

# CHAPTER

# 7



BOEING 707

MAINTENANCE MANUAL

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**MAINTENANCE MANUAL**

CHAPTER 7

LIFTING AND SHORING

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### AIRPLANE JACKING

#### 1. General

- A. Lifting the airplane is accomplished by using conventional airplane jacks at jacking points provided on the wing, forward and aft body, or at the nose and main landing gear. The jacking points on the wing and body are provided with receptacles for the attachment of removable ball-type jack adapters. The nose and main landing gear jacking points are an integral part of the landing gear.
- B. The airplane is provided with three main jacking points and three stabilizing jacking points. The main jacking points are the two inboard wing jacking points C and the aft fuselage jacking point G. The stabilizing jacking points are the two outboard wing jacking points F and the forward body jack point B. In addition, there are jack pads D and E on the under side of the main gear truck axles and a jack pad A under the nose gear axle. See figure 201 for jack point location, wing and body jack adapter pads, applicable jacks, and jack point allowable load limits.
- C. The three main jacking points allow the airplane to be jacked at any gross weight, provided the allowable load limits of the individual jacking points are not exceeded. By using the stabilizing jacking points in addition to the main jacking points, even greater gross weight airplanes can be jacked as long as the jack point allowable load limits are not exceeded. The landing gear jacking points allow the airplane to be jacked at weights up to the maximum taxi gross weight. The airplane center of gravity must be within the forward and aft limits prior to jacking. For additional information on airplane weights up to maximum taxi gross weight with respect to the center of gravity and charts that show airplane gross weight versus jack point load at various center of gravity limits, refer to Weight and Balance Control and Loading Manual.
- D. When nose gear maintenance is required or when both nose gear tires are flat, the most convenient jacking method is to use the forward body jacking point B. The aft body jacking point G should be used to prevent tipping.



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E. The following procedure will be used whenever inflation of landing gear struts is used as an aid to jacking aircraft.

- (1) Only the minimum amount of pressure required is to be used in blowing the strut.

**WARNING:** DO NOT PRESSURIZE LANDING GEAR SHOCK STRUTS ABOVE THE FOLLOWING MAXIMUM PRESSURE TO ASSIST IN JACKING.

<u>Aircraft</u>	<u>Nose Gear Strut</u>	<u>MLG Strut</u>
720	1750 psi	2000 psi
707-100	1750 psi	2400 psi
707-300	2000 psi	2400 psi

- (2) Inflate struts to a maximum extension of 26 inches for the MLG and 30 inches for the NLG measured between torsion link pin centerline, monitoring strut pressure in order not to exceed maximum pressure limits.
- (3) Install jacks, preload all jacks to 900 to 1100 pounds.

**CAUTION:** TO AVOID POSSIBLE DAMAGE TO SHOCK STRUT, DO NOT JACK AIRPLANE WEIGHT OFF WHEELS WITH SHOCK STRUTS INFLATED ABOVE NORMAL OPERATING PRESSURE. IF AIRPLANE IS JACKED TO A POINT WHERE THE MAIN LANDING GEAR OLEO SAFETY SWITCH CLOSES, CIRCUIT BREAKERS ON DRAIN MAST HEATER CIRCUITS MUST BE OPENED TO PREVENT BURNING OUT THE HEATERS.

- (4) Deflate struts. Proceed with jacking.
- (5) When lowering aircraft, let jacks down until struts have compressed three inches; then pressurize struts and remove jacks; observe limits of E.(1) and (2).
- (6) Immediately after removing jacks, reduce pressure in struts to proper servicing level.

2. Equipment and Materials

- A. Main Landing Gear Oleo Lock Assembly - F70027-503, or equivalent on Turbojet airplanes, and F70147, or equivalent on Turbofan airplanes
- B. Nose Landing Gear Oleo Lock Assembly - F70029, or equivalent
- C. Wing and fuselage jacks, landing gear axle jacks, and jack pad adapters (Fig. 201)
- D. Main Landing Gear Downlock Assembly - F71126-500, or equivalent
- E. Nose Landing Gear Downlock Assembly - F70008-500, or equivalent

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3. Jack Airplane

A. Raise Airplane (Fig. 201)

**CAUTION:** DO NOT EXCEED ONE INCH CLEARANCE FROM JACK RAM LOCKNUT TO COLLAR AS JACK IS BEING RAISED OR LOWERED. EXCESSIVE CLEARANCE CAN RESULT IN DAMAGE TO AIRPLANE STRUCTURE IF JACK FAILS.

- (1) Ensure that maximum allowable loads of individual jacking points are not exceeded. Ensure that all landing gear downlocks are in place.

**WARNING:** TO AVOID POSSIBLE INJURY TO PERSONNEL AND DAMAGE TO AIRPLANE, ALL JACKS AND JACK POINTS MUST BE MANNED AND MONITORED CONTINUOUSLY UNTIL A FINAL STATIC POSITION IS REACHED.

- (2) Head airplane into the wind if in an exposed area.

**CAUTION:** DO NOT JACK AIRPLANE IF WINDS EXCEED 35 MILES PER HOUR.

- (3) Deflate landing gear shock struts and lock in compressed position using the applicable landing gear oleo lock assemblies.

**WARNING:** DO NOT PRESSURIZE SHOCK STRUTS BEYOND NORMAL SERVICING LIMITS TO ASSIST WITH JACK PLACEMENT OR WHEN AIRPLANE IS TO BE JACKED WITH ALL WEIGHT OFF WHEELS. PERSONNEL INJURY OR AIRPLANE DAMAGE COULD RESULT.

**CAUTION:** DO NOT PERFORM THIS STEP IF AIRPLANE IS BEING RAISED TO PERMIT A GEAR RETRACTION TEST. SUCH A TEST REQUIRES THAT GEAR BE FULLY EXTENDED.



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- (4) Install jack pad adapters and position jacks per figure 201, making sure that one leg of each jack at positions C points forward.

**CAUTION:** STABILIZING JACKS, PRELOADED TO A MAXIMUM OF 5,000 POUNDS AT 35 MILES PER HOUR WIND VELOCITY, MUST BE USED DURING WINDY CONDITIONS. DO NOT EXCEED ALLOWABLE LOAD ON ANY JACK POINT.

**NOTE:** Jacks must be equipped with pressure gages and a conversion table to give pounds of load at each jack point. Jack adapters are attached to the airplane structure by screws or bolts as listed.

Jack Point B - F71139	Eight AN6-15A or equivalent
Jack Points C - F80060-2	One NAS514P1032-24 or equivalent
Jack Points F - F70009	One NAS603-26 or equivalent
Jack Point G - F71138-500	Two AN5-10A or equivalent

- (5) Remove wheel chocks and release parking brakes.
- (6) Use plumb bob and leveling scale in left wheel well to establish level lateral and longitudinal attitude while raising airplane. Refer to Leveling, Chapter 8.

**NOTE:** This method of leveling is accurate enough for general jacking requirements and gear retraction only.

- (7) Raise airplane in level attitude, using jacks at wing jack pads C and tail jack pad G, until landing gear clears ground. Raise airplane until wheels clear ground 4 to 5 inches for landing gear retraction test.

**CAUTION:** JACKS AT PADS C MUST BE RAISED PRIOR TO OR SIMULTANEOUSLY WITH JACK AT JACK PAD G. RAISING TAIL JACK AHEAD OF WING JACKS MAY OVERLOAD TAIL JACK POINT, BY FORCING NOSE OF AIRPLANE DOWN ON NOSE GEAR, OR IT MAY OVERLOAD TAIL JACK POINT AND NOSE STABILIZING JACK POINT WHEN LATTER IS USED.

JACK THE AIRPLANE IN A LEVEL ATTITUDE TO PREVENT INTRODUCING SIDE LOADS INTO THE JACK POINTS THAT COULD CAUSE THE JACKS TO SLIP OFF THE PADS OR OVERLOAD THE JACK POINTS AND DAMAGE STRUCTURE.



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- (8) If conditions require that airplane be stabilized, raise outboard wing jacks F and nose jack B until sufficient weight is supported to steady airplane. This load should be up to a maximum of 5000 pounds at 35 mph wind at each jacking point.

NOTE: Lower all jack ram locknuts as jacks are raised. Maintain a clearance of 1 inch or less from nut to collar until jacking is complete, then snug up nut and tighten lockscrew.

### B. Lower Airplane

CAUTION: DO NOT EXCEED ONE INCH CLEARANCE FROM JACK RAM LOCKNUT TO COLLAR AS JACK IS BEING RAISED OR LOWERED. EXCESSIVE CLEARANCE CAN RESULT IN DAMAGE TO AIRPLANE STRUCTURE IF JACK FAILS.

- (1) Check that the area immediately under the airplane is clear and that all landing gear downlocks are installed.
- (2) Loosen set screw in ram locknut at jack and adjust locknut up ram until it is no more than 1 inch from jack collar.

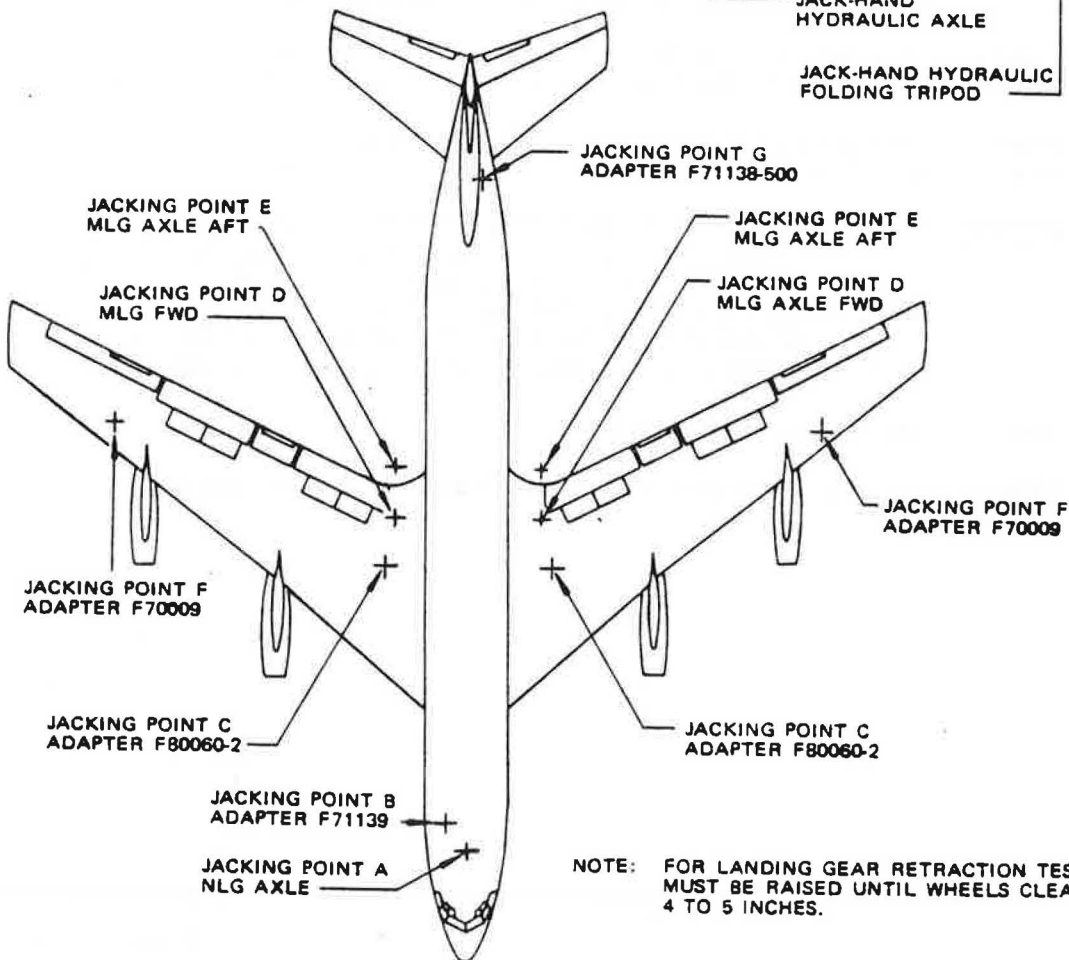
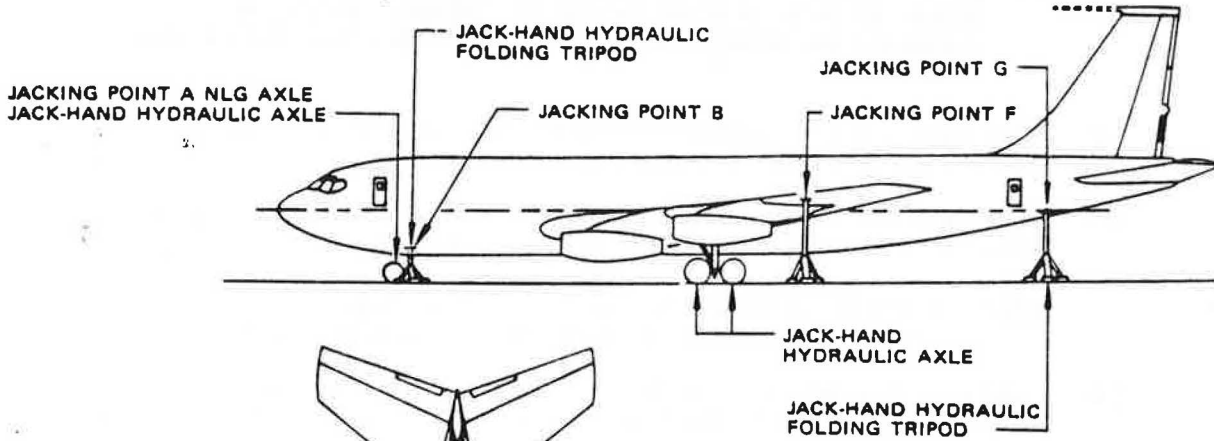
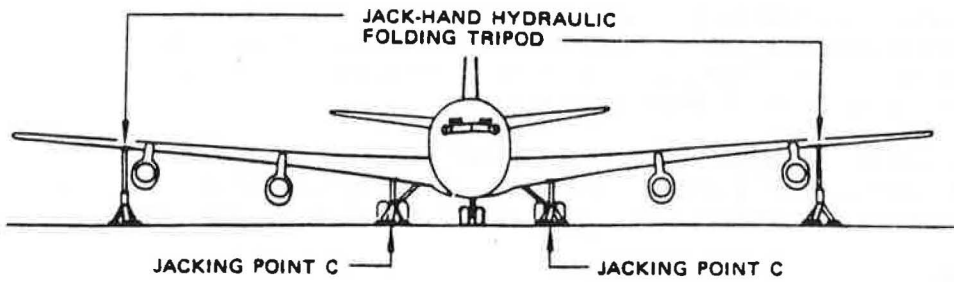
NOTE: It may be necessary to raise jack ram slightly to relieve load on locknut and allow locknut to be moved up ram.

- (3) Lower stabilizing jacks at jack points B and F (Fig. 201), maintaining 1 inch or less clearance between locknut and collar.
- (4) Lower main jacks at jack points C and G evenly and all together, maintaining 1 inch or less clearance between locknut and collar.

CAUTION: DO NOT ALLOW JACKS C UNDER WING TO PRECEDE TAIL JACK G, OTHERWISE NOSE GEAR WILL TOUCH FIRST AND OVERLOAD TAIL JACKING POINT G. A JACK HANG-UP CONDITION MAY BE RELIEVED BY RAISING AND LOWERING JACK UNTIL RAM IS FREED. IF HANG-UP CONTINUES IT WILL BE NECESSARY TO RAISE AND CRIB AIRPLANE WHILE FAULTY JACK IS REPLACED.

- (5) Remove jacks and jack pad adapters.
- (6) Inflate landing gear shock struts with clean, dry air per placard in wheel well.

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NOTE: FOR LANDING GEAR RETRACTION TEST, AIRPLANE MUST BE RAISED UNTIL WHEELS CLEAR GROUND 4 TO 5 INCHES.

Jacking Diagram  
 Figure 201 (Sheet 1)

MAXIMUM JACKING LOADS

**B 707-329**

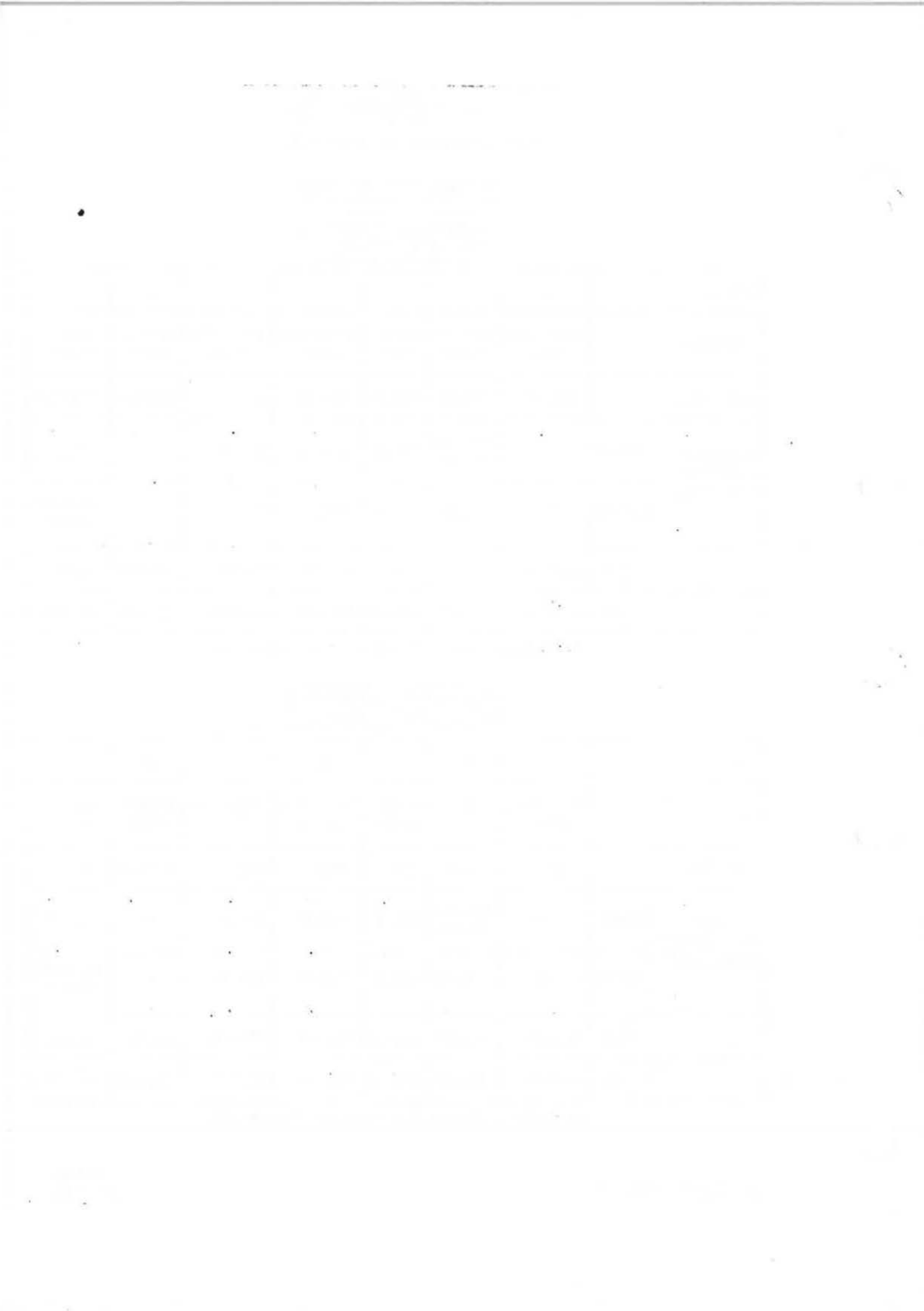
LETTER		A	B	C	D	E	F	G	
LOCATION		NOSE GEAR AXLE	FORWARD BODY	WING PANEL	MAIN GEAR AXLE	MAIN GEAR AXLE	OUTER WING	AFT BODY	
ARM (IN.)		179.0	200.0	799.0	859.0	915.0	1031.9	1547.0	
DISTANCE FROM CENTRE LINE (IN.)	LEFT	0	No Jack Point	137.1	132.6	132.6	-	15.4	
	RIGHT	0	52.0	137.1	132.6	132.6	-	No Jack Point	
MAXIMUM LOAD		LB	34,700	18,900	84,000	72,800	72,800	12,000	14,100
		KG	15,740	8,570	38,100	33,020	33,020	5,440	6,400

For Jacking Points Location See Figure 201

**B 707-329C**

LETTER		A	B	C	D	E	F	G	
LOCATION		NOSE GEAR AXLE	FORWARD BODY	WING PANEL	MAIN GEAR AXLE	MAIN GEAR AXLE	OUTER WING	AFT BODY	
ARM (IN.)		179.0	200.0	799.0	859.0	915.0	1031.9	1547.0	
DISTANCE FROM CENTRE LINE (IN.)	LEFT	0	No Jack Point	137.1	132.6	132.6	-	15.4	
	RIGHT	0	52.0	137.1	132.6	132.6	-	No Jack Point	
MAXIMUM LOAD		LB	34,700	18,900	84,000	78,500	78,500	12,000	14,100
		KG	15,740	8,570	38,100	35,610	35,610	5,440	6,400

For Jacking Points Location See Figure 201







C. Jacking With Nose Fuselage Jack Only (Fig. 201)

**CAUTION:** DO NOT EXCEED ONE INCH CLEARANCE FROM JACK RAM LOCKNUT TO COLLAR AS JACK IS BEING RAISED OR LOWERED. EXCESSIVE CLEARANCE CAN RESULT IN DAMAGE TO AIRPLANE STRUCTURE IF JACK FAILS.

- (1) Check that airplane weight and CG conditions are such that nose jacking point allowable load will not be exceeded during lifting operation. Refer to Weight and Balance Control and Loading Manual for jack point allowable load limits and CG limits.

**NOTE:** Shifting of weight in the airplane is permissible, within allowable CG and weight limits, to ensure compliance with nose jack point load limit.

- (2) Check that all landing gear downlocks are in place.
- (3) Head airplane into wind if an exposed area.

**CAUTION:** DO NOT JACK AIRPLANE IF WINDS EXCEED 35 MILES PER HOUR.

- (4) Install nose jack pad adapter at jack position B.

**CAUTION:** DO NOT OPERATE MAIN CARGO DOOR WHILE USING JACK POSITION B. FAILURE TO COMPLY COULD RESULT IN DAMAGE TO THE MAIN CARGO DOOR.

**NOTE:** Jack pad adapter at position B is attached by eight AN6-15A or equivalent.

- (5) Deflate nose gear shock strut and lock in compressed position using Lock Assembly F70029.

**NOTE:** If nose is being jacked for replacement of nose gear shock strut O-rings, this step is not necessary, since shock strut will have to be extended.

- (6) Install nose jack.

**NOTE:** Jack must be equipped with pressure gage and a table converting pressure readings to load in pounds at jacking point.

- (7) Raise nose jack, maintaining a distance of 1 inch or less between jack ram locknut and jack collar. To permit a nose landing gear only retraction test, raise nose until nose wheels clear ground approximately one inch.

CAUTION: DO NOT EXCEED NOSE JACKING POINT ALLOWABLE LOAD.

- (8) Screw down jack ram locknut and tighten set screw when nose gear clears the ground by required amount.

D. Lowering With Nose Fuselage Jack Only (Fig. 201)

CAUTION: DO NOT EXCEED ONE INCH CLEARANCE FROM JACK RAM LOCKNUT TO COLLAR AS JACK IS BEING RAISED OR LOWERED. EXCESSIVE CLEARANCE CAN RESULT IN DAMAGE TO AIRPLANE STRUCTURE IF JACK FAILS.

- (1) Check that area immediately under airplane nose is clear and that all gear downlocks are in place.
- (2) Lower nose jack maintaining a distance of 1 inch or less between jack ram locknut and jack collar.

CAUTION: A JACK HANG-UP CONDITION MAY BE RELIEVED BY RAISING AND LOWERING JACK UNTIL RAM IS FREED. IF HANG-UP CONTINUES, IT WILL BE NECESSARY TO RAISE AND CRIB NOSE FUSELAGE WHILE FAULTY JACK IS REPLACED.

NOTE: It may be necessary to work jack ram slightly to relieve load on jack ram locknut and allow locknut to be moved on ram.



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- (3) Remove jack, jack pad adapter, and nose gear lock assembly F70029.
- (4) Inflate nose gear shock strut with clean dry air per placard in nose wheel well.

### E. Lifting Landing Gear Axles

- (1) Jacking points are provided under each landing gear axle (figure 201) for removal of wheel and tire or brake assembly without raising the entire airplane. Approximate axle jack pad heights and clearances between tires are listed below. Table should be used as a guide only, since dimensions vary considerably.

**WARNING:** SINCE THE MAIN GEAR IS NOT STEERABLE THE TRUCK TENDS TO SCRUB ROUND WHEN THE AIRPLANE IS IN A TURN. THEREFORE, IF THE TRUCK IS JACKED WITH THE AIRPLANE IN A TURN, THE GEAR MAY UNTWIST WITH POSSIBILITY THAT JACK MAY HANG UP OR EVEN COLLAPSE UNDER EXCESSIVE LATERAL SIDE LOADS.

**CAUTION:** TO AVOID DAMAGE TO MAIN GEAR SNUBBER DO NOT RAISE AXLES ON MAIN GEAR TRUCK TO POINT WHERE FRONT AXLE IS MORE THAN 8 INCHES ABOVE REAR AXLE OR REAR AXLE IS 12 INCHES ABOVE FRONT AXLE.

DO NOT ATTEMPT TO JACK AIRPLANE BY PLACING JACK UNDER ANY PART OF TRUCK OTHER THAN AXLE JACK PADS. DAMAGE RESULTING FROM JACKING ELSEWHERE MAY ULTIMATELY CAUSE TRUCK FAILURE.

RELEASE BRAKES BEFORE RAISING OR LOWERING AXLE. TRUCK BEAM MUST BE FREE TO ROTATE RELATIVE TO WHEELS WHICH REMAIN ON GROUND.

**NOTE:** A visual inspection of the main gear wheel truck beam cover, or of the entire wheel truck on airplanes without a beam cover should be made after each truck jacking operation. Refer to Main Gear Wheel Truck - Maintenance Practices, Chapter 32.



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AXLE JACKING PAD HEIGHT AND CLEARANCES FOR TURBOJET AIRPLANES

<u>Condition</u>	<u>HEIGHT OF AXLE JACK PAD</u>			<u>CLEARANCE BETWEEN TIRES</u>	
	<u>NLG</u>	<u>MLG</u>		<u>NLG</u>	<u>MLG</u>
		<u>FWD</u>	<u>AFT</u>		
No tires flat	13.1	14.7	12.2	8.8	18.5
One tire flat	10.0	11.7	9.2	---	---
Two flat on one axle (with trapped rubber)	8.2	9.1	6.5	6.3	12.0
Jack pad height required for wheel change	16.6	18.7	16.1	---	---

AXLE JACKING PAD HEIGHT AND CLEARANCES FOR TURBOFAN AIRPLANES

<u>Condition</u>	<u>HEIGHT OF AXLE JACK PAD</u>			<u>CLEARANCE BETWEEN TIRES</u>	
	<u>NLG</u>	<u>MLG</u>		<u>NLG</u>	<u>MLG</u>
		<u>FWD</u>	<u>AFT</u>		
No tires flat	13.1	12.2	12.2	8.8	18.5
One tire flat	10.0	9.2	9.2	---	---
Two flat on one axle (with trapped rubber)	8.2	6.6	6.5	6.3	12.0
Jack pad height required for wheel change	16.6	16.1	16.1	---	---

(2) Main Gear Axles

- (a) For the condition in which both tires on the same main gear axle are flat, raising may be accomplished by jacking the airplane with either of the minimum height jacks. The Regent 35-Ton Crocodile axle jack, or the Sancor 40-Ton Cantilever axle jack may be used.



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- (b) If both tires on the same main gear axle are flat and the above jacks are not available, it may be necessary to raise the axle initially by a means other than axle jacking, since the height of the jacking pad may not permit insertion of a jack. The airplane may then be raised as follows:
- 1) By reinflating the tires. This presupposes that at least one of the tires is in good shape, well seated on its wheel, and that a source of high pressure air, such as air bottles, is available.
  - 2) By pushing or towing the airplane so that the main gear truck is moved up an inclined block (figure 202). If one block is used under each pair of inboard and outboard wheels there should be sufficient clearance between them to permit insertion of axle jack base. (See figure 201, sheet 2.)

NOTE: With two flat tires on one axle of a main gear truck, push or tow the airplane so that the flat tires move up the inclined block first.

- (c) Single flat tires or other combinations of flat tires produce conditions which can be resolved by adopting similar procedures to those suggested in paragraph E.(2)(a). For example, assuming both tires flat on inboard side of truck, a block similar to that shown in figure 202 might be used. Jacks will not be required if the 4 inch dimension is increased to 12 inches. If a 12 inch lift is required with two tires flat on one axle the 77 inch dimension must be increased to 229 inches.
- (3) Jack Nose Gear Axle
- (a) As with the main gear axles, for the worst nose gear axle case of both tires flat, raising may be accomplished by jacking the airplane with minimum height jacks. The Regent 35-Ton Crocodile axle jack, or the Sancor 40-Ton Cantilever axle jack may be used.



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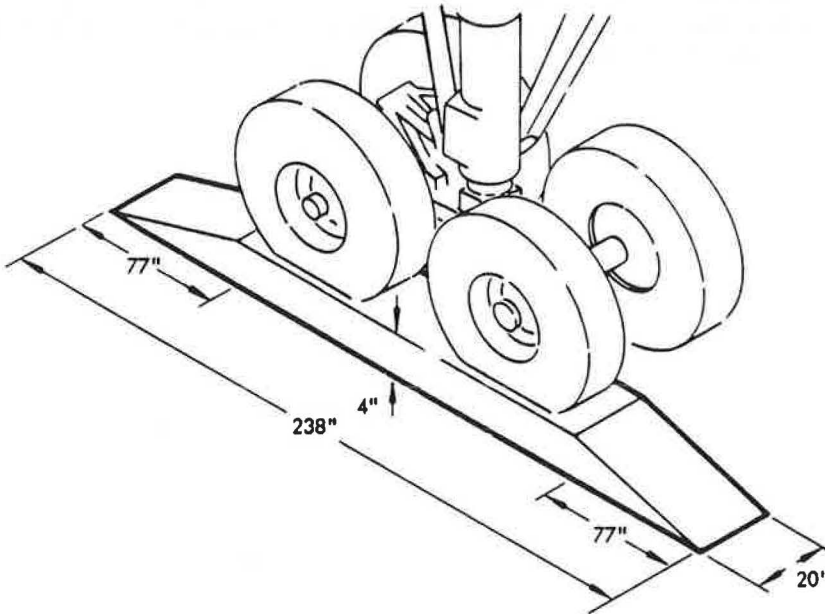
- (b) If both tires on the nose gear axle are flat and the above jacks are not available, it may be necessary to raise the axle initially by a means other than axle jacking, since the height of the jacking pad may not permit insertion of a jack. The airplane may then be raised as follows:
- 1) By reinflating the tires. This presupposes that at least one of the tires is in good shape, well seated on its wheel, and that a source of high pressure air, such as air bottles, is available.
  - 2) By pushing or towing the airplane so that the nose gear is moved up an inclined block. Unlike the main gear block, the slope is not important except from the viewpoint of increased drawbar load. The block should level out at a minimum height of 3 inches (assuming a jack with a collapsed height of 10 inches) and if one block is used under each wheel there should be sufficient clearance between them to permit insertion of axle jack base. (See figure 201, sheet 2.)
  - 3) By jacking the airplane at the nose jacking point as described in paragraph 3.C. Obviously this method makes the use of the axle jack unnecessary.
- (c) For a one flat tire nose gear condition similar procedures to those adopted in (a) may be applied if an axle jack cannot be inserted at once. In using an inclined block however, the block could be made of sufficient height to make subsequent use of an axle jack unnecessary. The good wheel would, of course, be run up on to the block.



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### F. Airplane Support with Engines Removed

- (1) Normally, no airplane support will be required during engine removal with the center of gravity maintained forward of 38% M.A.C. This assumes a complete weight empty airplane, plus those operating items that will normally be in the airplane; i.e., usable and unusable oil; unusable fuel, escape chutes, etc.
- (2) Unusual conditions such as personnel gathered in the aft fuselage, fuel in the outboard wing, deletion of major radio equipment components in the forward body, etc., should be carefully checked to ensure that the CG does not move aft of 38% M.A.C.





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### LIFTING DAMAGED AIRPLANE

#### 1. General

- A. When an airplane has a collapsed landing gear or has landed with gear retracted, an initial survey of the damage should be carefully made not only in anticipation of repairs, but also because it will influence the approach to the lifting problem. Buckled wing and fuselage skin, joggles, or bulges in the skin at structural joints or at heavy fittings are indication of damaged internal structure. Rivets, bolts or fasteners of any kind that are tipped, sheared or loose may serve as clues. Fairings and other nonstructural parts that are torn, cracked or buckled are reasons for close inspection of structure which they cover. Every attempt should be made to keep further damage at a minimum. To this end it is essential that personnel engaged in a lifting operation be familiar with the airplane structure, its limitations, and the use and load ratings of lifting equipment. In incidents involving collapsed landing gears, it will sometimes be possible to extend the gear after the airplane has been raised. It should be determined that the structure is capable of supporting the weight before the airplane is lowered into the gear. If the gear structure is damaged beyond immediate repair, it will be necessary to provide a crash truck, suitable cradles, dollies or trailers.
- B. One of the first steps in lifting a damaged airplane is to reduce the weight to a minimum. Weight and balance manuals that are prepared for each airplane series and model and supplied to the airlines contain detailed information on the weight of major components installed on each model. Components, such as engines, struts, major empennage surfaces, and landing gear, are detailed to provide exact weights in the basic document. Detailed weights for equipment, such as seats, galleys, life rafts, and other removable items, are included in a supplement to the basic weight and balance manual. A supplement is prepared for each individual airplane due to the differences that may exist between airplanes and should be kept up to date as changes are made. As parts and equipment are removed, the effect on gross weight and CG can be computed from data in the weight and balance manual and supplement applicable to the changed airplane.
- C. All possible fuel should be removed from tanks to further lighten the airplane except in special instances. (See Lifting One Side of Airplane.) In some cases this may require pumping fuel out through the overwing filler ports. Refer to DEFUELING, Chapter 28.



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D. The methods of lifting of damaged airplanes will be covered as follows:

- (1) Jacks
- (2) Pneumatic bags
- (3) Nose sling
- (4) Mobile cranes

### 2. Jacks

#### A. General

- (1) Consider an airplane resting on a hard surface with landing gear up and nonaccessible. The airplane will be resting on the keel beam and forward fuselage area and possibly on one wing tip. The usual method for lifting an airplane from this position is a series of air bags, however, the airplane size, weight, wing sweepback and narrow interspar areas limit possible bag location and extra care must be taken. If jack pads are accessible and not damaged, jacks should be used. The use of air bags will be covered later.

NOTE: The vertical fin and rudder are sometimes removed to reduce overall weight.

- (2) The airplane wing tips should be leveled and shored in a level position. The fuel, engines and all removable equipment, should be removed and the airplane weight reduced to a minimum. The CG should be calculated and checked to see that jack pads will not be overloaded. Jack pads may be installed at the wing jacking points and at the forward and aft fuselage jacking points. Refer to 7-1-1, Airplane Jacking.

CAUTION: LIFTING SHOULD NOT BE ATTEMPTED IN WINDS EXCEEDING 35 MILES PER HOUR.

- (3) If an airplane comes to rest away from a hard surface and the jack points are buried, it will be necessary to dig trenches to expose jacking points and provide enough area to accommodate the necessary cribbing.

#### B. Equipment and Materials

- (1) Low Profile Jacks (Refer to 7-1-1, Airplane Jacking.)
- (2) Padding and any other type material to protect airplane surface
- (3) Wood timbers suitable for cribbing wing and fuselage



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### C. Lift Damaged Airplane Using Jacks

- (1) Reduce axle jacks to their minimum heights and if necessary crib up to the jacking points.
- (2) Position jack at each jacking point. Refer to 7-1-1.

NOTE: Use jacks with load gages to prevent overloading the airplane structure.

- (3) Raise airplane as high as the axle jacks will extend.

CAUTION: KEEP AIRPLANE LEVEL. UNLESS A LEVEL ATTITUDE IS MAINTAINED, SIDE LOADS ON THE JACKS ARE UNPREDICATABLE AND COULD LEAD TO A TILTING OF THE AXLE JACKS. REFER TO "LEVELING AND WEIGHING," CHAPTER 8.

- (4) Since there are no alternate jack points on the wing capable of supporting the airplane, some other means are required to hold the airplane in its partially lifted position while jacks are readjusted and additional cribbing is moved under jack position.
  - (a) The only available structure capable of supporting such loads without inducing severe unbalance is the rear spar. By using two jacks under a 6 x 6 hardwood beam at least 40 inches long under the rear spar on each side of the body, the airplane can be supported while the load is removed from the main jack points.
  - (b) Two rear spar jacks should be placed under a wood beam placed at the wing rib intersections with the rear spar between the main landing gear support rib and the body. Two jacks may also be installed between the nacelles.
  - (c) Use heavy padding between the wood beam and the wing spar to prevent local damage to the structure. Make sure that each beam bears on the spar and not on unsupported skin.
  - (d) When these jacks are in place, use the load gages as a guide in taking up the load. Due to flexibility of the wing structure the load will be taken up gradually and will require a different extension at the outboard jack than at the inboard jack.
  - (e) Maintain loads at the outboard wing stabilizing jack points as the wing bends upward. A constant load can be maintained with the aid of load gages on the outboard jacks.



## MAINTENANCE MANUAL

- (f) Do not attempt to free the jacks by lifting the airplane with jacks under the wing rear spar any more than necessary. Jacks under the tail and nose should also be adjusted to keep the airplane level and to prevent overloading the nose and tail jack points.
  - (g) With the airplane supported by jacks under the rear spar, install more cribbing under the axle jacks at the wing jack points and compress the jacks to their minimum height again.
  - (h) Cradles should be used and the fuselage cribbed each time the body jacks are cribbed up and repositioned. Always keep the airplane level.
  - (i) Once the jacks are stable at a new height, they can be used to lift the airplane another increment. All stabilizing jacks should be taken to their nominal loads and the airplane maintained in a level attitude.
- (5) By using this lift-shift-and-hold system, the airplane can be raised in increments until tripod jacks can be installed under the main jack points. The landing gear should be extended and secured or some other type of moving should be used to remove the airplane from the area.

### D. Jack Airplane With Nose Gear Collapsed

- (1) Raise airplane by using a jack at each inboard wing jack pad, C. Do not exceed jack pad load limit on inboard wing jack pads. Refer to Weight and Balance Control and Loading Manual.
- (2) Crib forward fuselage as airplane is raised by wing inboard jacks.  

NOTE: To support the nose while jacks are being shifted or cribbing is installed at the nose jack pad, a padded cradle can be fabricated to match the lower contour at station 360 bulkhead.
- (3) Follow fuselage aft jack pad down with a jack to prevent airplane from tipping backward. Do not exceed jack pad load limit on fuselage aft jack pad.
- (4) If airplane is to be moved without using nose gear, use flat bed truck (capacity 20,000 pounds) under fuselage forward section. Tow airplane using two tractors attached by cable to main gear towing lugs. Coordinate movement of tractors and truck.



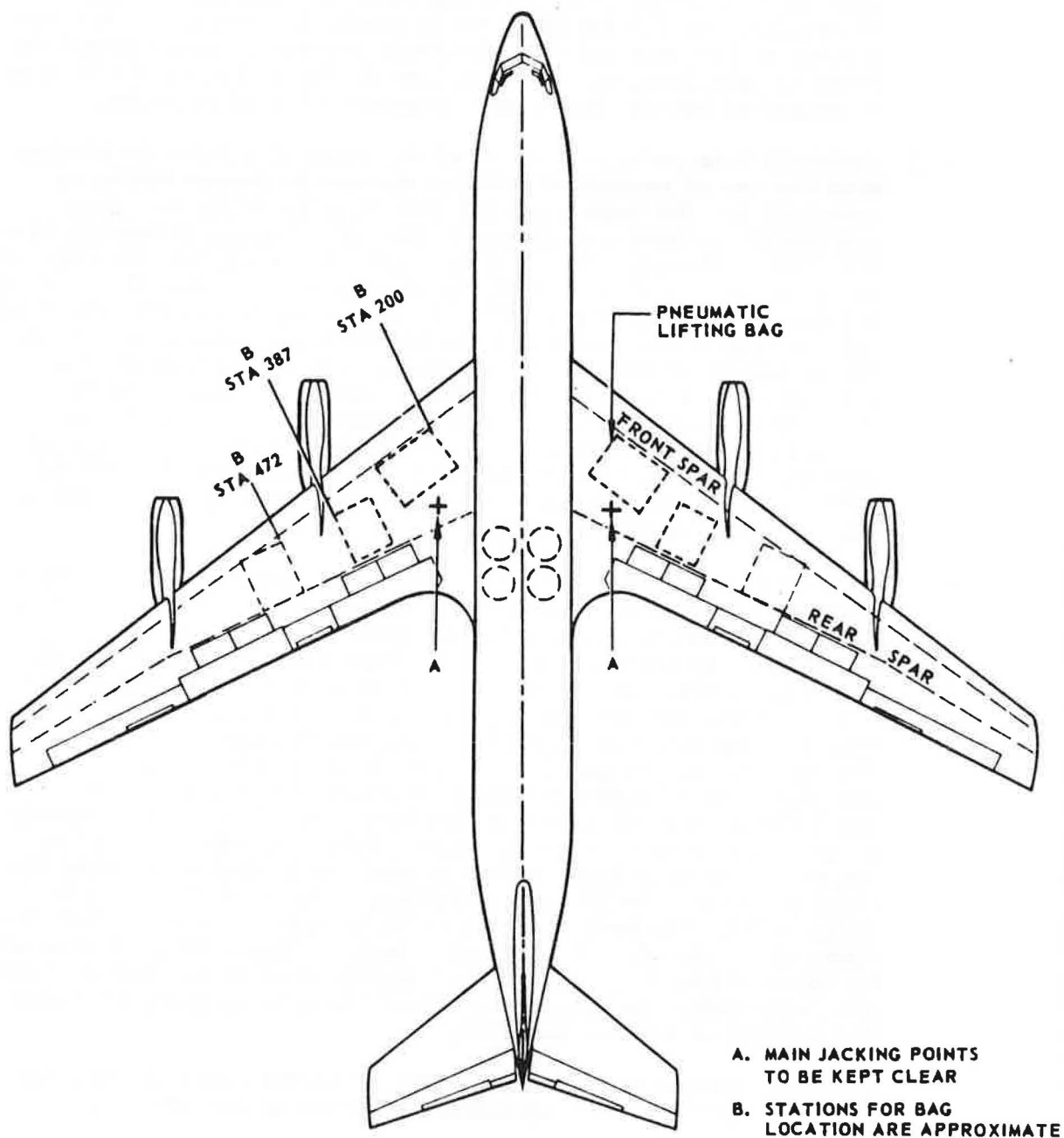
## MAINTENANCE MANUAL

### 3. Pneumatic Bags

#### A. General

- (1) When a damaged airplane comes to rest off a hard surface runway or pavement and ground conditions are muddy or unstable for purposes of jacking, air lifting bags may be required. Because of the area covered by the bags and the relatively low air pressure needed to raise the airplane, the reaction load on the bottom of the bags can be supported better than a more concentrated load on jacks.
- (2) Pneumatic Bags provide an alternative means of raising an airplane when the use of mechanical lifting devices is impracticable or undesirable. The bags are 6-1/2 feet wide by 7-1/2 feet long (inflated) and have a collapsed height of 6 inches, expanding to 6 feet when inflated. If additional lift is needed, two bags can be used, one on top of the other, laced together by means of the straps provided. An alternative method of obtaining extra lift, which is more desirable from the stability viewpoint, is to use one lifting bag on top of cribbing where possible. The bags are made of a nylon fabric, similar to fuel bladder cells, and have a lifting capacity of 24,000 pounds. Each bag weighs 135 pounds and is inflated using a 3.5 psig at 40 cfm. blower, through a hose supplied with the bag. The bags can be used in temperatures of -55°C to 70°C. The tarpaulin cover serves as a protective pad on which to place the bag during lifting.
- (3) The manner in which the bags are used will vary considerably with different factors such as airplane weight, position of CG, terrain, structural condition, physical position and availability of equipment. In general however, the bags should be placed so that the maximum possible lifting area is in contact with the airplane structure and the airplane is kept in a stable condition. Use as many bags as possible. Careful consideration should be given to the position of the airplane CG for the particular case. If possible, the CG position should be improved and the bags placed and inflated according to the findings. In this manner it should be possible to prevent the airplane tilting or shifting position suddenly. An additional safety precaution is that of mooring the airplane during the lifting operation. This is explained more fully below. The best place at which to apply lift is between the spars along the wing at positions shown in figure 201. Care should be taken to avoid the jacking pad positions as it is desirable to get jacks under the wing or to extend the landing gear, if possible, for support as soon as possible.

WARNING: PNEUMATIC BAGS ARE A MEANS OF LIFTING ONLY AND ARE NOT INTENDED AS A SEMIPERMANENT MEANS OF SUPPORT.



Pneumatic Bag Placement Under Wing  
Figure 201



## MAINTENANCE MANUAL

- (4) Air bags may be placed under the fuselage near the nose and tail in order to keep the airplane level while it is being lifted. Ordinarily the lifting loads on the fuselage structure is not enough to develop local damage, but some areas should not be lifted with air bags. Forward of the wing, body station 360 is capable of withstanding lift loads. Also, the body area below the forward cargo door can be used for air bag lifting. Underbody areas between the aft edge of the forward cargo door and the front wing spar should not be used with air bags for lifting. Air bags should not be used under the air conditioning bays or main landing gear wheel well door areas. Aft of the wheel well compartment nearly any area will support air bags except the local areas where antennas are installed. However, whenever possible bags should be located near the cargo doors or at major structural bulkheads, such as those at body stations 1200 and 1440. Drains, masts, etc. that might interfere with lifting should be removed.

### B. Equipment and Materials

- (1) Pneumatic Bags - 24,000 pound lifting capacity, MIL-P-6640. Available from the following sources:

U.S. Rubber Co., Woonsocket, R.I.  
General Tire and Rubber Co., Akron, Ohio  
Goodyear Tire and Rubber Co., Box 3339 Terminal Annex Station,  
Los Angeles 54, California  
Firestone Tire and Rubber Co., 2525 Firestone Blvd., Los Angeles  
54, California

- (2) Air Compressor, or equivalent - capable of maintaining 3.5 psig minimum at a volume of 40 cfm.

NOTE: For convenience in rough terrain, air-nitrogen bottles, used with a regulator, would be the best means of inflation.

- (3) Wood timbers suitable for cribbing wing and fuselage.

- (4) Mooring Equipment

- (a) Cables or ropes of sufficient strength to adequately moor the airplane during lifting operation.
- (b) Block and tackle to provide means of keeping cable taut or paying cable out.
- (c) Wing hoist sling assembly - F71143-500 or equivalent.
- (d) Padding for insertion between cables and structure, and for padding air bag near any sharp surface.



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### C. Mooring Airplane

(1) The airplane is not equipped with mooring or tie-down provisions. For mooring while using pneumatic air bags, see figure 202 and the following instructions:

- (a) Wrap heavy padding around fuselage at station 360.
- (b) Wrap cable around fuselage over padding and directly over fuselage production break (approximately station 360 bulkhead) and attach cables to anchor stakes or heavy truck or tractor.

NOTE: Anchor cables must be attached to anchor in such a manner as to facilitate letting-out or taking-in of cable as airplane is raised or lowered.

- (c) Attach similar padding and cable at fuselage production break (approximately station 1200) and outboard wing to inboard wing production break.
- (d) Attach mooring fittings to outboard wing hoist sling attachment points and attach mooring cables to be secured to anchors forward of wing. Refer to 57-2-1, Outboard Wing - Maintenance Practices.

### D. Lifting Airplane

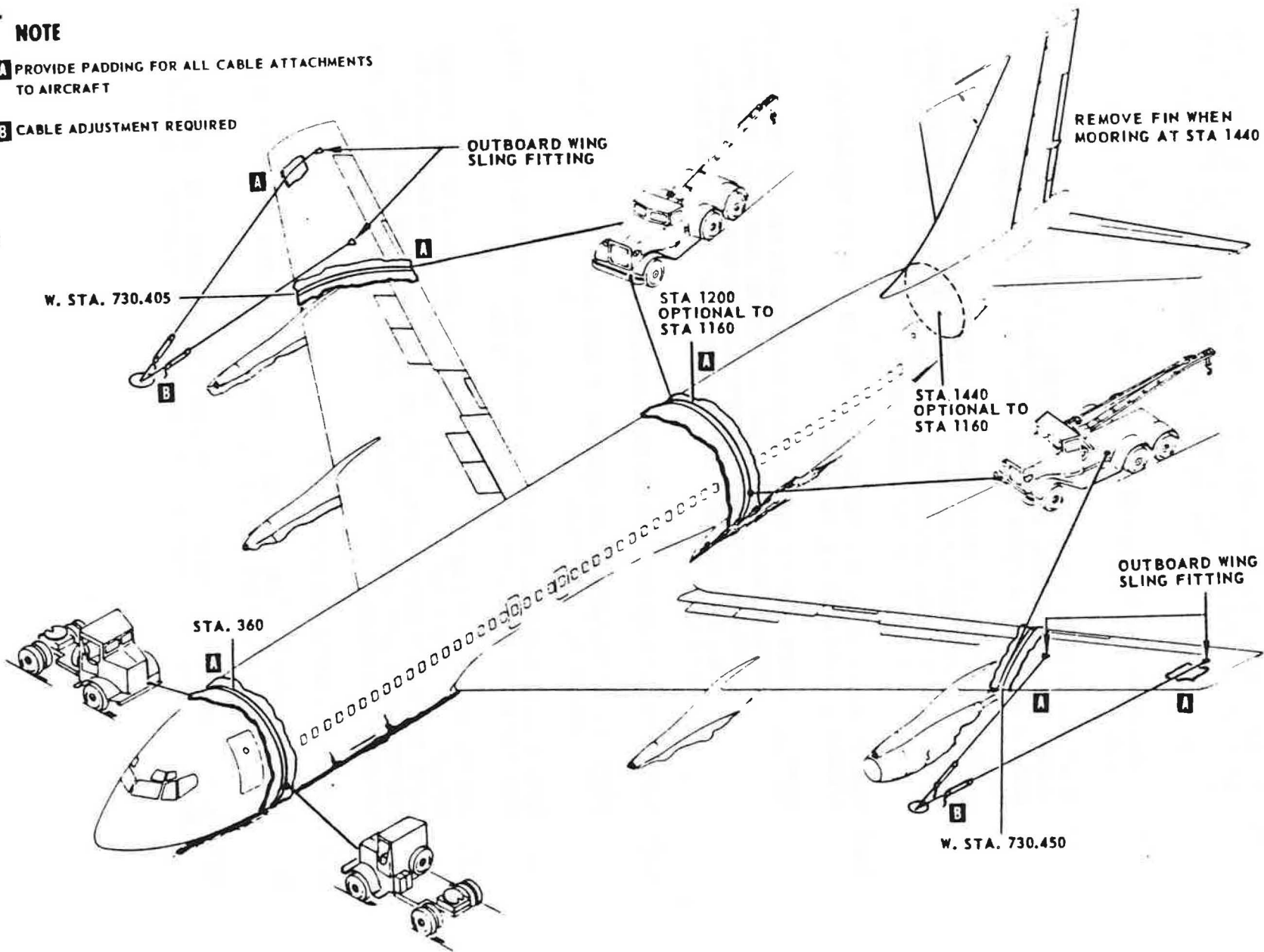
- (1) Moor airplane to restrict its movement. See paragraph C, Mooring Airplane.
- (2) Clear ground, on which bag is to be placed, of all sharp or rough objects and ensure that underside of structure to be lifted has no sharp protrusions or other possible sources of damage to bag. Any such hazards should be removed or covered with a thick padding.
- (3) Position a bag near each location shown on figure 201, undo tarpaulin cover straps and remove inflation hose.
- (4) Spread the tarpaulin cover flat, unroll the bag and arrange the bottom of the bag so it is flat and properly centered on the cover.
- (5) Unfasten outlet covers and ensure that each outlet sleeve is properly tied off to prevent air escaping.
- (6) Replace sleeve inside its base reinforcement, and close and secure outlet covers.

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**NOTE**

**A** PROVIDE PADDING FOR ALL CABLE ATTACHMENTS TO AIRCRAFT

**B** CABLE ADJUSTMENT REQUIRED



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Airplane Mooring for Pneumatic Bag Restring  
Figure 202



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- (7) Maneuver tarpaulin cover into position, attempting to get the inlet valve as near the air supply source as possible. The cover should be positioned so that the bag will have maximum contact with the structure.
- (8) Remove valve cap and attach inflation hose to bag and to air supply source.
- (9) Start the blowers and inflate the bags. Progressively crib the inspar area of the wing and under bulkhead 360 in fuselage to provide secondary support in the event of a bag collapse.

**CAUTION:** KEEP THE AIRPLANE LEVEL TO PREVENT SLIPPING OR TILTING. WHERE TERRAIN AND AIR SUPPLY SOURCE PERMIT LIFTING, BAGS SHOULD BE INFLATED SIMULTANEOUSLY IN ORDER THAT BOTH WINGS ARE RAISED AT THE SAME TIME.

- (10) Support airplane on its landing gear or, if this is impossible, on cribbing, crash dollies, or jacks.

**CAUTION:** JACKS MUST BE SET ON LEVEL GROUND WITH THE RAM VERTICAL TO AVOID IMPOSING SIDE LOADS ON JACK OR JACK PAD. USE STEEL OR WOODEN SUPPORTS OF SUFFICIENT THICKNESS AND BEARING AREA, TO DISTRIBUTE LOADS AND PREVENT JACKS FROM TIPPING OR SINKING.

- (11) Deflate bags by opening one or both outlets.

**NOTE:** In an emergency, the opening of both outlets reduces time needed for deflation.

- (12) Detach inflation hose, and replace valve cap. Move tarpaulin cover, with bag still on it, to an uncongested area.
- (13) Examine each of the bag components for oil, grease or other foreign matter. Oil or grease will hasten bag deterioration and should be wiped off with a clean cloth. Follow up by cleaning with a rag moistened with dry cleaning solvent P-S-661, and then wipe dry with another clean cloth.
- (14) Examine all parts and surfaces for damage.
- (15) Coil the inflation hose and secure with cord. Wrap metal fittings with cloth to avoid rubbing on bag.
- (16) Deflate the bag by compressing and rolling it towards the outlets. Having deflated it as much as possible by hand, securely tie off



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outlets with cord and stow outlets within their covers. Complete bag deflation with a vacuum cleaner or deflating pump at the inlet valve, or roll the bag tightly towards the inlet valve. Replace inlet cap.

- (17) Place rolled bag centrally on tarpaulin, place coiled inflation hose toward one end of rolled bag, fold over tarpaulin ends and secure strap.
- (18) Wrap rest of tarpaulin around bag and hose and secure remaining straps.

### E. Lifting One Side of Airplane

#### (1) General

- (a) When one main gear is collapsed the other main gear and the nose gear supports the airplane in a one-wing-down position. The low wing must be rotated until it is level with the opposite wing. Air bags are advantageous for lifting one side of airplane only. As the low wing comes up, the wing jack point moves outboard as it rotates about the opposite main gear. If a jack were to be used for such a lifting job, severe side loads would be induced, and the jack would require shifting outboard in increments to keep up with the outboard shift of the jack point.
- (b) With one main gear and the nose gear firmly in place, the airplane remains relatively stable if moored securely. Use mooring at sta 1200 as shown in figure 202. Since only one side of the airplane is to be lifted, the down-wing and center tanks should be defueled, with fuel left in the up-wing main tank to aid in rotating the down-wing up again. Since most of the fuel is outboard of the operable landing gear, the weight of the fuel reduces the lifting load under the down-wing.

#### (2) Use of Pneumatic Bags

- (a) Position bags centered on wing stations 387 and 472. Only two bag locations are required in this operation. (See figure 201.)
- (b) Refer to paragraph D, Lifting Airplane.

### 4. Nose Sling

#### A. General



## MAINTENANCE MANUAL

- (1) When only the nose gear is damaged, a crane may be used in combination with a lifting sling to lift the nose section into a dolly or to extend the nose gear. The lifting sling shall be a cable or strap capable of lifting and supporting loads of jacking point B. See 7-1-1, figure 201. The lifting sling shall be placed at station 360 and thick padding must be used to distribute the load. Even when a crane of sufficient capacity is available, the load at the nose should be released to about 4000 to 5000 pounds by ballasting in the aft section of the airplane. A load in the aft section, whether in the cargo compartment or spread evenly on the cabin floor, will move the CG aft. Using this method of lifting avoids the problem of rotation about the MLG centerline.

NOTE: If a crane is not available, use jacks and cribbing to lift nose. Refer to paragraph 2.D., Jack Airplane with Nose Gear Collapsed.

### B. Equipment and Materials

- (1) Lifting sling assembly (Boeing F72712 or equivalent).

NOTE: Lifting sling should be used with a spreader bar above the fuselage to reduce loads on the side of the fuselage.

- (2) Padding to protect airplane surface.
- (3) Aft body jack, refer to 7-1-1, Airplane Jacking.
- (4) Wood timbers suitable for cribbing under fuselage.

### C. Lifting Nose With Sling

- (1) Set main gear parking brakes or place wheel chocks under wheels.
- (2) Place thick padding at station 360 and install lifting sling and spreader bar.
- (3) Attach lifting sling to suitable crane.

CAUTION: DO NOT EXCEED LIFTING LOADS OF SLING ASSEMBLY.

- (4) Using cradle or similar structure at station 360, crib forward fuselage as the airplane nose is raised by crane.



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- (5) Position jack at aft fuselage jack pad G and follow jack pad down with jack as airplane nose is being lifted. Do not exceed jack point load limit of aft jack pad or allow lifting sling to be overloaded.

NOTE: Make allowance for moving jack aft as the airplane rotates about the main landing gear. Check that hydraulic jack screw is raised to sufficient height to eliminate possibility of jack hydraulic ram contacting tail skid.

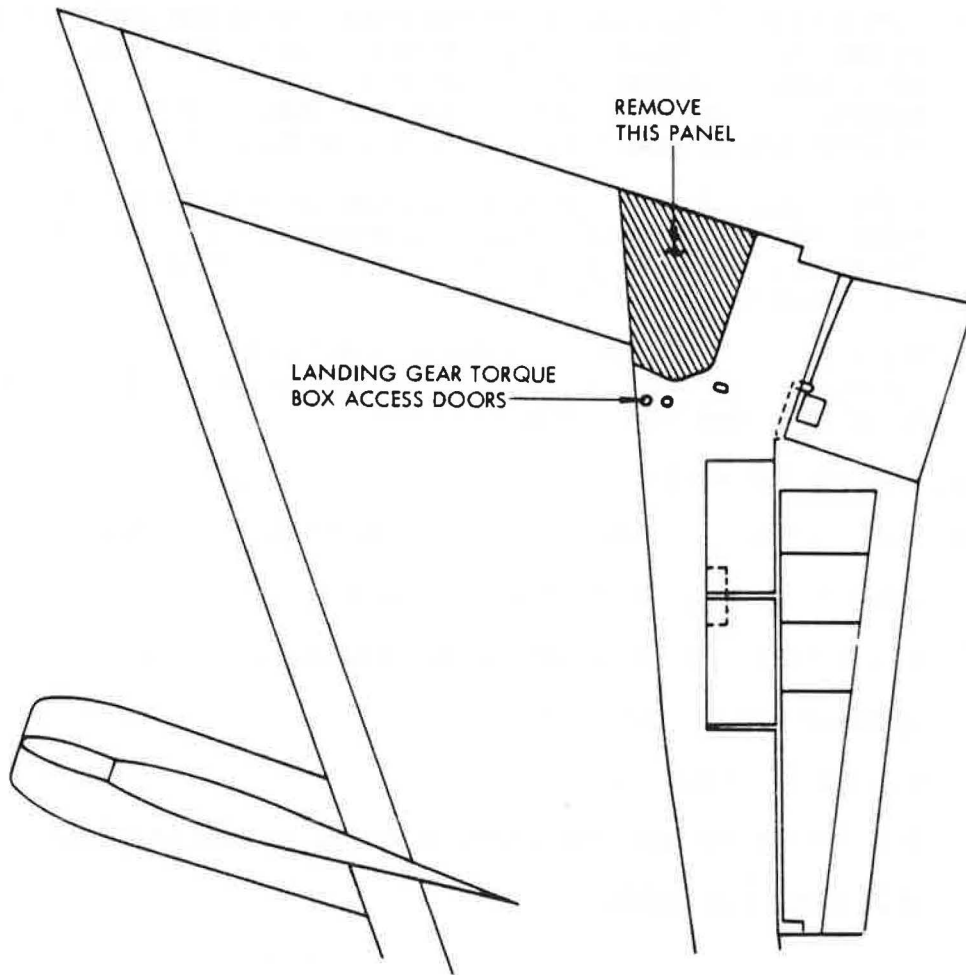
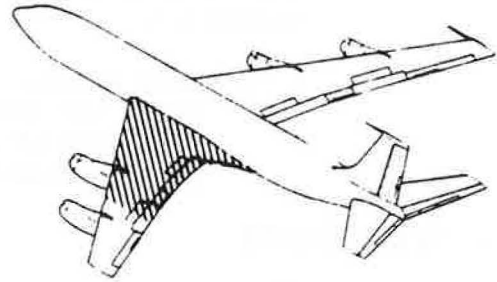
### 5. Mobile Cranes

#### A. General

- (1) When a damaged airplane is on the runway or on any surface that can support large mobile cranes, the main landing gear trunnion or the aft trunnion fitting may be considered as points to attach hoisting cables. Airplanes on surfaces that are unable to support the weight of large mobile cranes must be lifted by jacks or pneumatic bags.
- (2) A three point lift system uses the nose of the airplane as one point and the main landing gear trunnions as the other two points. The method can be used only if the trunnion support was not wiped out during the crash landing.
- (3) The wing panel immediately inboard from the two landing gear torque box access doors must be removed to gain access to the main gear trunnion. (See figure 203.)

#### B. Equipment and Materials

- (1) Mobile cranes, two 25 ton (minimum) and one 10 ton (minimum)
- (2) Hoisting cables, steel, 1/2 inch diameter
- (3) BOEING F72712, Nose Lifting Sling Assembly or equivalent
- (4) Spreader bar for nose sling
- (5) Mooring Equipment
  - (a) Cables and rope sufficiently strong to moor airplane.
  - (b) Block and tackle





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(c) Padding to insert between cables and airplane

### C. Attach Cables to Main Gear Trunnion

(1) Remove wing panel immediately inboard from the two landing gear torque box access doors. (See figure 203.)

NOTE: The wing panel is fastened by rivets.

(2) If main gear trunnion is still intact:

(a) Disconnect flexible pneumatic and hydraulic brake lead-in lines attached to clamp on trunnion. (See figure 204.)

(b) Insert hoisting cables, between main gear trunnion and main landing gear rib.

(c) Slip each cable around trunnion and pull up.

(d) Attach cables to crane and take up slack.

(3) If main gear trunnion has been severely damaged but trunnion support is still intact:

(a) Unbolt trunnion bearing cap from aft trunnion fitting.

(b) Slide out trunnion. Refer to Landing Gear, Chapter 32.

(c) Bolt trunnion bearing cap back on aft trunnion fitting.

(d) Slip hoisting cables through opening.

(e) Place padding between cables and fitting.

(f) Attach hoisting cables to crane and take up slack.

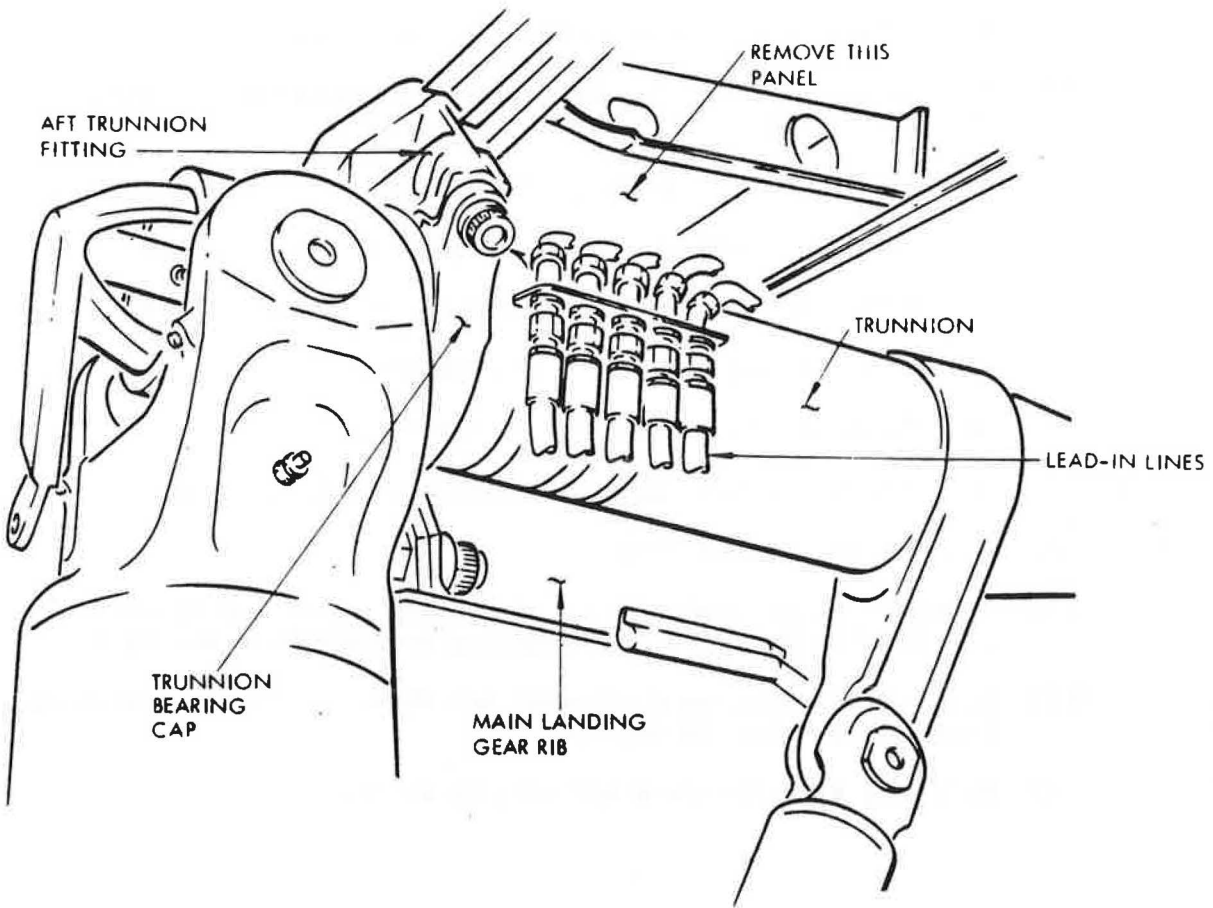
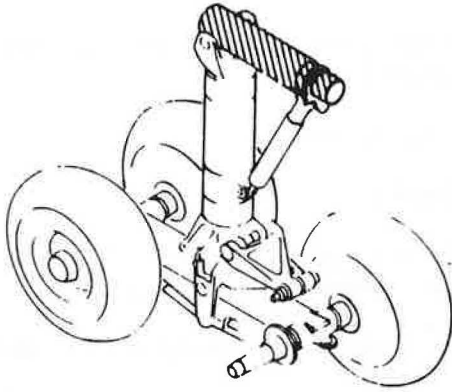
### D. Install Sling on Airplane Nose

(1) Install a sling, preferably a wide band, around the fuselage at Body Station 360. Use thick padding to distribute the load.

(2) Ensure that sling has a spreader bar above the fuselage to reduce loads on the sides of the body.

(3) Hook nose sling to crane and take up slack.

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### E. Stabilize Airplane

- (1) Refer to Mooring Airplane, page 208.

### F. Lift Airplane

- (1) Ensure that slings on all three points are secure.
- (2) Lift airplane.
- (3) Move airplane to desired location.



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SHORING

1. General

- A. Shoring can be accomplished by using contour boards that conform to the lower wing and body surfaces. Contour boards should be made from four thicknesses of 1-inch plywood, laminated together and secured by bolts. The contour surfaces should be padded with 1/2-inch gray felt and covered with 10-ounce canvas duck.
- B. Inboard wing and aft body jacks should be used while shoring airplane. The body should be supported at the aft body jacking point during shoring of wing or fuselage. Refer to 7-1-1 for maximum loads at inboard wing and aft body jacking points.
- C. Contour shoring should be restricted to areas near the forward and aft cargo doors on the fuselage or to major structural bulkheads. On each wing contour shoring should be limited to the interspar areas shown in figure 201.
- D. Shoring of cargo inside the airplane must comply with Section 65 of the Boeing Weight and Balance Control and Loading Manual.

