AEROSPACE INFORMATION REPORT

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Superseding AIR1800A

Aircraft Tail Bumpers

RATIONALE

This SAE Aerospace Information Report (AIR) was reviewed during the Five-Year Review cycle during meeting A-5B Meeting 109 and determined by the committee to be balloted for stabilization.

STABILIZED NOTICE

This document has been declared “Stabilized” by the SAE A-5B Gears, Struts and Couplings Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. SCOPE:

This SAE Aerospace Information Report (AIR) covers the field of civilian, commercial and military airplanes and helicopters. This summary of tail bumper design approaches may be used by design personnel as a reference and guide for future airplanes and helicopters that require tail bumpers. Those described herein will consist of simple rub strips, structural loops with a wear surface for runway contact, retractable installations with replaceable shock absorbers and wear surfaces and complicated retractable tail landing gears with shock strut, wheels and tires. The information will be presented as a general description of the installation, its components and their functions.

1.1 Purpose:

To document the design approaches used for tail bumpers in contemporary airplanes and helicopters.

2. REFERENCES:

The following publications contain information relative to applications of tail bumpers. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP1107 Tail Bumpers for Piloted Aircraft

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-A-8863A Airplane Strength and Rigidity Ground Loads for Navy Procured Airplanes, dated July 12, 1974

3. REASONS FOR TAIL BUMPER:

The reasons tail bumpers are required on certain current aircraft are listed as follows:

a. Inadequate tail clearance in landing attitude.
b. Prevent back tip over rotation during ground handling.
c. Over rotation on takeoff.
d. Tip back during deck handling on aircraft carrier.
e. For tail protection, tie down and jack point.
f. For protection against hard flared landings.
g. To protect tail rotor from hitting objects.

Some air vehicle designers (Douglas DC-10, MD-11, Airbus A320, A330, A340) do not use tail bumpers for reasons noted below:

a. Reduced maintenance and service problems without tail bumpers.
b. Increased ground clearance without tail bumpers.
c. Experience at some airframe manufacturers has shown that in the case of hard tail/ground impact damage to the fuselage is considerable with or without tail bumpers or skids.
d. Likelihood of tail strike is very low due to tail clearance or aircraft performance.

In all cases critical aircraft performance characteristics and dynamic analysis of motion of the aircraft under all moving conditions will decide the need for a tail bumper. This analysis will also determine the frequency of possible tail contacts, providing information necessary to determine the type of tail bumper required for a specific new airplane.

4. GENERAL DESCRIPTIONS:

Following is a brief description of tail bumpers on current aircraft.

4.1 Cessna Twins and Single Engined Airplanes:

Structural loop extending below the tail of the aircraft.

Figure 1 shows the loop contact surface and support structure that can be sacrificially failed in ground contact. The loop and support structure is readily replaceable. The loop may also be used as a tie down point.

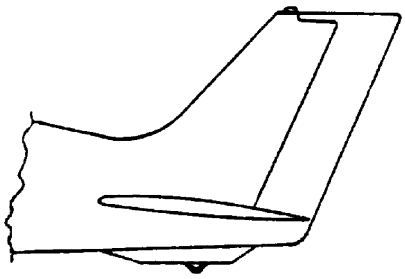

FIGURE 1

4.2 Piper Twins and Single Engined Airplanes:

Loop contact tail bumpers similar to Figure 1 are used.

4.3 Bell Helicopter Model 212:

Helicopter tail bumpers are generally fixed structure type, supported in the tail boom to protect the tail rotor from contacting the ground or landing deck. The tail bumper ground contact point is a hardened (Stellite) wear surface. Figure 2 represents the fixed tail skid in the Bell Model 212 helicopter. It is constructed of swaged steel tubing installed as a simply supported beam. The hardened contact surface is welded to the swaged tube.

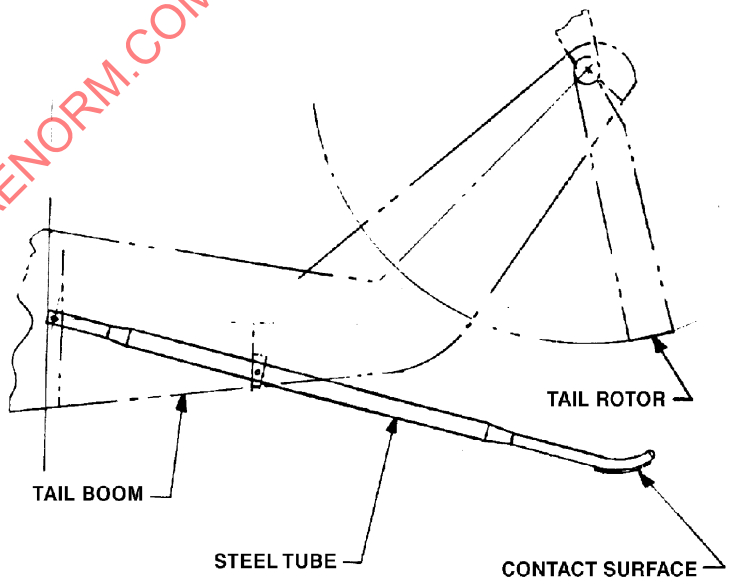

FIGURE 2

4.4 Boeing Vertol YUH-61A Helicopter:

Figure 3 depicts a fixed tail bumper with aft trailing arm/skid with pin jointed shock absorber. The shock absorber was solid media (silicone rubber compound) liquid spring. This type of shock absorber unit needs no servicing. This tail bumper was a partial emergency device. The unit was qualified for 50 landings at 18 ft/s descent. Its service life is far greater at lower contact velocities.

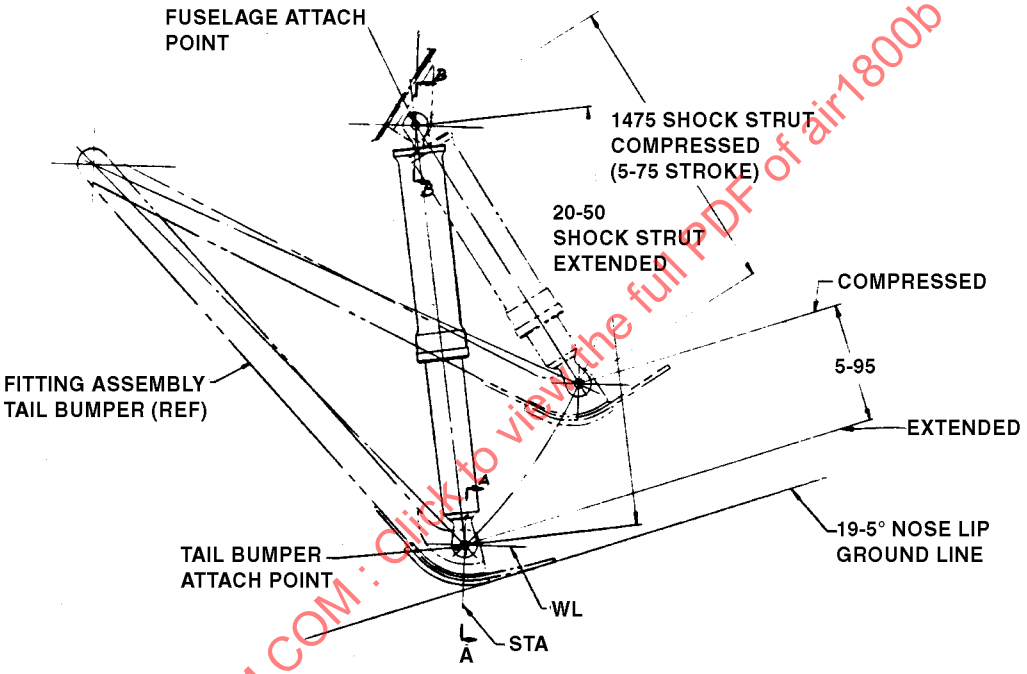

FIGURE 3

4.5 Boeing 727-200 Series Aircraft:

Figure 4 shows the general geometry and components of the retractable tail bumper on the 727-200 series aircraft. The tail bumper consists of a drag link, a yoke assembly, an energy absorber, and a hydraulic actuator.

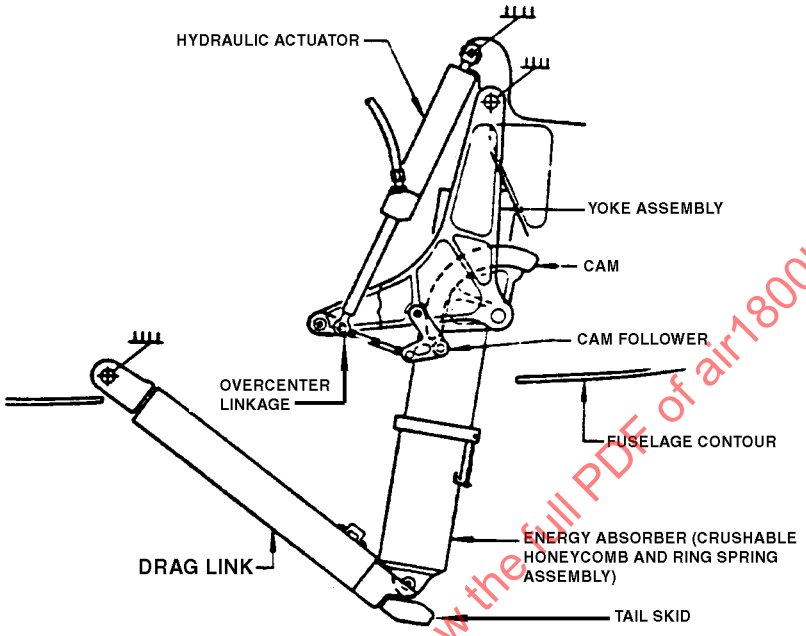

FIGURE 4

4.5 (Continued):

The tail bumper is held in the down and locked position by a cam follower forced against a cam by an overcenter linkage of the yoke assembly. The tail bumper is held in the retracted and locked position by an internal locking mechanism incorporated in the hydraulic actuator.

The energy absorber consists of a telescoping inner and outer cylinder assembly with a crushable honeycomb cartridge in the lower half and a ring spring assembly in the upper half. When the drag link contacts the runway, the shock tends to move the drag link aft and up to compress the cylinder assembly. The lower or inner cylinder telescopes within the outer cylinder and compresses the energy absorber cartridge and the spring assembly. The ring spring assembly provides the capability to repeatedly protect the airplane without excessive replacement of the energy absorber cartridge. The ring spring assembly absorbs the initial shock and will resist compression up to approximately 30,000 lb and 2-1/2 in before bottoming out. When the ring spring assembly has been bottomed and the energy absorber cartridge has been crushed 1 in, the indicator chip will shear off indicating that the cartridge should be replaced.

4.6 Lockheed L-1011-1, -15 Tail Bumper:

Figure 5 shows the L-1011 tail bumper which is located in the fuselage underneath the horizontal tail.

Energy absorption is provided by a modified oleo-pneumatic shock strut capable of retracting to the fully compressed position. The shock strut is cantilever supported in the aft fuselage structure. The shock strut contains a regulator valve to meter flow of hydraulic fluid during compression. The shock strut and retract actuator are concentric within the body of the strut. It is retracted by hydraulic pressure forcing the piston into the cylinder against an initial air charge which is used for bumper extension. The actuation is integrated and slaved with the landing gear control lever. Retracted and extended positions are indicated by proximity sensors. It is held in the retracted position by locked hydraulic fluid controlled by an uplock/unlock valve. The shoe is readily replaceable and the shock strut piston has a fuse to indicate if it has been overloaded and requires replacement.

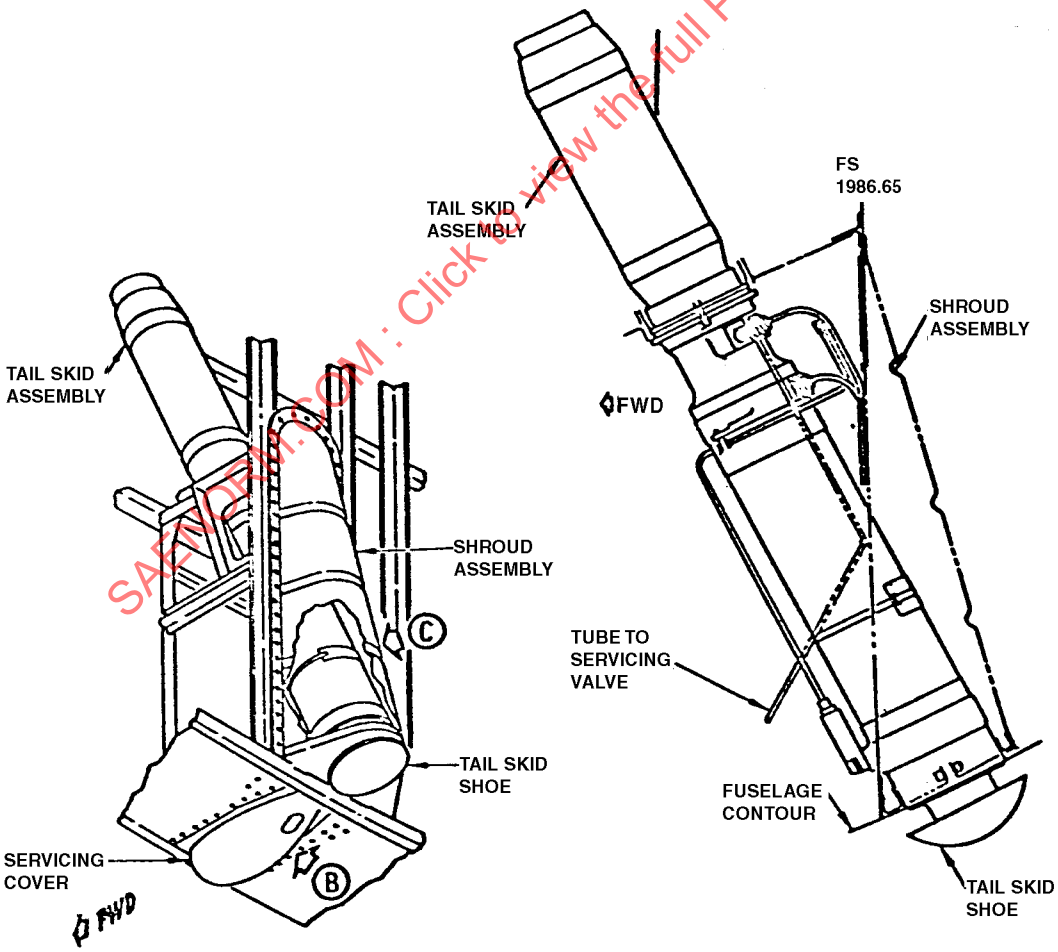

FIGURE 5

4.7 Airbus Industries A-300:

4.7.1 A-300 B2/B4: The tail bumper is covered by a plastic fairing and is not retractable. It is composed basically of a metal tail skid shoe, which is attached to a shock strut, mounted on an arm and the rear fuselage structure.

The cylinder of the shock strut consists of a light alloy honeycomb structure which is compressed when the skid shoe touches the runway, thus absorbing the shock. Figure 6 shows a side view of the general arrangement of the A-300 tail bumper.

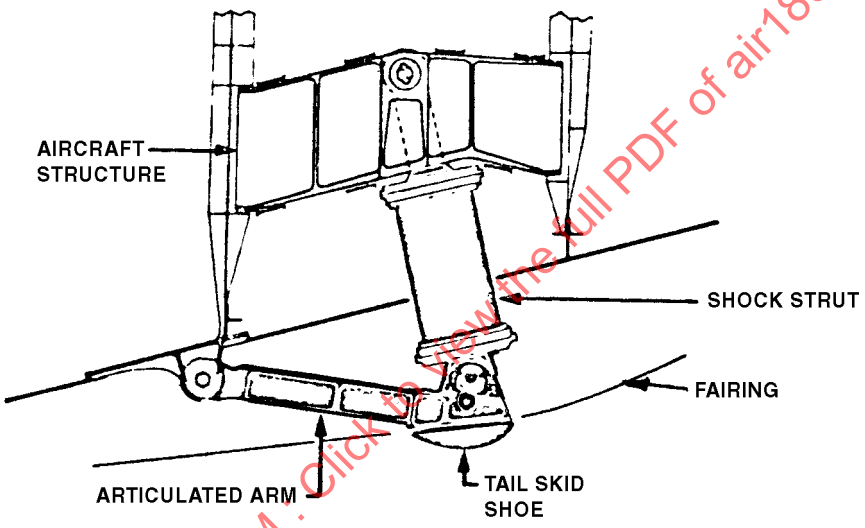

FIGURE 6

4.7.2 A300-600, A310: Figure 7 shows the tail bumper installation and backup structure. A .15 mm (.59 inch) abrasion of the tail bumper is allowed before replacement is necessary.

4.7.3 A320, A330, A340: On all new Airbus aircraft there is no tail bumper. Without a tail bumper there is more tail clearance. In case of a slight impact, there is a standard repair instruction available.

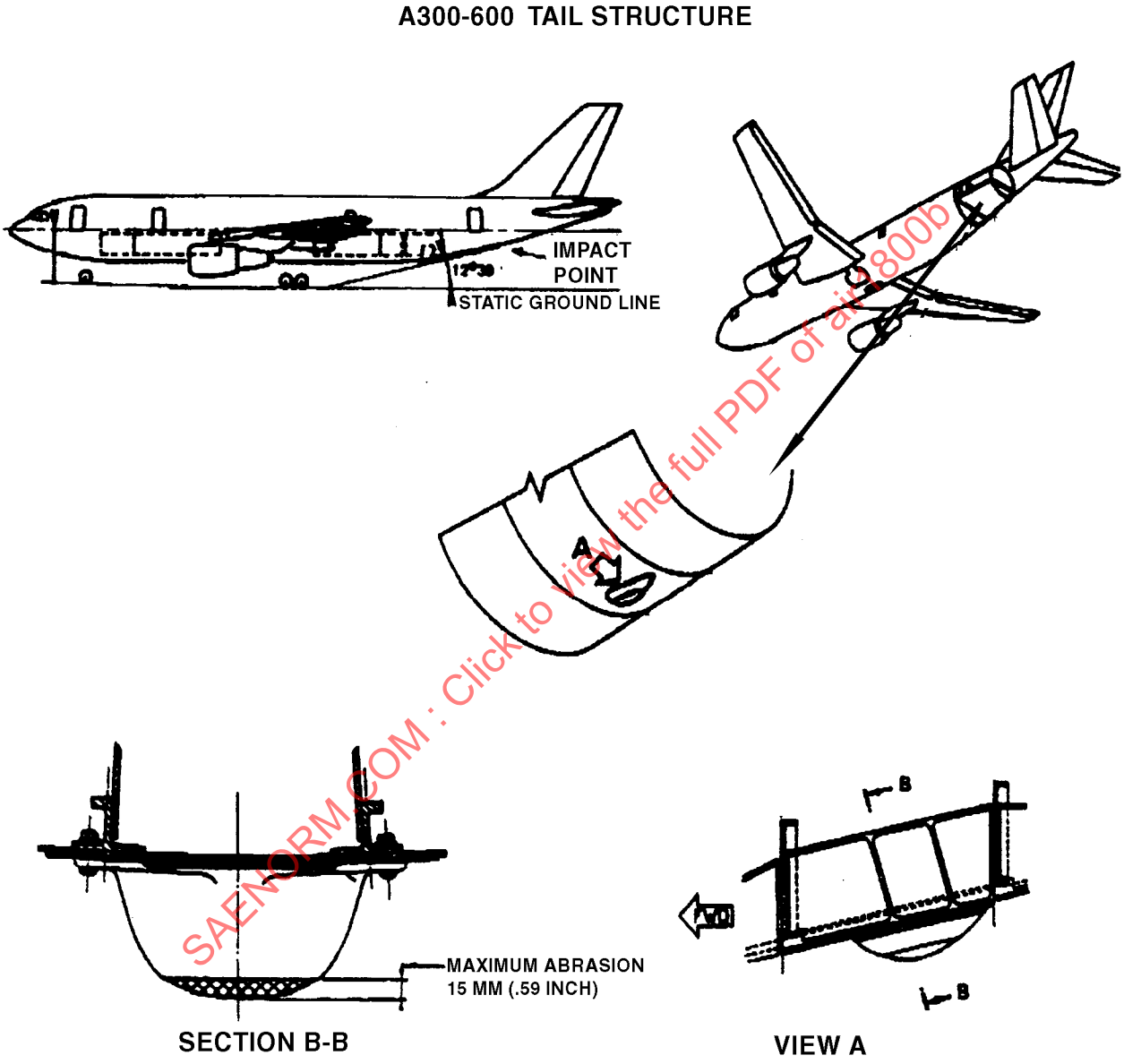

FIGURE 7

4.8 The Concorde:

The Concorde tail bumper resembles a small dual wheeled tail landing gear. The tail gear is designed to protect the engine nacelle rear section and the rear fuselage during takeoff or landing with the aircraft in the nose high attitude. Actuation is accomplished with a separate hydraulic actuator which is slaved to the landing gear control lever. Energy absorption is accomplished with a conventional nitrogen pressurized oleo-pneumatic shock absorber containing a metering pin. Instead of a skid surface the tail gear is fitted with two pneumatic tires. This tail gear arrangement was necessary because of critical performance characteristics causing frequent tail gear runway contacts. Figure 8 depicts a general arrangement of the Concorde tail landing gear.

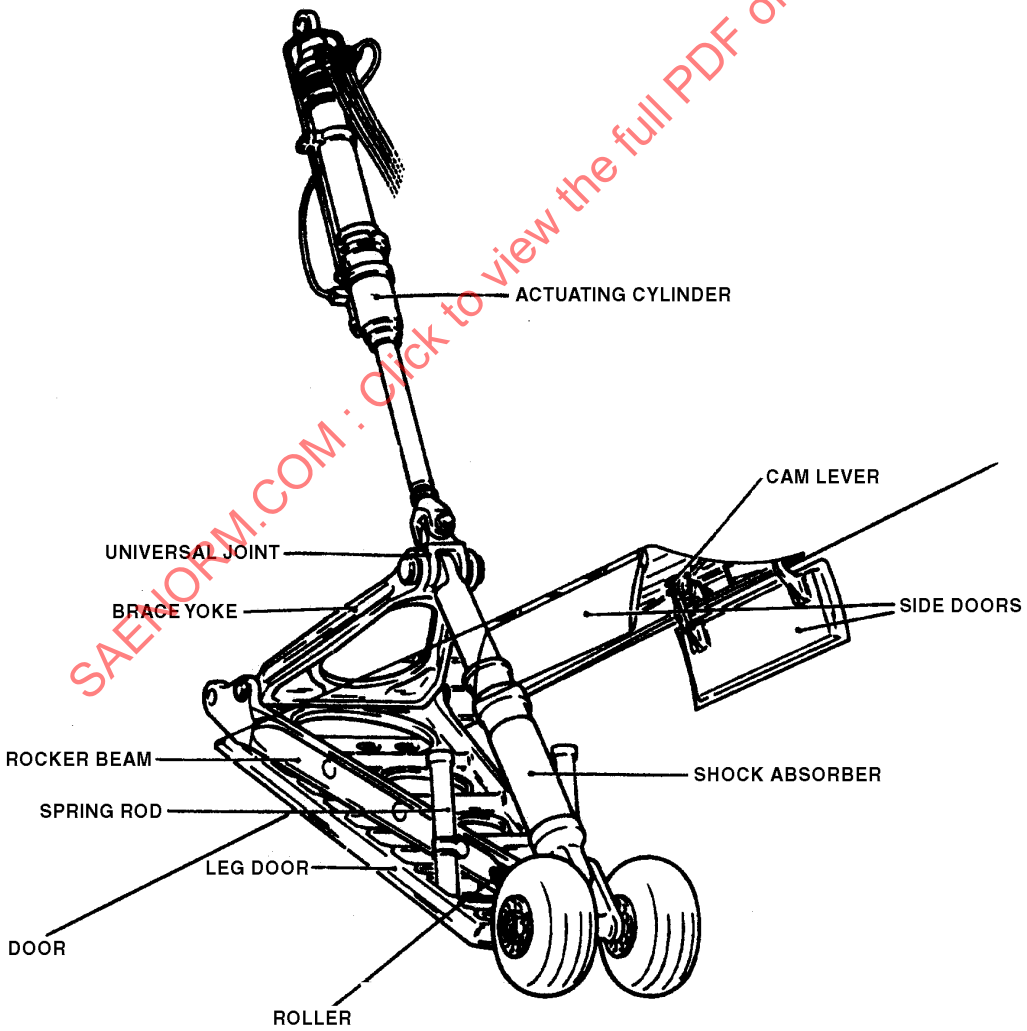

FIGURE 8