AEROSPACE INFORMATION REPORT

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AIR 1558

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Revised

INTERFACE PROTECTIVE DEVICES - GROUND EQUIPMENT TO AIRCRAFT

1. PURPOSE

This Aerospace Information Report (AIR) discusses damage to aircraft caused by ground equipment contact and suggests methods of protecting against that damage.

2. SCOPE

The protective device hereinafter called a "fender," is intended to serve its purpose during normal aircraft servicing and prevent damage during docking contact rather than agressive impact.

3. GENERAL DISCUSSION, MATERIALS AND APPLICATION

3.1 Fenders General: Most ground equipment damage to aircraft is described as skin punctures, dents and abrasions in the fuselage areas adjacent to and below passenger, cargo and galley doors. These loading and servicing areas are served by various types of servicing equipment. Most of these are equipped with rubber cylinders and/or other protective pads, positioned on the equipment at points normally in contact with, or in proximity to, the aircraft skin during servicing. Widely differing methods of installation and varying materials of these devices exist. Some of these have contributed directly to aircraft damage.

3.2 Operation General: It is necessary also to examine the approach of vehicles and equipment to the aircraft fuselage. Some servicing positions are at points on the aircraft where the fuselage tapers. This tapering may cause the driver and signalman to misjudge the interface with the airplane. The contacting surface may then be jammed against the fuselage. Also, some positions may not permit the vehicle contact surfaces to be brought parallel to the fuselage. Care must be taken to keep fender contacting surfaces sufficiently away from the fuselage to prevent over-compression if the aircraft settles.

3.3 Application: All ground equipment used in direct contact with or proximity to the aircraft should be fitted with non-marking cushion devices known as a "fender". Any portion of the equipment which normally comes within 6 in. (150 mm) of aircraft in normal operation should be so equipped.

3.4 Characteristics

3.4.1 Fenders shall be functional in all environmental conditions as outlined in ARP 1247A.

3.4.2 Fenders must resist lubricants, fluids and solvents used in aircraft servicing and maintenance.

3.4.3 Fender material shall be of a non-scuffing, non-marking type material.

3.4.4 Tensile strength of fender material shall be a minimum of 1200 psi (8.27 MPa).

3.4.5 Fender tear strength shall be a minimum of 650 pli (1.14 kN/cm).

3.4.6 Fender hardness shall have a nominal rating (Shore-A) per section 5.

3.4.7 Elongation rating of all fenders shall be a minimum of 65%.

4. DAMAGE CAUSES AND METHODS OF CONTROL

4.1 Excessive Approach Speed: Speed should be reduced appropriately when maneuvering near the aircraft. Docking speed of about 1 in. per sec. (25 mm/sec.) should be initiated at approximately 18 in. (500 mm) prior to contact with the working surface. Judgment/caution should be applied so as not to cause an aggressive contact with the aircraft. See 6.1.1.

4.2 Inadequate Coverage of Contact Area: Fenders should not be too short, failing to cover the entire length of contact area or leaving sharp cutting ends exposed. Cylinders should wrap around or extend beyond ends at least 2 in. (50 mm). Item 2B, Fig. 1, depicts correct design.

4.3 Cylinder Thickness Not Adequate: Large hexagonal head bolts may pierce the thin-walled (approximately .25 in. (6 mm), item 3, Fig. 1) rubber cylinder and then contact the aircraft skin. At the ends the cylinders compress easiest, therefore the thin-walled cylinder is especially ineffective in preventing aircraft damage.

4.4 Incorrect Choice of Fender: Consideration must be given to type of equipment and aircraft area contact. Some units have a sort of "pecking" action when braked and require fenders such as type "0" with greater compressibility.

4.5 Rubber Cylinder Deterioration: Some rubber materials are subject to deterioration from environmental conditions. Aircraft fluid contact with unbuffered rubbers can cause deterioration. An environmentally induced breakdown in the structure of fender can result in deteriorated performance as a protective device.

4.6 Method of Installation: Of even greater importance than thickness or condition in the effectiveness of these protective devices is the manner in which they are installed (Fig. 2).

4.6.1 The ends of the rubber cylinder must extend beyond the steel strap or channel. Item 5A, Fig. 1. depicts incorrect design.

4.6.2 The steel strap or channel can penetrate the end walls of the rubber cylinder. The strap is generally affixed to vehicle by large, damage inducing, hexagonal head bolts. Channel iron itself also has a cutting edge. (See Item 5B, Fig. 1.) These hazards must be taken into account.

4.6.3 The steel strap or channel iron length should be no longer than the contact area and the rubber cylinder ends should extend beyond the ends of the strap or channel by not less than 2 in. (50 mm). Item 5C, Fig. 1 depicts correct design. To eliminate damage from hexhead bolts, they can be replaced with countersunk, flathead bolts, tack-welded in place. Item 5D, Fig. 1, depicts correct design. To prevent damage from the cutting edges of the channel iron, the ends should be rounded off or bevelled. Item 5E, Fig. 1 depicts correct design.

5. TYPES OF FENDERS AND INSTALLATION PRACTICES

5.1 Variety of Fenders: The great variety of equipment and configuration of fenders makes it necessary to limit consideration to typical types. Fenders may be expected to differ in many respects by vendor, material, dimensions and design. Any indication as to recommended type is from the viewpoint of application rather than vendor.

5.2 "D" Type Fender: Shaped in a section like the letter "D" is used primarily on equipment which does not actually dock at the aircraft. It can have a higher durometer rating than A 50 Shore. "D" fenders this size (Fig. 3) shall be installed as detailed on Fig. 3 with a continuous flat steel bar (Fig. 3, Item A), which shall be completely concealed in the finished installation. (See 4.6.3). Fenders shall be secured with bolts, studs or screws, spaced not more than 18 in. (500 mm) on centers (Item C, Fig. 3). So that fastening bolt heads do not damage skin of aircraft if fender is compressed to its fullest, counter-sunk flat head fasteners should be used (Item 5D, Fig. 1.). Access holes and bolt hole diameters should be no larger than necessary for admission of tooling and fasteners.

5.3 "O" Type Fender: Shaped in a section like the letter "O" is used primarily on equipment which contacts the aircraft. As a general rule, these fenders have the softest durometer ratings of A40 to A50 Shore. Installation is similar to "D" type. Being heavier and less rigid, they require a heavier support bar and bolt hole spacing less than 6 in. (150 mm). See Fig. 1.

5.4 "D II" Type Fenders: Although it is a "D" fender, this cushioning device is used as a substitute for the "O" type. Not quite a true "D", the "D II" is a flexible flat piece of rubber until installed on the equipment facing to form a "D" shape. The "D II" fender is of a harder durometer rating of A50 Shore than the "O" type but is also suitable for face to face contact with aircraft (due to it being .5 in. (12 mm) thick, giving it much flexibility). Caution should be used when choosing this type of fender. It has less ability to protect aircraft during docking. This fender allows almost flat transfer of personnel and equipment from the front platform across the fender and into the aircraft (Fig. 4). Note in installation Fig. 4, item "A", steel bar is located below platform rubber flap to allow flat transfer, securing screw countersunk per Item "D", Fig. 4.

5.5 Corner Fenders: Used on types of equipment which could contact the aircraft at a corner. See Fig. 5 and 6. Note that the configuration may be that of a molded soft pad of durometer rating A40 or A50 Shore rather than the more firm vaned type shown. Installation is self-explanatory, with screws or small bolts.

5.6 Padded Pivot Fenders: These fenders (Fig. 7) are generally used on handrails or guardrails that have extendable sections for enclosing the opening between the aircraft and the handrail for guardrail structure. The pivot fender is bolted through the structure and when extended to the aircraft fuselage pivot to fit the fuselage contour. (Fig. 7, Item A).

5.7 Flat Fender: The fenders (Fig. 8) are generally used on heavy pieces of equipment which are not required to contact the aircraft structure but do come in proximity to same. They are generally recommended for use on vehicles that service at large door openings on the aircraft where the fender will not make aircraft contact caused by aircraft height changes. The fender is bolted into the face structure of the unit with the bolts recessed appreciably. (Fig. 8, Item 4).

6. NOTES AND DATA

6.1 Terminology Used in This Document:

6.1.1 Docking Speed: The average speed of a vehicle during the last 18 in. (500 mm) of travel before contact with the aircraft (See 4.1).

6.1.2 Tensile Strength: The ability to puncture rubber measured in pounds per square inch or SI equivalent (Pascal), (Refers to ASTM D412. - American Society for Testing & Materials)

6.1.3 Tear Strength: The tearing point measured in pounds per linear inch or SI equivalent (Newton/linear unit).

6.1.4 Durometer: The measurement of compressibility of rubber. The lower the durometer number, the more flexible/compressible.

6.1.5 Shore: Unit of durometer measurement.

6.1.6 Elongation Rating: The maximum elongation/distortion measured in percent by pulling the fender until failure.

6.2 Fender Material Comparative Characteristics:

6.2.1 Load Deflection: Elastomer load deflection plots are curves and have no straight line portion. Modulus or spring rate has a definite value only at a given deformation. A crude relationship between Shore A durometer rating and load deformation exists. (Ref. McPhersin & Klemin, "Engineering Uses of Rubber").

6.2.2 Hardness: Relative hardness is an indication of elasticity, flexibility, and other related properties of elastomeric parts. Hardness is measured by use of a Shore durometer. The "A" scale is used for soft materials, and provides an indication of hardness on a 0 - 100 scale by measuring the material's resistance to identation.

6.2.3 Examples of Shore "A" Readings:

ITEM	DUROMETER READING
Art Gum Eraser	30
Rubber Band	40
Rubber Stamp Characters	50
Pencil Eraser	60
Rubber Heel	70
Rubber Shoe Sole	80
Typewriter Platen	90
Pipe Stem	95

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SAE COMMITTEE AGE-2, AIR CARGO AND AIRCRAFT GROUND EQUIPMENT AND SYSTEMS

BASIC FENDER INSTALLATION

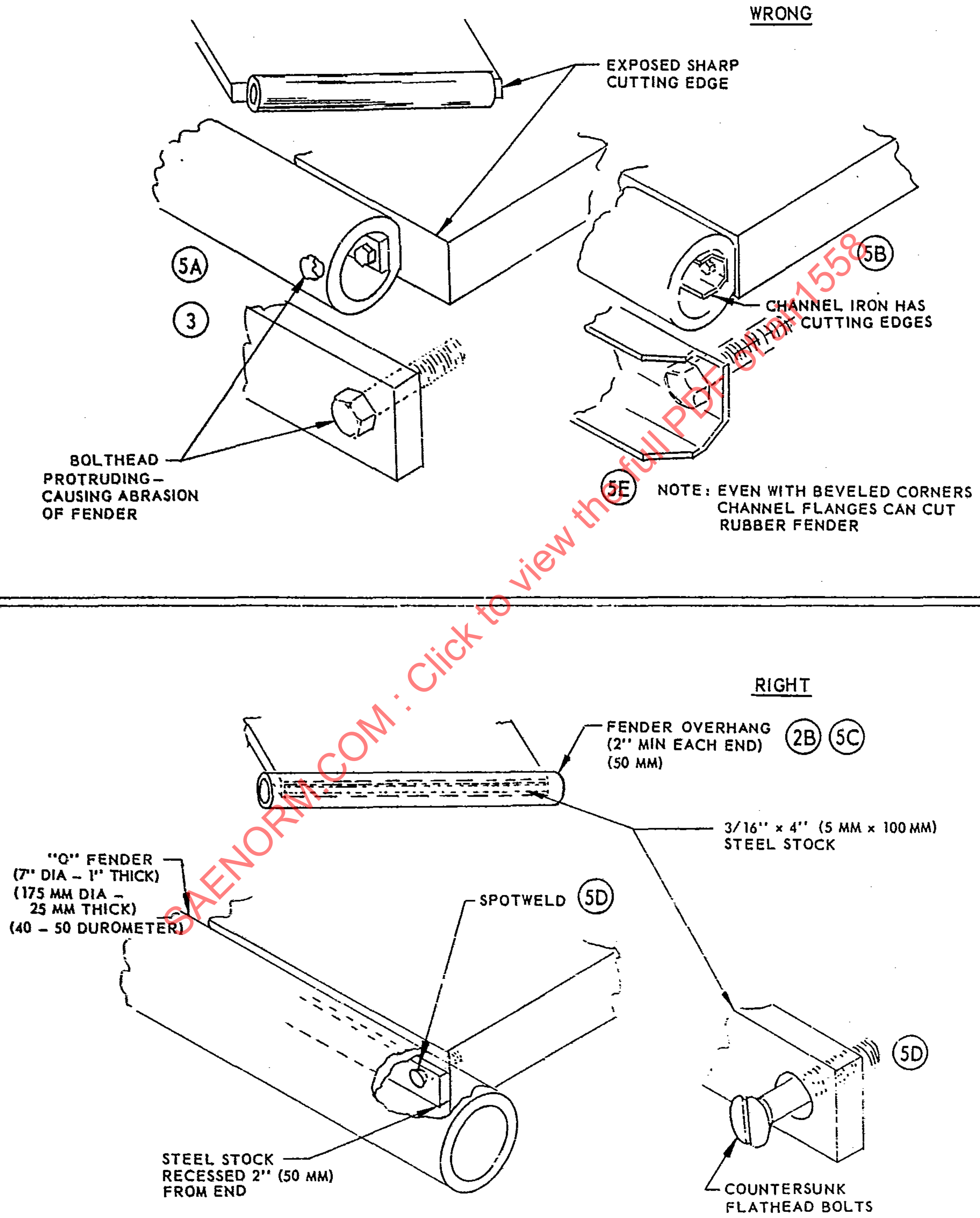
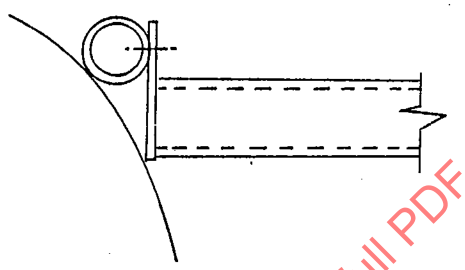


FIGURE 1

EXAMPLE OF CORRECT PLACEMENT OF BUMPERS OR FENDERS

WRONG



RIGHT

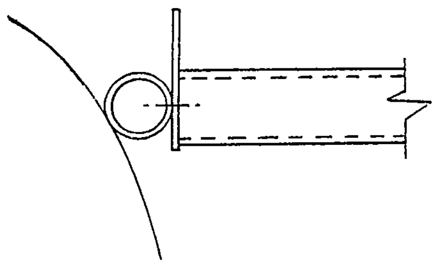


FIGURE 2

TYPE "D" FENDER INSTALLATION
(DIMENSIONS APPROX)

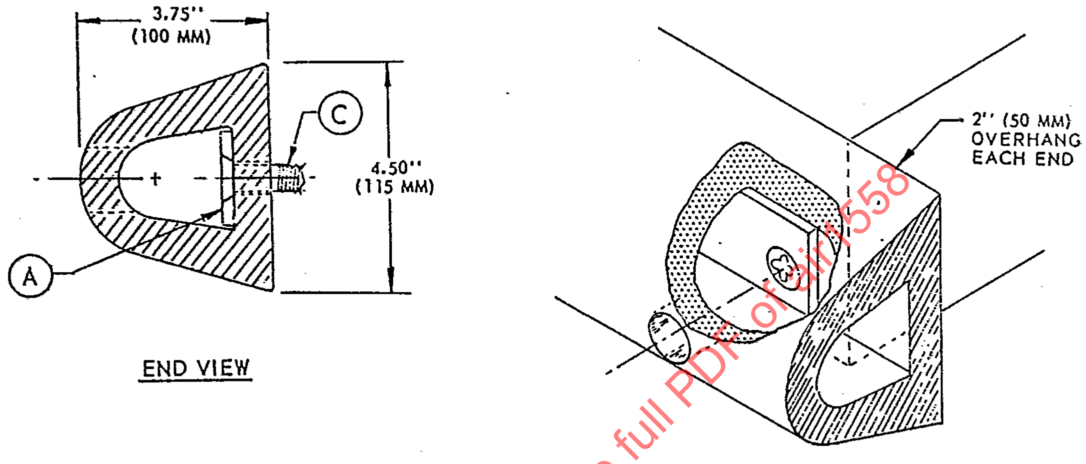


FIGURE 3

TYPE "D II" FENDER INSTALLATION
(DIMENSIONS APPROX)

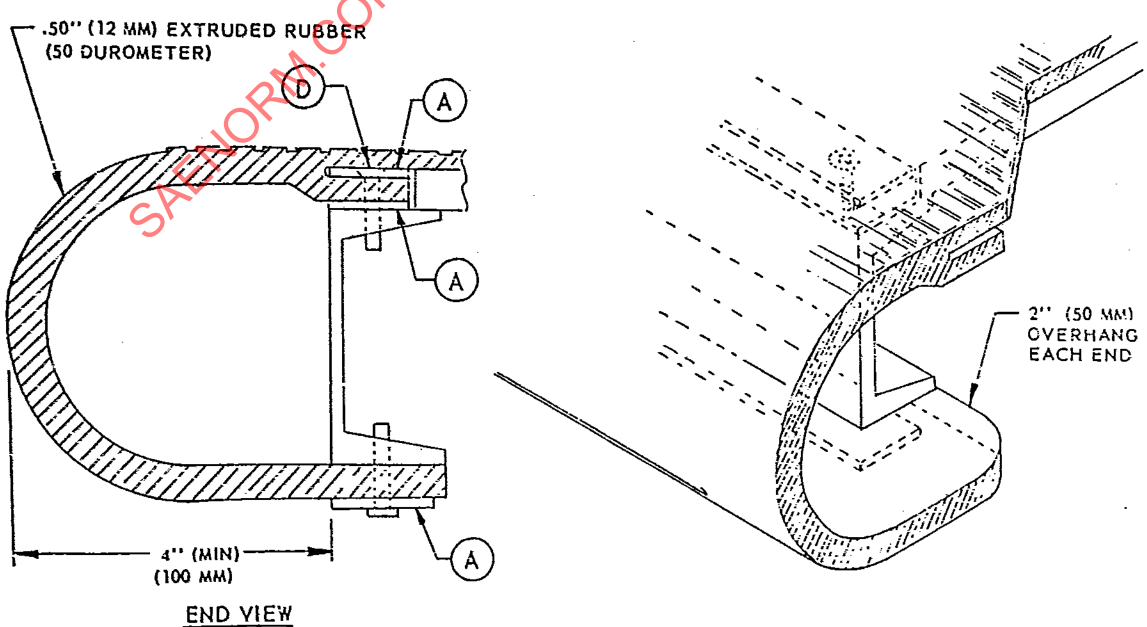


FIGURE 4

CORNER FENDERS
(DIMENSIONS APPROX)

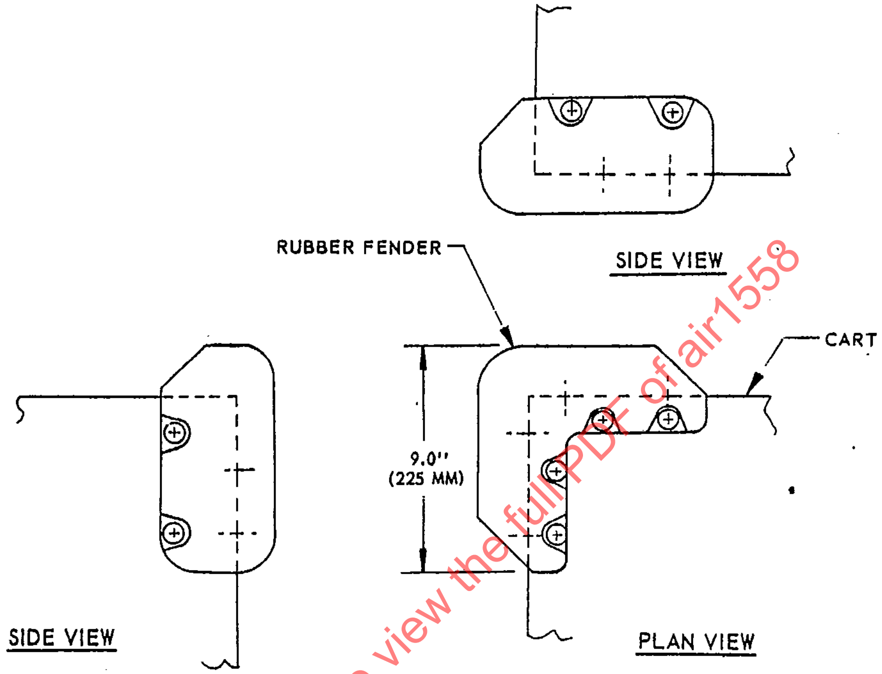


FIGURE 5

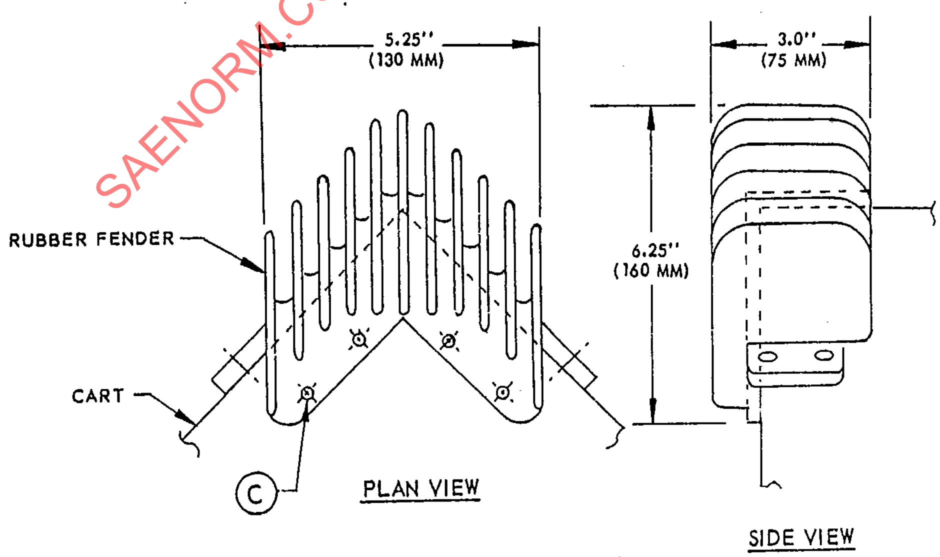


FIGURE 6