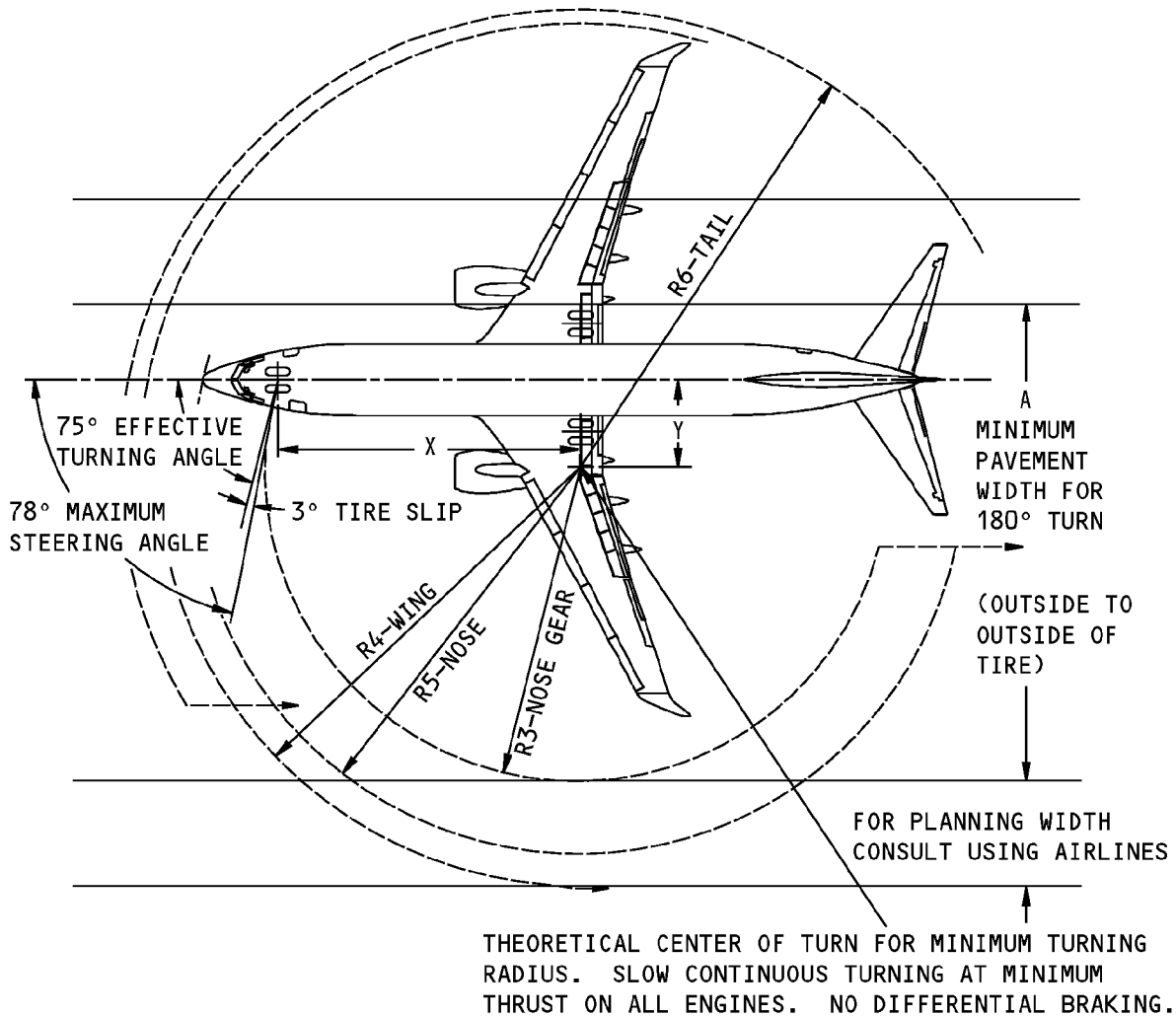
CAUTION: DEPRESSURIZE NOSE GEAR STEERING BEFORE TOWING AIRPLANE. FAILURE TO COMPLY COULD RESULT IN DAMAGE TO NOSE GEAR STEERING ACTUATOR.

**Towing Loads and Turning Radius
Figure 203 (Sheet 2 of 3)/09-11-00-990-803**

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AIRCRAFT MAINTENANCE MANUAL**



AIRPLANE MODEL	EFFECTIVE TURNING ANGLE (°)	X		Y		A		R3 NOSE GEAR		R4 WING		R5 NOSE		R6 TAIL	
		FT	M	FT	M	FT	M	FT	M	FT	M	FT	M	FT	M
737-700	75	41.3	12.6	11.1	3.4	66.4	20.3	43.8	13.3	72.6	22.1	55.9	17.0	65.5	20.0

NOTE:

- 3° TIRE SLIP ANGLE APPROXIMATE ONLY FOR 78° STEERING ANGLE.
- DIMENSIONS ROUNDED TO NEAREST 0.1 FOOT AND 0.1 METER.
- EFFECTIVE TURNING ANGLE IS 75°.

**MINIMUM TURNING RADII WITH WINGLET
3 DEGREE SLIP ANGLE**

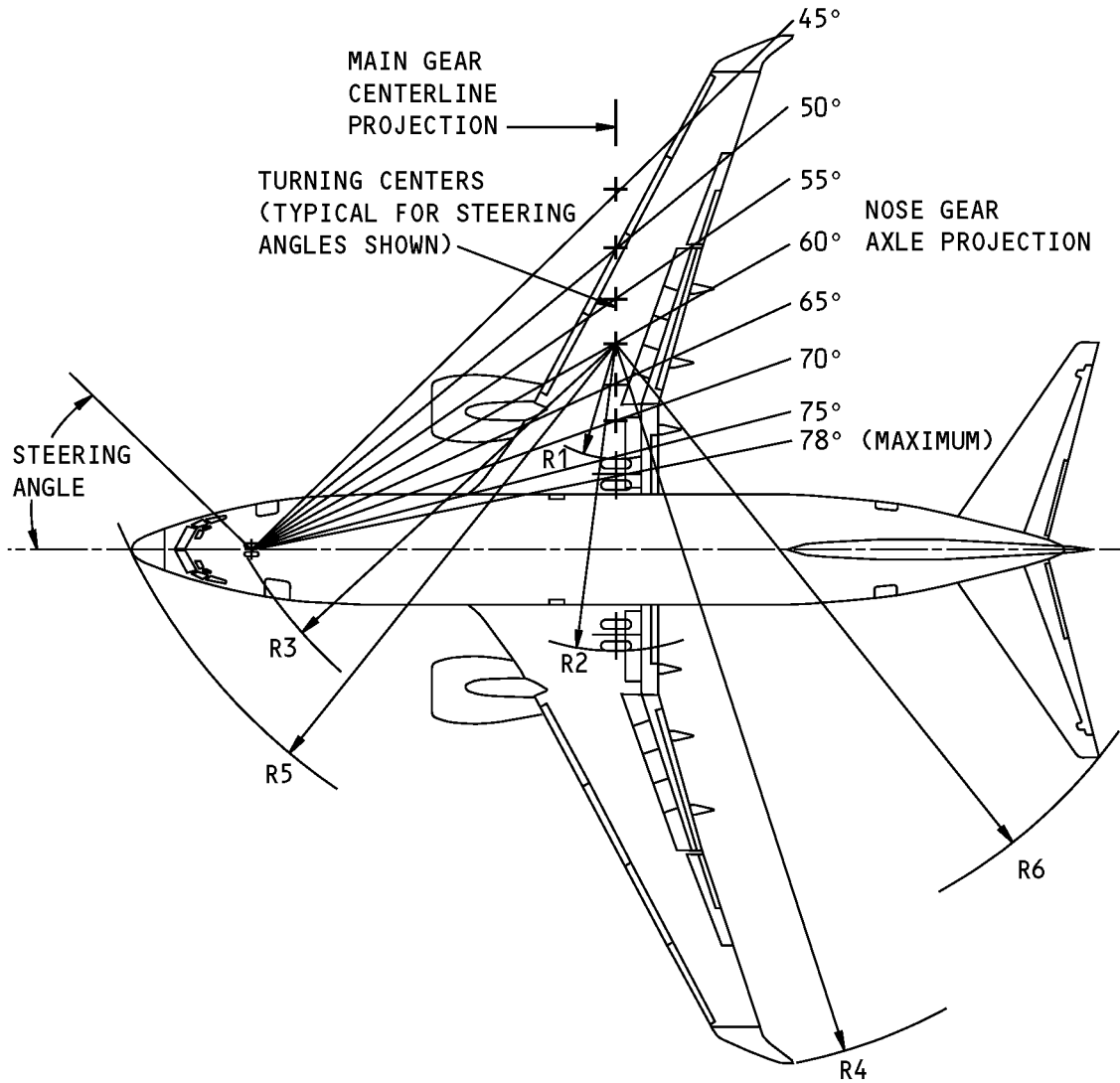
**Towing Loads and Turning Radius
Figure 203 (Sheet 3 of 3)/09-11-00-990-803**

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL**



- NOTE:**
- ACTUAL OPERATING TURNING RADII MAY BE GREATER THAN SHOWN.
 - ALL OF THE WING TIP RADII (R4) THAT ARE GIVEN ARE FOR THEORETICAL TURNS. THEORY IGNORES TIRE SCRUFFING ON A TURN, FRICTION FACTORS, ETC. ACTUAL RADII (R4) WILL BE LARGER THAN THEORETICAL NUMBERS.
 - DIMENSIONS ROUNDED TO NEAREST FOOT AND 0.1 METER.

737-700 WITH WINGLET

**Turning Radii - No Slip Angle
Figure 204 (Sheet 1 of 2)/09-11-00-990-807**

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL**

STEERING ANGLE (DEGREES)	R1 INNER GEAR		R2 OUTER GEAR		R3 NOSE GEAR		R4 WING TIP		R5 NOSE		R6 TAIL	
	FT	M	FT	M	FT	M	FT	M	FT	M	FT	M
30	59.9	18.3	83.0	25.3	83.0	25.3	131.8	40.2	90.0	27.4	110.1	33.6
35	47.4	14.4	70.5	21.5	72.5	22.1	119.4	36.4	80.4	24.5	99.5	30.3
40	37.6	11.5	60.7	18.5	64.8	19.8	109.8	33.5	73.5	22.4	91.6	27.9
45	29.7	9.1	52.8	16.1	59.0	18.0	102.0	31.1	68.5	20.9	85.5	26.0
50	23.0	7.0	46.2	14.1	54.6	16.7	95.5	29.1	64.7	19.7	80.5	24.5
55	17.3	5.3	40.4	12.3	51.2	15.6	89.9	27.4	61.8	18.8	76.5	23.3
60	12.3	3.7	35.4	10.8	48.5	14.8	85.0	25.9	59.6	18.2	73.1	22.3
65	7.7	2.3	30.8	9.4	46.4	14.2	80.5	24.5	58.0	17.7	70.2	21.4
70	3.5	1.1	26.6	8.1	44.8	13.7	76.4	23.3	56.7	17.3	67.7	20.6
78 (MAXIMUM)	-2.8	-0.8	20.3	6.2	43.1	13.1	70.4	21.5	55.4	16.9	64.4	19.6

737-700 WITH WINGLET

**Turning Radii - No Slip Angle
Figure 204 (Sheet 2 of 2)/09-11-00-990-807**

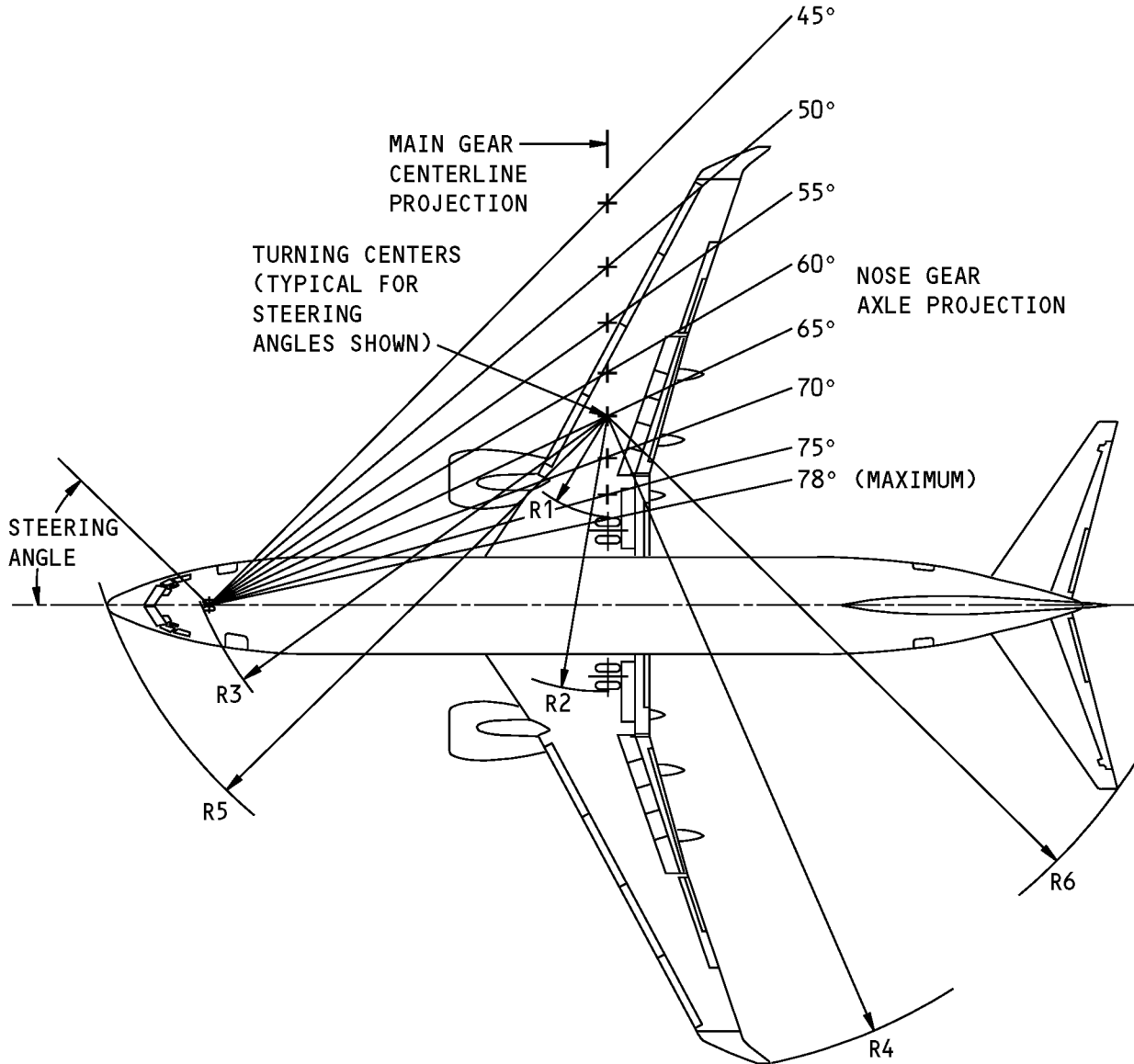
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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL**



- NOTE:**
- ACTUAL OPERATING TURNING RADII MAY BE GREATER THAN SHOWN.
 - ALL OF THE WING TIP RADII (R4) THAT ARE GIVEN ARE FOR THEORETICAL TURNS. THEORY IGNORES TIRE SCRUFFING ON A TURN, FRICTION FACTORS, ETC. ACTUAL RADII (R4) WILL BE LARGER THAN THEORETICAL NUMBERS.
 - DIMENSIONS ROUNDED TO NEAREST FOOT AND 0.1 METER.

737-800 WITH WINGLET

**Turning Radii - No Slip Angle
Figure 205 (Sheet 1 of 2)/09-11-00-990-808**

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STEERING ANGLE (DEGREES)	R1 INNER GEAR		R2 OUTER GEAR		R3 NOSE GEAR		R4 WING TIP		R5 NOSE		R6 TAIL	
	FT	M	FT	M	FT	M	FT	M	FT	M	FT	M
30	76.9	23.4	100.0	30.5	102.7	31.3	149.1	45.4	109.5	33.4	129.5	39.5
35	61.4	18.7	84.5	25.8	89.6	27.3	133.6	40.7	97.4	29.7	116.4	35.5
40	49.3	15.0	72.4	22.1	80.1	24.4	121.6	37.1	88.7	27.0	106.6	32.5
45	39.5	12.0	62.6	19.1	72.9	22.2	111.9	34.1	82.3	25.1	99.0	30.2
50	18.2	9.5	54.4	16.6	67.4	20.6	103.8	31.6	77.4	23.6	93.0	28.3
55	24.2	7.4	47.3	14.4	63.2	19.3	96.8	29.5	73.8	22.5	88.0	26.8
60	17.9	5.3	41.0	12.5	59.8	18.3	90.6	27.6	70.9	21.6	83.9	25.6
65	12.3	3.7	35.4	10.8	57.3	17.5	85.1	25.9	68.8	21.0	80.4	24.5
70	7.0	2.1	30.1	9.2	55.3	16.9	80.0	24.4	67.1	20.5	77.5	23.6
78 (MAXIMUM)	-0.7	-0.2	22.4	6.8	53.2	16.2	72.5	22.1	65.4	19.9	73.6	22.4

737-800 WITH WINGLET

**Turning Radii - No Slip Angle
Figure 205 (Sheet 2 of 2)/09-11-00-990-808**

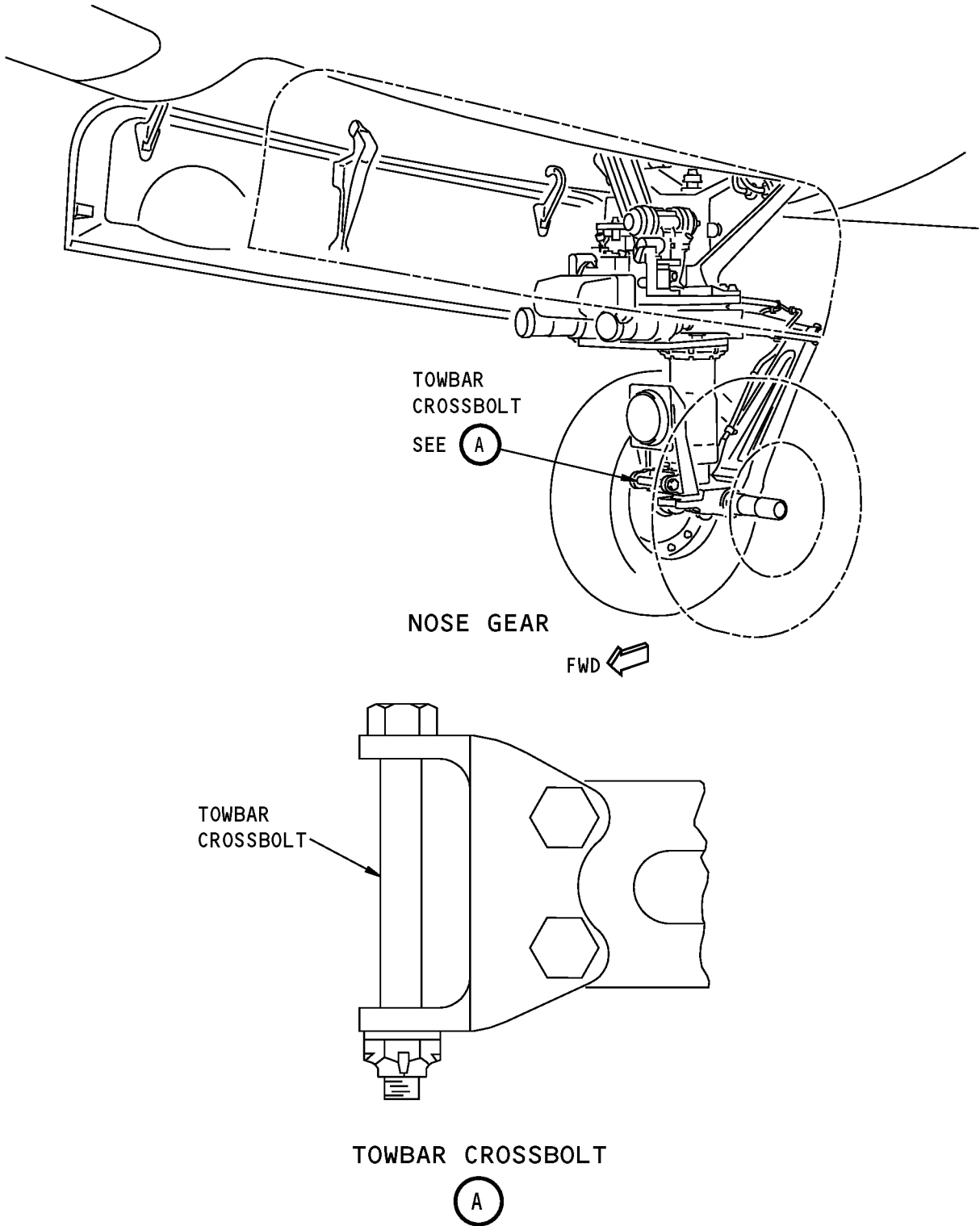
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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL**



**Airplane Towbar Attach Point
Figure 206/09-11-00-990-805**

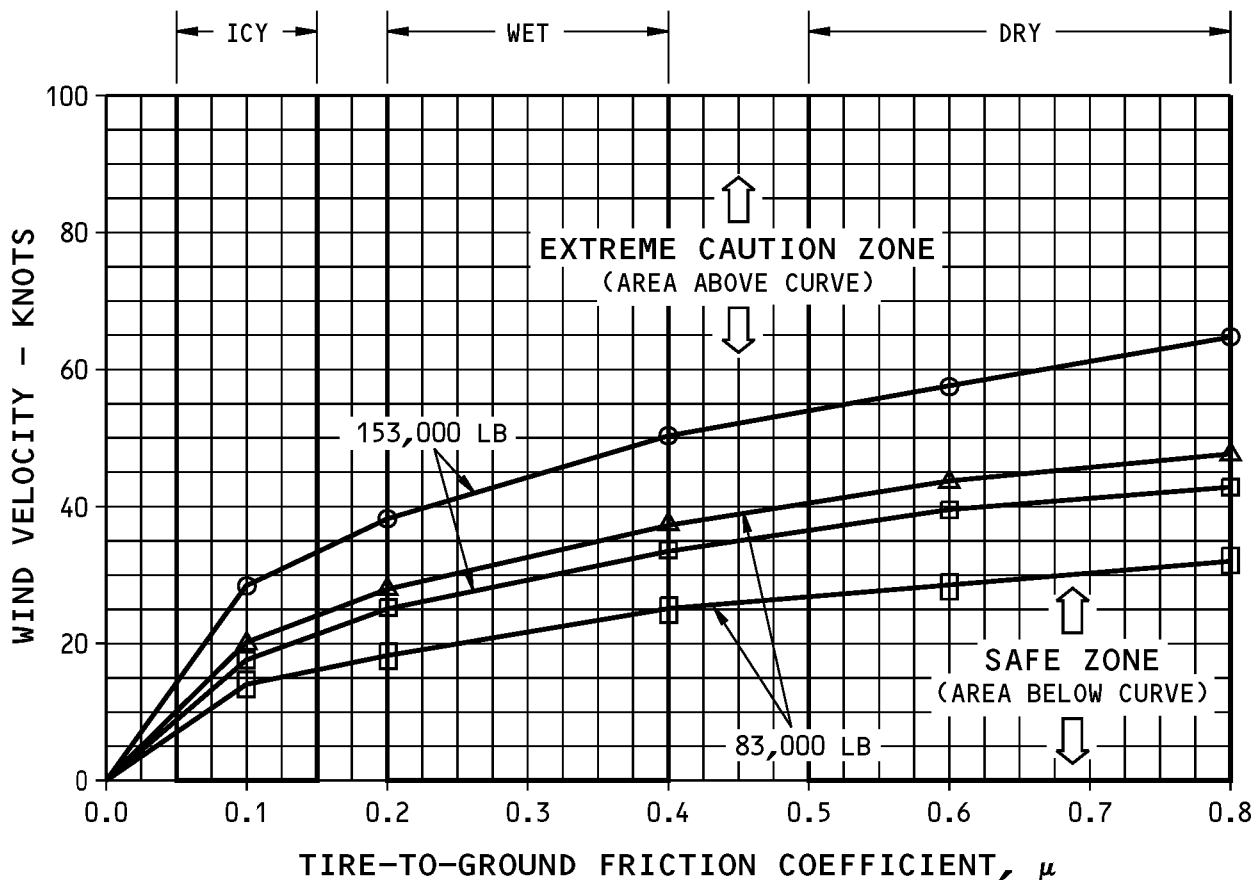
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AIRCRAFT MAINTENANCE MANUAL



	WEIGHT (LB)	CG (%MAC)	
○	153,000	0.09	—— TOWING
□	153,000	0.33	
△	83,000	0.09	
□	83,000	0.33	

- NOTE:**
- FLAPS UP, STAB = 4 PILOT UNITS (HORIZONTAL)
 - WIND FROM ANY DIRECTION
 - WIND GUST SHOULD BE ADDED TO STEADY WIND VELOCITY FOR MAXIMUM WIND SPEED
 - USE ACTUAL AIRPLANE WEIGHT, CG POSITION, AND TIRE-TO-GROUND FRICTION COEFFICIENT FOR INTERPOLATION
 - IF NO MEASURED VALUE FOR TIRE-TO-GROUND FRICTION COEFFICIENT IS AVAILABLE, USE THE LOWER LIMIT OF THE APPROPRIATE BOUNDED FRICTION BAND
 - FOR TOWING AND MANEUVERING IN CLOSE PROXIMITY TO BUILDINGS OR OTHER AIRPLANES, THE ALLOWABLE WIND VELOCITY SHOULD BE REDUCED BY ONE THIRD
 - REDUCE WIND SPEED LIMITS TO ACCOUNT FOR OPERATIONAL CONSIDERATIONS SUCH AS HIGH SPEED TOWING OR CONTAMINATED TIRES OR RUNWAYS
 - BASED ON ZERO PERCENT GROUND SLOPE

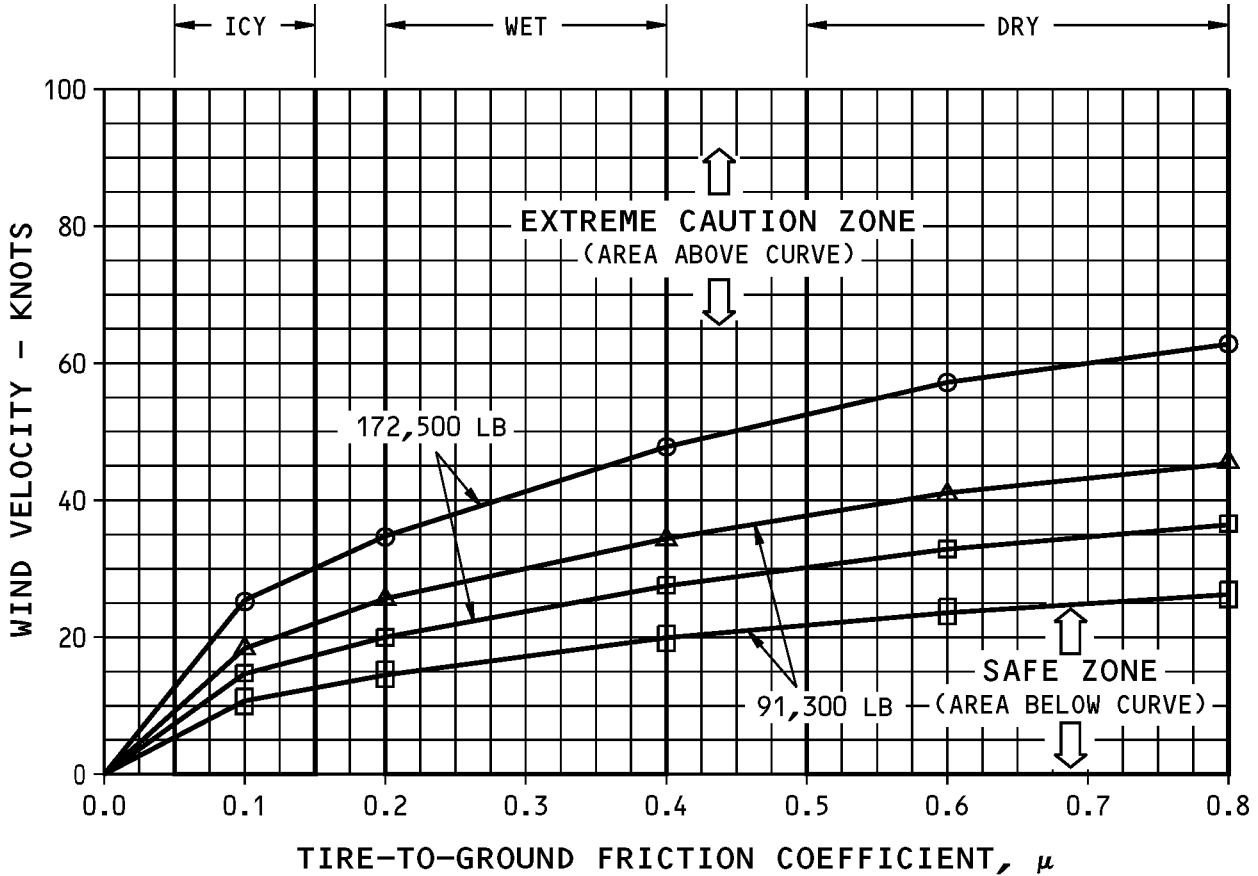
737-700 MAXIMUM WINDS FOR TOWING

Wind Velocity During Towing
Figure 207/09-11-00-990-816

EFFECTIVITY
HAP 101-999

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AIRCRAFT MAINTENANCE MANUAL



TIRE-TO-GROUND FRICTION COEFFICIENT, μ

WEIGHT (LB)	CG (%MAC)	
○ 172,500	0.06	—— TOWING
□ 172,500	0.36	
△ 91,300	0.06	
◻ 91,300	0.36	

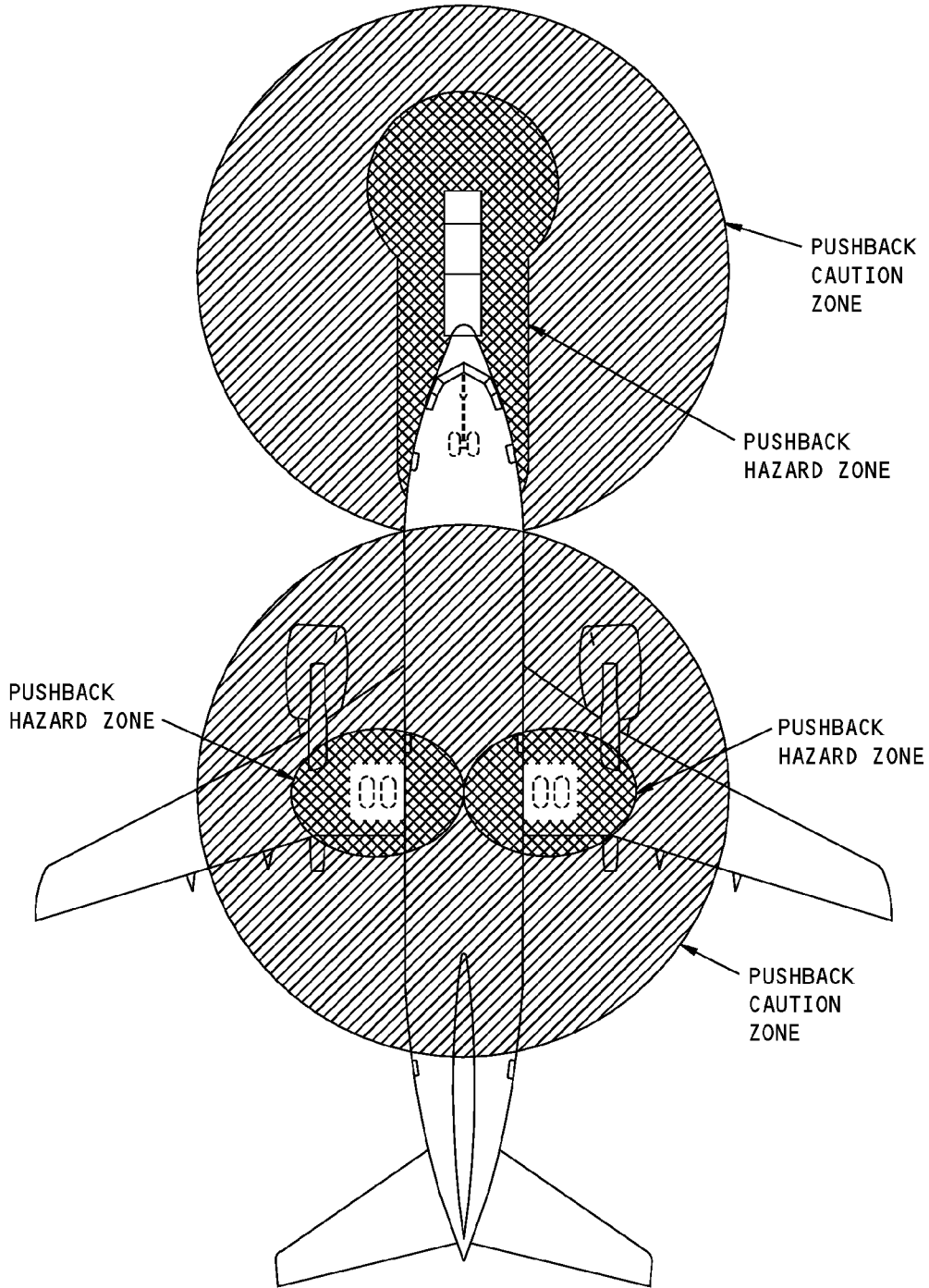
- NOTE:**
- FLAPS UP, STAB = 4 PILOT UNITS (HORIZONTAL)
 - WIND FROM ANY DIRECTION
 - WIND GUST SHOULD BE ADDED TO STEADY WIND VELOCITY FOR MAXIMUM WIND SPEED
 - USE ACTUAL AIRPLANE WEIGHT, CG POSITION, AND TIRE-TO-GROUND FRICTION COEFFICIENT FOR INTERPOLATION
 - IF NO MEASURED VALUE FOR TIRE-TO-GROUND FRICTION COEFFICIENT IS AVAILABLE, USE THE LOWER LIMIT OF THE APPROPRIATE BOUNDED FRICTION BAND
 - FOR TOWING AND MANEUVERING IN CLOSE PROXIMITY TO BUILDINGS OR OTHER AIRPLANES, THE ALLOWABLE WIND VELOCITY SHOULD BE REDUCED BY ONE THIRD
 - REDUCE WIND SPEED LIMITS TO ACCOUNT FOR OPERATIONAL CONSIDERATIONS SUCH AS HIGH SPEED TOWING OR CONTAMINATED TIRES OR RUNWAYS
 - BASED ON ZERO PERCENT GROUND SLOPE

737-800 MAXIMUM WINDS FOR TOWING

**Wind Velocity During Towing
Figure 208/09-11-00-990-818**

EFFECTIVITY
HAP 001-013, 015-026, 028-054

09-11-00



WARNING: MAINTAIN A MINIMUM OF TEN FEET (3 METERS) SEPARATION BETWEEN PERSONS ON THE GROUND, AND THE NOSE WHEELS, THE TOW BAR AND TOW VEHICLE, AND THE MAIN WHEELS WHILE THE AIRPLANE IS MOVING.

Towing Hazard Zones
Figure 209/09-11-00-990-811

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AIRCRAFT MAINTENANCE MANUAL

TOW THE AIRPLANE WITH FLAT TIRES - MAINTENANCE PRACTICES

1. General

A. This procedure has a task to tow the airplane with flat tires.

NOTE: If it is possible, replace the flat tires before you move the airplane.

TASK 09-11-04-580-801

2. Tow the Airplane with Flat Tire(s)

A. General

CAUTION: DO NOT USE THE NOSE WHEEL TO TOW THE AIRPLANE IF THERE IS MORE THAN ONE FLAT TIRE ON EACH LANDING GEAR. YOU CAN PUT TOO MUCH FORCE ON THE NOSE LANDING GEAR IF YOU TOW THE AIRPLANE WITH MORE THAN ONE FLAT TIRE ON EACH GEAR. THIS CAN CAUSE DAMAGE TO THE NOSE LANDING GEAR.

- (1) You can use the nose wheel to tow the airplane if there is only one flat tire on each landing gear, do this task: (Towing, TASK 09-11-00-580-801).
- (2) When there is more than one flat tire per landing gear, replace the flat tires with serviceable tires before the airplane is towed at the nose wheel.
 - (a) Do not turn the airplane quickly.
 - (b) Move the airplane slowly to minimize further damage to the flat tire or to the wheel, do this task: (Towing, TASK 09-11-00-580-801).
 - (c) Alternatively, you can attach cables to each main landing gear to tow the airplane.
- (3) Do not use Towbarless Towing if one or two nose landing gear tires are flat.

B. References

Reference	Title
09-11-00-580-801	Towing (P/B 201)
29-11-00-860-801	Hydraulic System A or B Pressurization (P/B 201)
29-11-00-860-805	Hydraulic System A or B Power Removal (P/B 201)

C. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-1498	Eyebolt - Towing, Main Gear (737 Classic and NG) (Part #: F72719-500, Supplier: 81205, A/P Effectivity: 737-ALL)

D. Location Zones

Zone	Area
700	Landing Gear and Landing Gear Doors

E. Tow the Airplane with One Flat Tire on Each Landing Gear

SUBTASK 09-11-04-580-001

- (1) To tow the airplane with one flat tire on each landing gear, do the steps that follow:
 - (a) Do the normal towing procedure to tow the airplane safely, do this task: (Towing, TASK 09-11-00-580-801).
 - (b) Keep the tow speeds to a minimum.

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(c) Prevent sharp turns when you tow the airplane.

F. Tow the Airplane with More Than One Flat Tire on Each Landing Gear

SUBTASK 09-11-04-480-001

CAUTION: DO NOT USE THE NOSE WHEEL TO TOW THE AIRPLANE IF THERE IS MORE THAN ONE FLAT TIRE ON EACH LANDING GEAR. YOU CAN PUT TOO MUCH FORCE ON THE NOSE LANDING GEAR IF YOU TOW THE AIRPLANE WITH MORE THAN ONE FLAT TIRE ON EACH GEAR. THIS CAN CAUSE DAMAGE TO THE NOSE LANDING GEAR.

(1) Install the main gear towing eyebolt assembly on each main landing gear eyebolt, SPL-1498.

NOTE: It is possible some electrical brackets will have to be removed when you tow the airplane in the aft direction from the main landing gear.

(a) Make sure the eye points in the direction you want to tow the airplane.

SUBTASK 09-11-04-420-001

(2) Attach the cables between the eyebolts and the vehicle you use to tow the airplane.

SUBTASK 09-11-04-780-001

(3) Put pressure in hydraulic system A, do this task: (Hydraulic System A or B Pressurization, TASK 29-11-00-860-801).

NOTE: This makes it possible to steer and stop the airplane. When you pull the airplane, you can steer the airplane with an unequal pull of the tow vehicles and/or the airplanes ground steering system. You can only stop the airplane with its brakes.

SUBTASK 09-11-04-580-002

(4) Pull the airplane with the tow vehicle(s).

(a) Make sure the angle does not exceed ± 30 degrees on the cables.

(b) Have a person who can see both the flight deck and the tow vehicles control the movement of the airplane.

G. Put the Airplane Back to Its Usual Condition

SUBTASK 09-11-04-840-001

(1) Remove the hydraulic power, do this task: (Hydraulic System A or B Power Removal, TASK 29-11-00-860-805).

SUBTASK 09-11-04-080-001

(2) Remove the main gear towing eyebolt assembly from each main landing gear.

————— **END OF TASK** —————

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TAXI THE AIRPLANE - MAINTENANCE PRACTICES

1. General

A. This procedure has the instructions to taxi the airplane for maintenance.

- (1) Refer to the Operations Manual to taxi the airplane for revenue service.

TASK 09-20-00-580-801

2. Taxi the Airplane

(Figure 201, Figure 202)

A. General

(1) Taxi Safety

(a) When you taxi an airplane, caution and precision are necessary.

- 1) The taxi procedure must be done only by persons that are trained to taxi the airplane.

(b) The taxi path must be clear of all persons and vehicles.

(c) You must get approval from the airport ground control to taxi the airplane.

- 1) This will prevent interference with other airport operations.

(d) You must keep clearance from the buildings and the other airplanes, at all times.

(e) You must have electrical power to operate:

NOTE: This is necessary to taxi the airplane safely.

- 1) the taxi lights
- 2) the navigation lights
- 3) the radio and intercom equipment
- 4) other necessary systems.

(f) The applicable airplane hydraulic systems must be pressurized to supply hydraulic pressure.

NOTE: This is for the airplane brakes and the nose wheel steering systems.

(g) When you taxi the airplane at night or in bad weather conditions, the crew must know the area around the airplane.

- 1) They must know the location of parked vehicles, maintenance stands, and the condition of the pavement surface.

(h) A taxi checklist is necessary to help the crew have a safe taxi operation.

(2) Maintenance Persons Necessary to Taxi the Airplane

(a) The persons necessary for a safe taxi operations must include a flight compartment crew and a ground crew.

(b) There must be a minimum of two flight compartment persons (One taxi approved person and one observer).

- 1) One flight compartment person must be trained in all of the procedures that follow, for the taxi operations:

NOTE: It is not necessary for the observer to be taxi approved.

- a) Correct procedure to prepare the flight compartment
- b) The engine start, operation, and shutdown procedures
- c) The engine fire and emergency procedures

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- d) The radio and intercom operation and procedures
- e) The taxi procedures (turning, wing tip clearances, taxi speeds, etc)
- (c) One or two ground crew persons are necessary to do the tasks that follow:
 - NOTE:** In areas of congestion or a limit of space (hangers, ramp areas next to the terminal, airplane parking areas, etc.) more ground persons are necessary. This is to help monitor the wing clearances and to be general observers.
 - 1) To remove and replace the wheel chocks
 - 2) To help during the engine start
 - 3) To help the flight compartment crew during the airplane movement
 - 4) To make sure the airplane taxi path is clear.
- (3) Communications
 - (a) Most areas around the airplane are out of the field of view permitted by the flight compartment windows.
 - 1) Also, it is hard to see much of the ground operations work near the airplane from the flight compartment crew.
 - (b) There must be communication between the airplane and the ground crew.
 - 1) This is necessary during the engine start, removal and replacement of wheel chocks, and during the engine shutdown.
 - (c) To have a safe taxi operation you must use hand signals, lights, intercom and/or radio communication.
 - (d) The communications with the ground control authority is also necessary for taxi operations.
 - 1) This will make sure that the persons in the tower know of the taxi operation.
 - 2) This will also make sure the control tower knows the path that the airplane will follow.
- (4) Taxi the Airplane
 - (a) When you taxi the airplane on the ground, the movement is equivalent to other conventional tricycle geared airplanes.
 - 1) The nose wheel steering, and the engine thrust are used as necessary, to taxi the airplane.
 - (b) Airplane ground stability.
 - 1) During the airplane taxi, the center of gravity (CG) must always be below the Ground Stability Limits line, see, do this task: (Towing, TASK 09-11-00-580-801), (Figure 201)
 - 2) Find the airplane center of gravity (CG) for the applicable airplane configuration.
 - a) Use component weight and CG data, and the procedures to calculate them, in the approved weight and balance manuals.
 - (c) Airplane clearance during the taxi.
 - 1) Make sure you have the necessary clearance when you go near a parked airplane or other structures.
 - 2) When the APU in the taxi airplane or the parked airplane is on, you must have a minimum clearance of 32.8 feet (10 meters).
 - a) The clearance must be between the APU exhaust port and the adjacent airplane's wingtip (fuel vent).
 - (d) Airplane taxi speed.

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- 1) The taxi speed must not be more than approximately 20 knots.
 - a) Speeds more than this, added to long taxi distances will cause heat to collect in the tires.
 - 2) Before you make a turn, decrease the speed of the airplane to a speed which is applicable to the local conditions.
 - a) On a dry surface, use a speed of approximately 8 to 12 knots.
- (e) Airplane turns during taxi.
- 1) Always use the largest turn radius possible.
 - 2) Do not try to turn the airplane until it has started to moved.
 - 3) Make sure you know the taxi turn radii, see, do this task: (Towing, TASK 09-11-00-580-801, Figure 202)
 - a) Monitor the wingtips and the horizontal stabilizer carefully for clearance with buildings, equipment, and other airplanes.
 - 4) Make all turns at a slow taxi speed to prevent tire skids.
 - 5) When a left or right engine is used to help make a turn, use only the minimum power possible.
 - 6) Do not let the airplane stop during a turn.
 - 7) Do not use the brakes to help during a turn.

NOTE: See the paragraph on airplane taxi in bad weather conditions about differential braking.

- a) Decrease the speed of the airplane with the brakes when it is necessary, before the turn is started.
 - b) Make a minimum radius turn with maximum nose wheel steering, and the engine thrust only.
 - c) When you use the brakes during a turn, they will cause the main and nose landing gear tires to wear.
- 8) When it is possible, complete the taxi in a straight line roll for a minimum of 12 feet (4 meters).

NOTE: This will remove the torsional stresses in the landing gear components, and in the tires.

- (f) Airplane taxi in bad weather conditions.
- 1) You must know the conditions of the taxi surface, and reduce the taxi speeds when you taxi in bad weather conditions.
 - 2) If the taxi surface has snow, slush, or ice on it, be very careful.
 - 3) Taxi the airplane with the flaps up.
 - 4) Use the differential engine thrust when you taxi the airplane on a slick surface at decreased speeds.
- NOTE: This will help to keep airplane movement through a turn.
- 5) A light differential braking can have more of an effect than nose wheel steering, on very slick surfaces.

- (5) Airplane Characteristics, see figures (Figure 201, Figure 202), and, do this task: Towing, TASK 09-11-00-580-801.

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- (a) The minimum turn radius that the airplane can make is shown in, do this task: (Towing, TASK 09-11-00-580-801, Figure 202)

NOTE: The wingtips and the horizontal stabilizer move in larger arcs during a turn than the nose of the airplane. You must monitor these areas of the airplane carefully for clearance with buildings, equipment, and other airplanes.

- (b) The basic factors that can change the diameter of a turn are as follows:

- 1) the nose wheel steering angle
- 2) the engine power
- 3) the center of gravity of the airplane
- 4) the airplane gross weight
- 5) the taxi surface conditions
- 6) the airplane ground speed
- 7) the differential braking that you use.

- (c) Engine operation.

WARNING: YOU MUST FOLLOW ALL PRECAUTIONS WHEN YOU OPERATE THE JET ENGINES. INJURY TO PERSONS OR DAMAGE TO BUILDINGS, EQUIPMENT, OR OTHER AIRPLANES CAN OCCUR.

- 1) To find the dangerous areas at engine idle and at the engine breakaway thrust see (Figure 201), and, do this task: (Engine Ground Safety Precautions, TASK 71-00-00-800-805-F00).

- a) All persons must keep away from the two engine inlet and exhaust areas.
- b) Hot, high velocity gases come out of the exhaust nozzles of the engine.

NOTE: The velocity of the engine fan air, specially at high thrust positions, is sufficient to cause injury or death to persons.

- 2) When the thrust reverser is in the reverse position, the high velocity fan air will come out and move forward.

- a) When this occurs, the hot, high velocity engine exhaust gases will continue to come out rearwards.

- (d) To find the angles of view from the flight compartment, for a person in the left seat, see (Figure 202, Figure 203).

NOTE: This is when the pilot or first officer's seat is in the correct position to operate the rudder and brake pedals.

B. References

Reference	Title
09-11-00-580-801	Towing (P/B 201)
12-15-31-610-802	Main Landing Gear Shock Strut Servicing (P/B 301)
12-15-41-610-802	Nose Landing Gear Shock Strut Servicing (P/B 301)
24-22-00-860-811	Supply Electrical Power (P/B 201)
29-11-00-860-801	Hydraulic System A or B Pressurization (P/B 201)
71-00-00-800-805-F00	Engine Ground Safety Precautions (P/B 201)

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C. Location Zones

Zone	Area
211	Flight Compartment - Left
212	Flight Compartment - Right

D. Prepare to Taxi the Airplane

SUBTASK 09-20-00-580-001

(1) To prepare to taxi the airplane, you must do the steps that follow:

NOTE: These steps are only minimum procedures.

- (a) Use a taxi checklist applicable to your operation.
- (b) Examine the external areas of the airplane.
 - 1) Make sure that the wheel chocks are in the correct position.

NOTE: If the ramp does not slope: Move the aft NLG chocks away from the tires. During the refuel, the NLG tires roll aft as the MLG shock absorber compresses. Make sure that the chocks do not touch the MLG tires. The weight of the fuel can lower the aircraft and cause the tires to catch the chocks.

NOTE: If the ramp slopes: Make sure that the chocks down from the tires touch the NLG and MLG tires. - make sure that the chocks up from the tires do not touch the NLG and MLG tires.

- 2) Make sure that all engine cowl, doors, and hatches are in a latched/locked position or restrained from swinging by some other means.
- (c) Make sure that all engine inlets and exhausts are clear.
- (d) Make sure that the flight control surfaces are clear and will not touch the ground equipment.
- (e) Make sure that the tires are in a satisfactory condition.

CAUTION: DO NOT TAXI THE AIRPLANE WITH THE SHOCK STRUTS OF THE MAIN LANDING GEAR FULLY COMPRESSED. DAMAGE TO THE SHOCK STRUTS CAN OCCUR.

- (f) Make sure that the shock struts of the main landing gear are filled correctly, do this task: (Main Landing Gear Shock Strut Servicing, TASK 12-15-31-610-802).

CAUTION: DO NOT TAXI THE AIRPLANE WITH THE SHOCK STRUT OF THE NOSE LANDING GEAR FULLY COMPRESSED. DAMAGE TO THE SHOCK STRUT CAN OCCUR.

- (g) Make sure that the shock strut of the nose landing gear is filled correctly, do this task: (Nose Landing Gear Shock Strut Servicing, TASK 12-15-41-610-802).

CAUTION: DO NOT LET THE SHOCK STRUT OF THE NOSE LANDING GEAR EXTEND MORE THAN THE MAXIMUM PERMITTED EXTENSION OF 10 INCHES (25.4 CENTIMETERS). AN EXTENSION MORE THAN 10 INCHES (25.4 CENTIMETERS) CAN CAUSE THE CENTERING CAM TO ENGAGE AND CAUSE DAMAGE TO THE SHOCK STRUT DURING A TURN. ALSO, THIS IS TO DEEP A FORWARD CENTER OF GRAVITY TO MAKE SURE THE AIRPLANE DOES NOT FALL ON ITS TAIL. IF YOU DO NOT FOLLOW THESE INSTRUCTIONS, DAMAGE TO THE AIRPLANE CAN OCCUR.

- (h) Make sure the shock strut of the nose landing gear does not show more than 10 inches (25.4 centimeters) of chrome surface.

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- (i) Make sure that the towing lever on the nose landing gear is in the NORMAL position.
- (j) Make sure the flight compartment seats are adjusted as follows:
 - 1) To give the correct view from the flight compartment windows.
 - 2) To give the correct position to operate the rudder and brake pedals.
- (k) Make sure that all airplane systems are prepared to have electrical power safely put on the airplane.
- (l) Put electrical power on the airplane, do this task: (Supply Electrical Power, TASK 24-22-00-860-811).

CAUTION: A MINIMUM OF 1675 POUNDS (760 KILOGRAMS) OF FUEL IS NECESSARY IN NO. 1 AND 2 FUEL TANKS TO GIVE COOLING TO THE HYDRAULIC FLUID. WHEN SUFFICIENT FUEL IS NOT IN THE FUEL TANKS, THE HYDRAULIC FLUID WILL BECOME TOO HOT.

- (m) Make sure that the fuel quantity indicator on the upper center display unit shows a minimum of 1675 pounds (760 kilograms) of fuel.

NOTE: Also increase the quantity of fuel over the minimum to that necessary for the engine start and taxi operations.

- (n) Make sure that the hydraulic systems are pressurized for the brake and nose wheel steering operations, do this task: (Hydraulic System A or B Pressurization, TASK 29-11-00-860-801).

NOTE: Hydraulic power for the brakes comes from hydraulic system B. Hydraulic system A gives automatic backup when system B does not operate. If all hydraulic systems do not operate, the airplane must not be taxied. But, if all hydraulic systems stop during the taxi, the brakes will be operated through the brake accumulator.

Fully charged accumulators are capable of approximately six brake applications.

The nose wheel steering gets power from the hydraulic System A. Backup power for steering comes from Hydraulic System B. The landing gear control lever must be in the DN position to use the nose wheel steering system.

- (o) Make sure that the landing gear control lever is in the DN position.
- (p) Make sure that the VHF radio is on and set to the correct frequency.

NOTE: This is for radio communications with the authority for the airport ground control.

WARNING: DO NOT CONNECT A HEADSET AND DO NOT TOUCH CONNECTIONS TO THE AIRPLANE DURING ATMOSPHERIC ELECTRICAL ACTIVITY OR STRONG RADIATIVE FIELDS. LIGHTNING STRIKE AND HIGH DISCHARGE CURRENTS CAN CAUSE SEVERE INJURY.

- (q) Make sure that the service interphone and the hand radios operate, and the ground crew can hear you.
- (r) Check for a fuel imbalance condition and adjust the current fuel loading as appropriate.
 - 1) The fuel imbalance between the main wing tanks must not exceed 1000 lb (454 kg).

E. Taxi the Airplane

SUBTASK 09-20-00-580-002

- (1) To taxi the airplane, do the steps that follow:
 - (a) Get the necessary approval from the airport ground control to start the engine.

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- (b) Make sure that the parking brake is set.
- (c) Tell the ground crew to remove the wheel chocks, and the static electrical ground wire (as necessary).
- (d) Make sure that the beacon light that turns, is on.

NOTE: The beacon light must be on while the engines are on.

WARNING: STAY AWAY FROM THE ENGINE INLET, AND THE EXHAUST AREAS WHILE THE ENGINE OPERATES. INJURIES TO PERSONNEL CAN OCCUR.

- (e) Obey these precautions before starting the engines:
 - 1) To find the dangerous areas at engine idle and at the engine breakaway thrust, see Figure 201, and, do this task: Engine Ground Safety Precautions, TASK 71-00-00-800-805-F00.
 - 2) All persons must keep away from the two engine inlet and exhaust areas.

(f) Start the engines.

(g) Make sure that the navigation lights are on.

NOTE: The navigation lights must be on during movement of the airplane.

- (h) When the airplane is prepared to taxi, get approval to taxi from the airport ground control.
- (i) When the ground crew gives the signal, release the brakes and start to taxi the airplane.
 - 1) Supply engine power smoothly to start the airplane in forward movement.
 - 2) Put the engines back to idle power when the airplane starts to move.

(j) Make sure the airplane moves, forward in a straight line before a turn is started.

(k) Turn the airplane with the tiller, or the rudder pedals for the nose wheel steering.

NOTE: You will get approximately 78 +/-2 degrees of nose wheel steering when the tiller for the nose wheel steering is turned to its maximum. You will get approximately 7 degrees of nose wheel steering through maximum movement of the rudder pedals.

(l) Talk to the ground crew during a turn to make sure the airplane has the necessary clearance.

- 1) Make sure the airplane stays clear of all equipment, buildings, and airplanes.
 - a) Use the service interphone or the hand radios.

(m) When the taxi surface has taxi lines available, taxi the airplane with the nose wheel on the line.

CAUTION: DO NOT USE THE BRAKES CONTINUOUSLY TO KEEP THE NECESSARY TAXI SPEED. IF YOU USE THE BRAKES WITHOUT SUFFICIENT TIME FOR THEM TO COOL, YOU CAN CAUSE THE BRAKES TO BECOME TOO HOT. THIS CAN CAUSE BRAKE DAMAGE OR THE TIRE INFLATION PRESSURE TO DECREASE BECAUSE A WHEEL-THERMAL-FUSE PLUG MELTED.

- (n) Taxi the airplane slowly with the engines at minimum power.
 - 1) Use the Air Data Inertial Reference System (ADIRS) to monitor the taxi speed.
 - 2) If the airplane taxi speed is too fast (with the engines at idle), operate the brakes slowly and smoothly for a short time.

NOTE: This will decrease the taxi speed.

- a) If the taxi speed increases again, operate the brakes as you did in the step before.

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- (o) Always use the largest radius possible when you turn the airplane.

NOTE: This will decrease landing gear side loads, and the tire wear will be decreased.

- 1) Make sure that the airplane continues to move while a turn is made.
- 2) Do not stop during a turn.

- (p) When it is possible, complete the taxi in a straight line roll for a minimum of 12 feet (4 meters).

NOTE: This will remove the torsional stresses in the landing gear components, and in the tires.

- (q) Operate the brakes to stop the airplane.

- (r) Set the parking brake after the airplane has stopped.

- (s) Use the airline checklist to deactivate, and to shutdown the applicable airplane systems.

- (t) Tell the ground crew to install the wheel chocks, and to install the static electrical ground wire.

NOTE: If the ramp does not slope: Move the aft NLG chocks away from the tires. During the refuel, the NLG tires roll aft as the MLG shock absorber compresses. Make sure that the chocks do not touch the MLG tires. The weight of the fuel can lower the aircraft and cause the tires to catch the chocks.

NOTE: If the ramp slopes: Make sure that the chocks down from the tires touch the NLG and MLG tires. - make sure that the chocks up from the tires do not touch the NLG and MLG tires.

- (u) Release the parking brake after the wheel chocks are installed (optional).

————— **END OF TASK** —————

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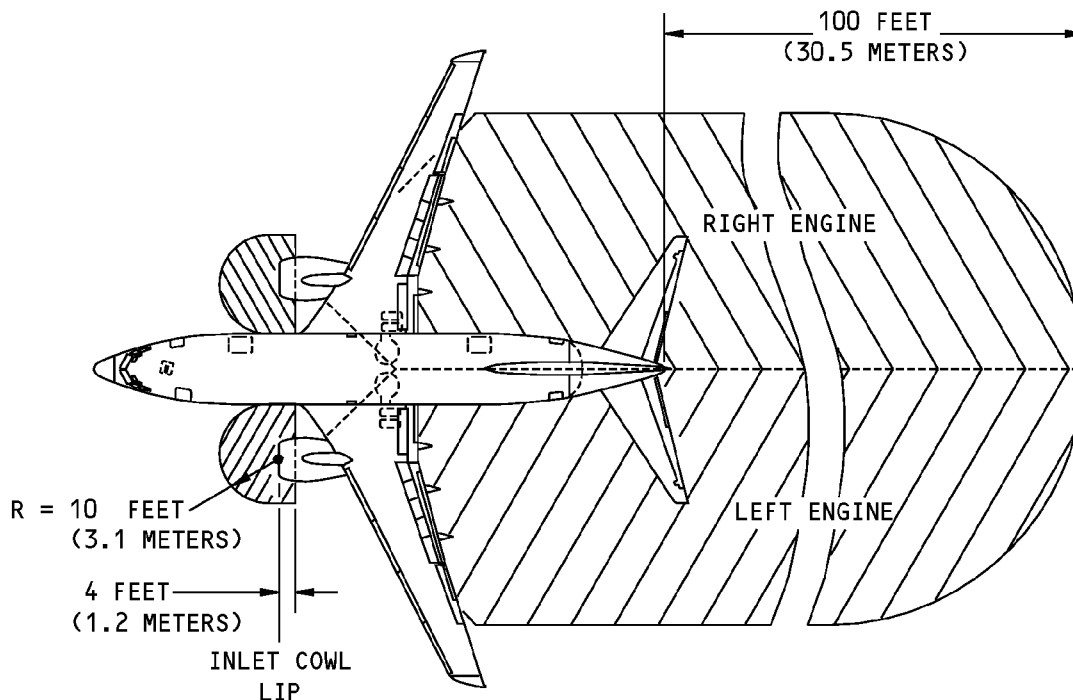
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WARNING: KEEP ALL PERSONS OUT OF THE DANGEROUS AREA DURING ENGINE OPERATION. IF THE SURFACE WIND IS MORE THAN 25 KNOTS, INCREASE THE DANGEROUS AREA AT THE ENGINE INLET BY 20 PERCENT.

CLEAN THE RAMP IF THERE IS SNOW, ICE, WATER, OIL OR OTHER CONTAMINATION ON THE RAMP. YOU CAN ALSO MOVE AIRPLANE TO A LOCATION THAT IS CLEAN.

MAKE SURE THAT ALL PERSONS ARE SAFE BEFORE YOU START THE ENGINE.

MAKE SURE THE PERSONS IN THE FLIGHT COMPARTMENT CAN SPEAK TO ALL PERSONS NEAR THE DANGEROUS AREA DURING ENGINE OPERATION.

OBEY ALL OF THE GROUND SAFETY PRECAUTIONS FOR THE ENGINES.

THE ENGINES CAN PULL PERSONS OR UNWANTED MATERIALS INTO THEM AND CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

**IDLE POWER
(FORWARD THRUST)**

**Engine Inlet and Exhaust Hazard Areas
Figure 201 (Sheet 1 of 4)/09-20-00-990-801**

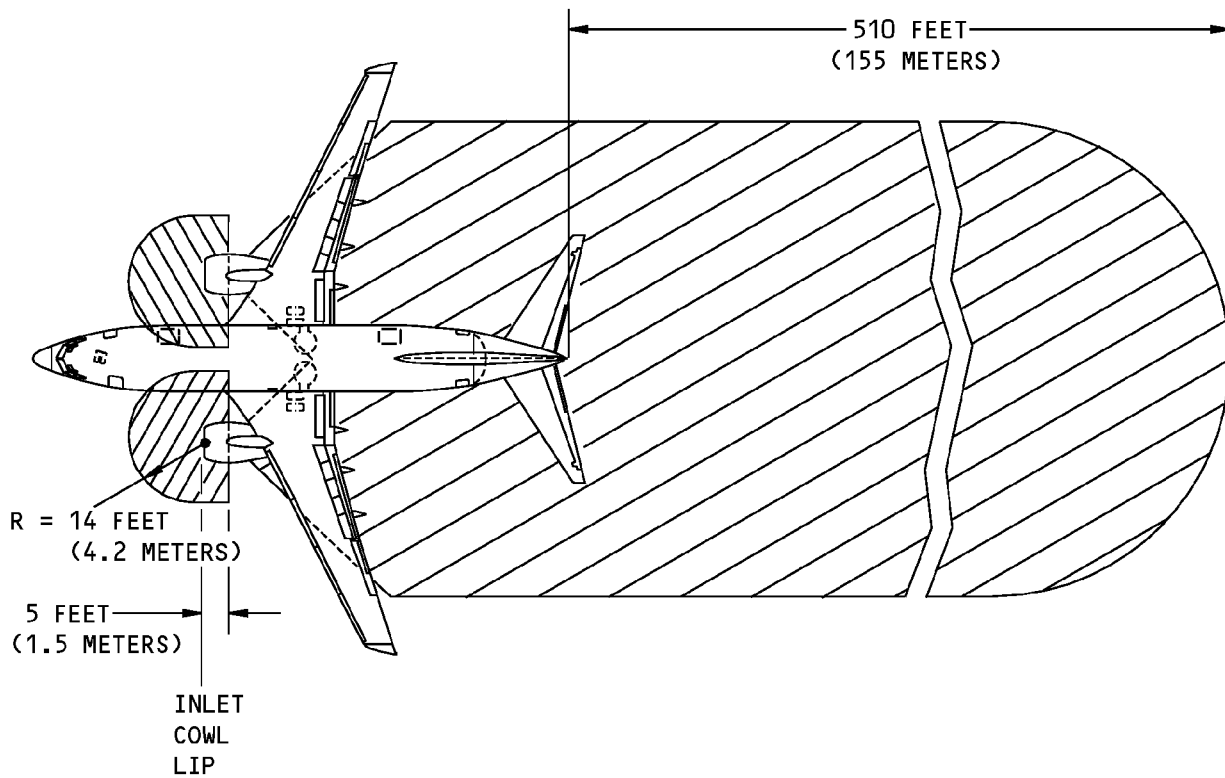
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WARNING: KEEP ALL PERSONS OUT OF THE DANGEROUS AREA DURING ENGINE OPERATION. IF THE SURFACE WIND IS MORE THAN 25 KNOTS, INCREASE THE DANGEROUS AREA AT THE ENGINE INLET BY 20 PERCENT.

CLEAN THE RAMP IF THERE IS SNOW, ICE, WATER, OIL OR OTHER CONTAMINATION ON THE RAMP. YOU CAN ALSO MOVE THE AIRPLANE TO A LOCATION THAT IS CLEAN.

MAKE SURE THAT ALL PERSONS ARE SAFE BEFORE YOU START THE ENGINE.

MAKE SURE THE PERSONS IN THE FLIGHT COMPARTMENT CAN SPEAK TO ALL PERSONS NEAR THE DANGEROUS AREA DURING ENGINE OPERATION.

OBEY ALL OF THE GROUND SAFETY PRECAUTIONS FOR THE ENGINES.

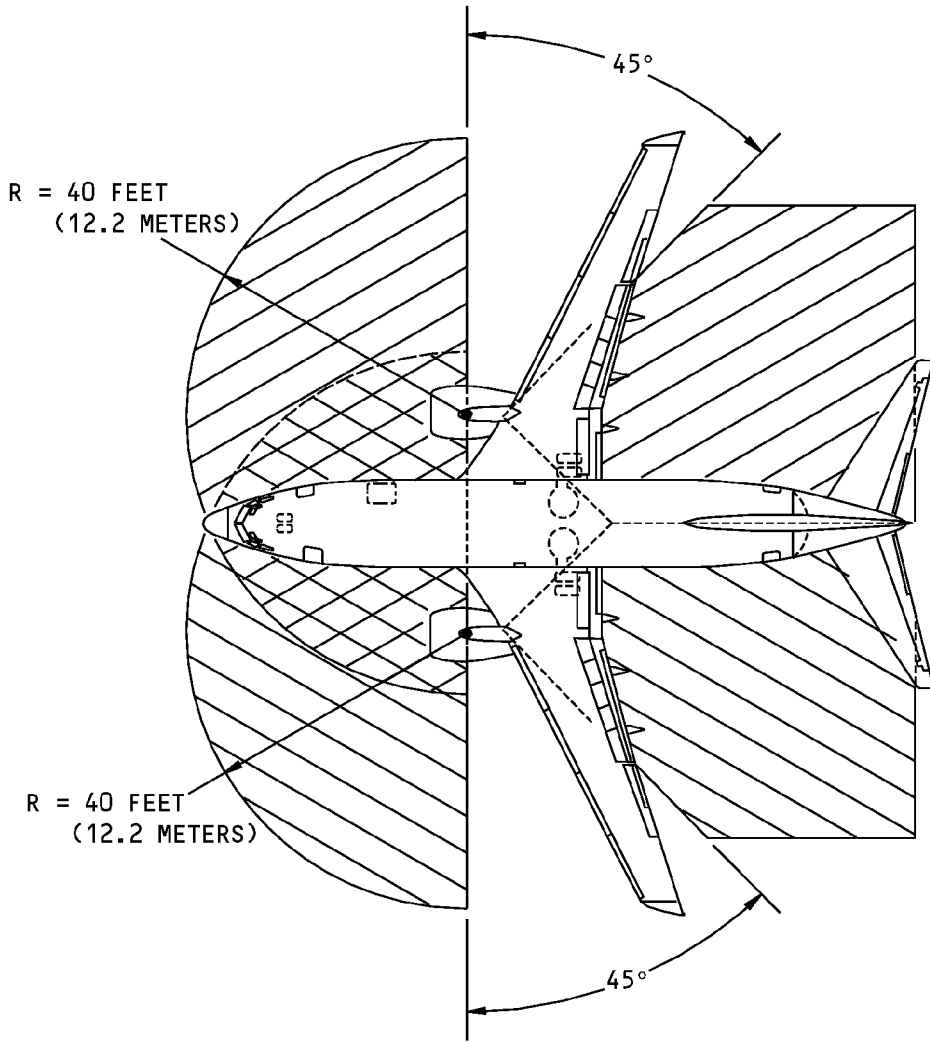
THE ENGINES CAN PULL PERSONS OR UNWANTED MATERIALS INTO THEM AND CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

**FORWARD BREAKAWAY POWER
(BOTH ENGINES OPERATING)**

**Engine Inlet and Exhaust Hazard Areas
Figure 201 (Sheet 2 of 4)/09-20-00-990-801**

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WARNING: MAKE SURE THAT ALL PERSONS ARE SAFE BEFORE YOU START THE ENGINE.

MAKE SURE THE PERSONS IN THE FLIGHT COMPARTMENT CAN SPEAK TO ALL PERSONS NEAR THE DANGEROUS AREA DURING ENGINE OPERATION.

OBEY ALL OF THE GROUND SAFETY PRECAUTIONS FOR THE ENGINES.

THE ENGINES CAN PULL PERSONS OR UNWANTED MATERIALS INTO THEM AND CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

**REVERSER OPERATION AT IDLE POWER
(RIGHT ENGINE ONLY)**

**Engine Inlet and Exhaust Hazard Areas
Figure 201 (Sheet 3 of 4)/09-20-00-990-801**

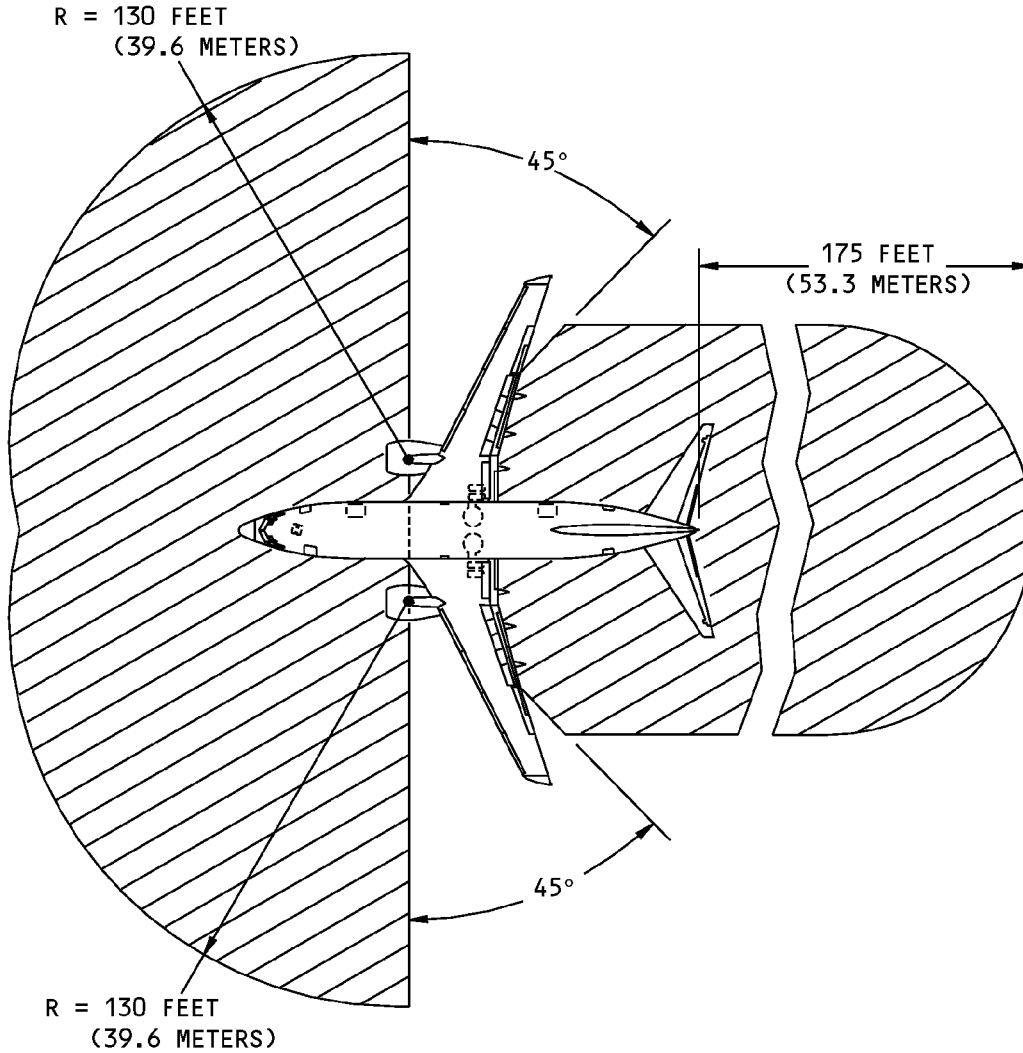
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WARNING: MAKE SURE THAT ALL PERSONS ARE SAFE BEFORE YOU START THE ENGINE.

MAKE SURE THE PERSONS IN THE FLIGHT COMPARTMENT CAN SPEAK TO ALL PERSONS NEAR THE DANGEROUS AREA DURING ENGINE OPERATION.

OBEY ALL OF THE GROUND SAFETY PRECAUTIONS FOR THE ENGINES.

THE ENGINES CAN PULL PERSONS OR UNWANTED MATERIALS INTO THEM AND CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

**REVERSER OPERATION AT BREAKAWAY POWER
(BOTH ENGINES OPERATING)**

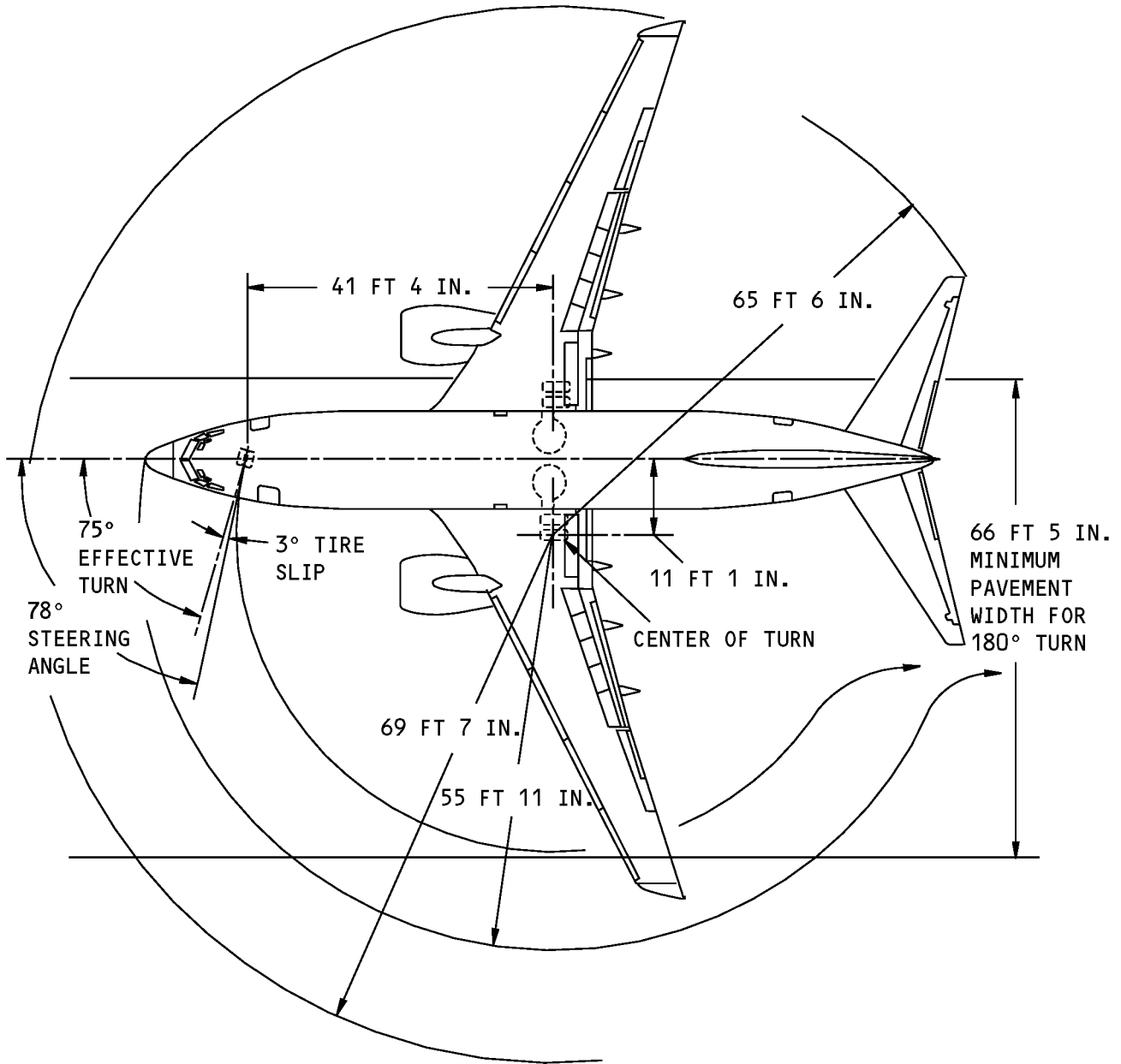
**Engine Inlet and Exhaust Hazard Areas
Figure 201 (Sheet 4 of 4)/09-20-00-990-801**

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**Taxi Turning Radius
Figure 202/09-20-00-990-802**

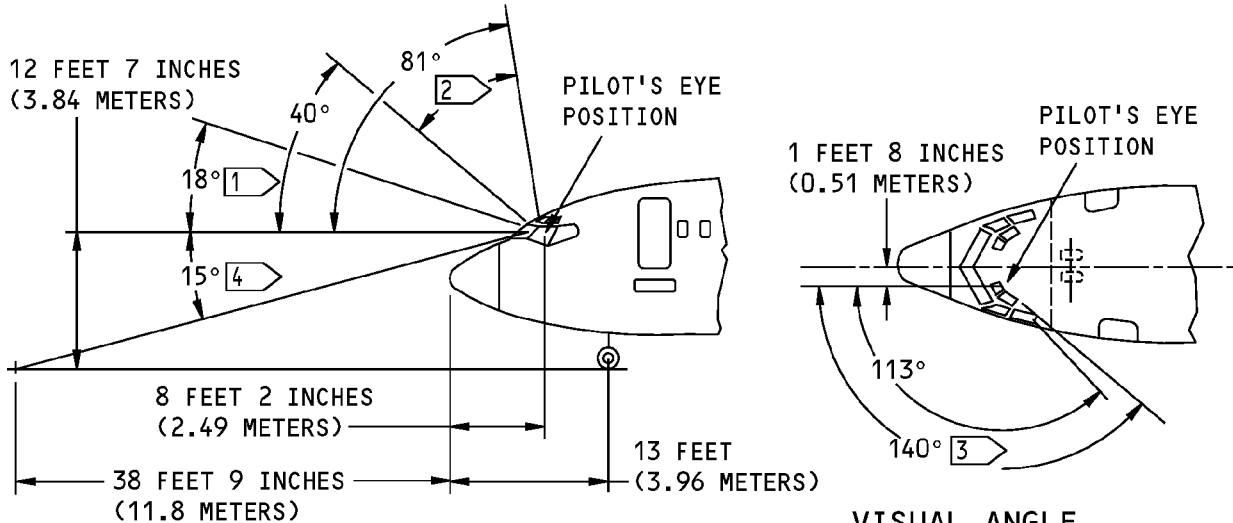
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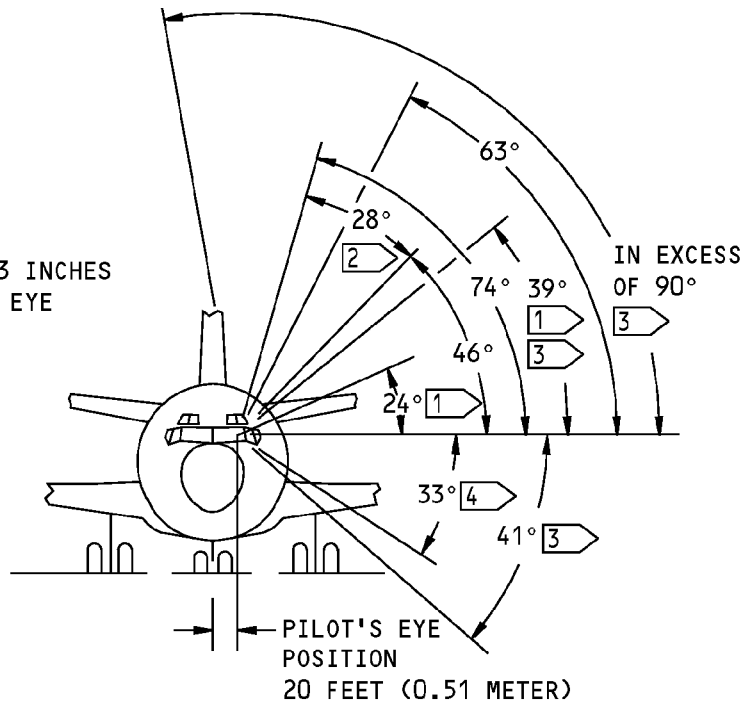


**VISUAL ANGLES IN PLANE
PARALLEL TO LONGITUDINAL AXIS
THROUGH PILOT'S EYE POSITION**

**VISUAL ANGLE
IN HORIZONTAL PLANE
THROUGH PILOT'S EYE POSITION**

NOTE: HEAD ROTATED ABOUT POINT 3.3 INCHES (0.08 METER) AFT OF PILOT'S EYE POSITION.

- 1** UPWARD VISION THROUGH MAIN WINDOW.
- 2** VISION THROUGH EYEBROW WINDOW.
- 3** WITH HEAD MOVED 5 INCHES (0.13 METERS) OUTBOARD
- 4** DOWNWARD VISION THROUGH MAIN WINDOW.



**VISUAL ANGLES IN PLANE
PERPENDICULAR TO LONGITUDINAL AXIS
THROUGH PILOT'S EYE POSITION**

**Angle of View
Figure 203/09-20-00-990-803**

EFFECTIVITY
HAP ALL

09-20-00