

V.F. - AIRCRAFT - ACCIDENTS - SEATS



**FAILURE OF
REARWARD FACING SEAT-BACKS
AND RESULTING INJURIES
IN A
SURVIVABLE TRANSPORT
ACCIDENT**

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c. 2

**FEDERAL AVIATION AGENCY,
Civil Aeronautical Research Institute
AERONAUTICAL CENTER
OKLAHOMA CITY, OKLAHOMA**

APRIL 1962

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FOREWORD

"Murphy's Law" says in effect that if a unit is capable of being installed in an aircraft in both a correct and an incorrect manner, sooner or later it will be installed *incorrectly*, possibly with dire results.

Although the seat manufacturer designed the seats (mentioned in this report) to thwart "Murphy's Law," slight dimensional changes made by the aircraft's operator permitted full exercise of the "Law."

In the case described here, modification of attachment fittings and incorrect installation of several sets of armrests on rearward facing seats permitted failure of the seat-backs in a moderate force accident. This failure reduced the desired degree of occupant protection and restraint and probably was a factor in producing the spinal injuries sustained by several occupants of the aircraft.

A detailed report providing a complete analysis of the force vectors and other pertinent factors involved in this accident is being prepared and will be released at a later date.

FAILURE OF REARWARD FACING SEAT-BACKS AND RESULTING INJURIES IN A SURVIVABLE TRANSPORT ACCIDENT

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ABSTRACT

Photographs with captions showing seat-back failures and their causes and a description of the injuries sustained in a relatively low force transport accident are presented.

THE ACCIDENT

While making a night ILS-GCA approach, a Convair 340 struck a shallow embankment at about 85 knots, slid across a railroad track and a macadam road, struck another shallow embankment and slid to a gradual stop, just short of the intended runway. All landing gears were collapsed and both engines were torn free; there was no fire.

Despite extensive damage to portions of the belly structure, the cabin floor and fuselage remained intact with the exception of a circular tension tear extending from the floor (at the wing's forward spar station) on both sides up through the walls and ceiling structure.

All passenger seats remained attached to the floor fittings; however, some of these seats, as well as the crew seats, sustained component failure. Galley equipment in the rear of the aircraft tore free, obstructing a rear exit door.

Of the twelve occupants aboard - all of whom survived - five were uninjured, five sustained non-dangerous injury, and two had minor injury. Four of the five non-dangerously injured persons had spinal injuries - two of these were sitting in rearward facing seats (Row No. 1), whose seat-backs collapsed.

Photographs 1, 2, and 3.

One rearward facing survivor who sustained serious spinal injury reportedly was sitting in the position shown, looking out the window toward the No. 1 engine at the time of impact.

Seat-back "A" failed completely at its point of attachment to the load bearing armrest (arrow No. 1). Seat-back "B" although not failing, went through its complete recline range, probably due to inadvertent operation of the recline release lever (arrow No. 2).

There are several possible means of inadvertently unlocking the recline mechanism; (a) the occupant may have had the fingers of his left hand on the release lever at the time of impact (arrow No. 2, photo No. 1) acceleration of his hand could have caused the recline lock to disengage; or (b) if the occupant's leg was in the position shown in photo No. 2 (instead of up over the armrest) acceleration of the knee up against the recline release lever (arrow, photo No. 3) may have caused inadvertent release.

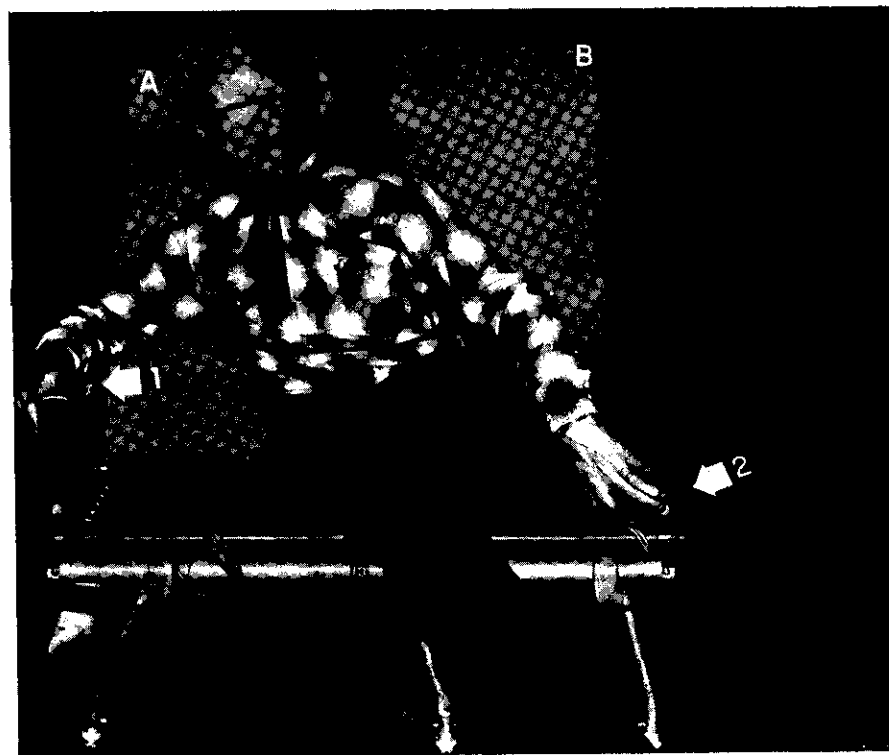


PHOTO 1

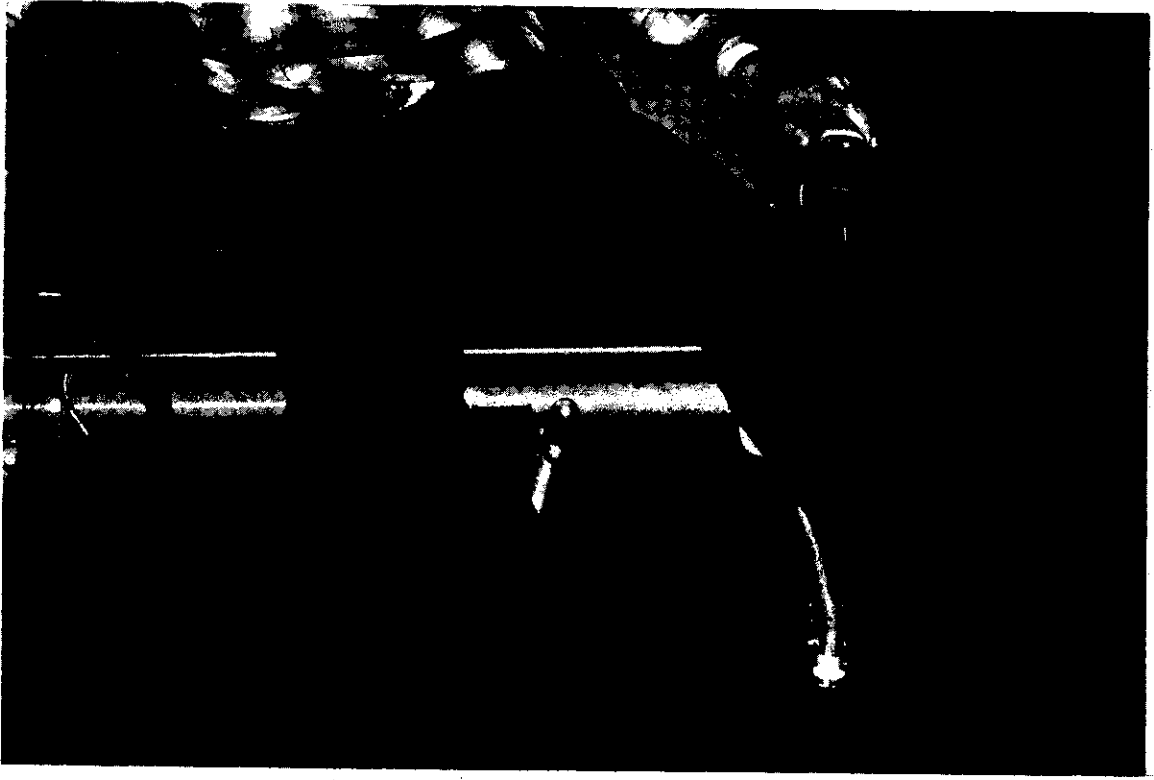


PHOTO 2

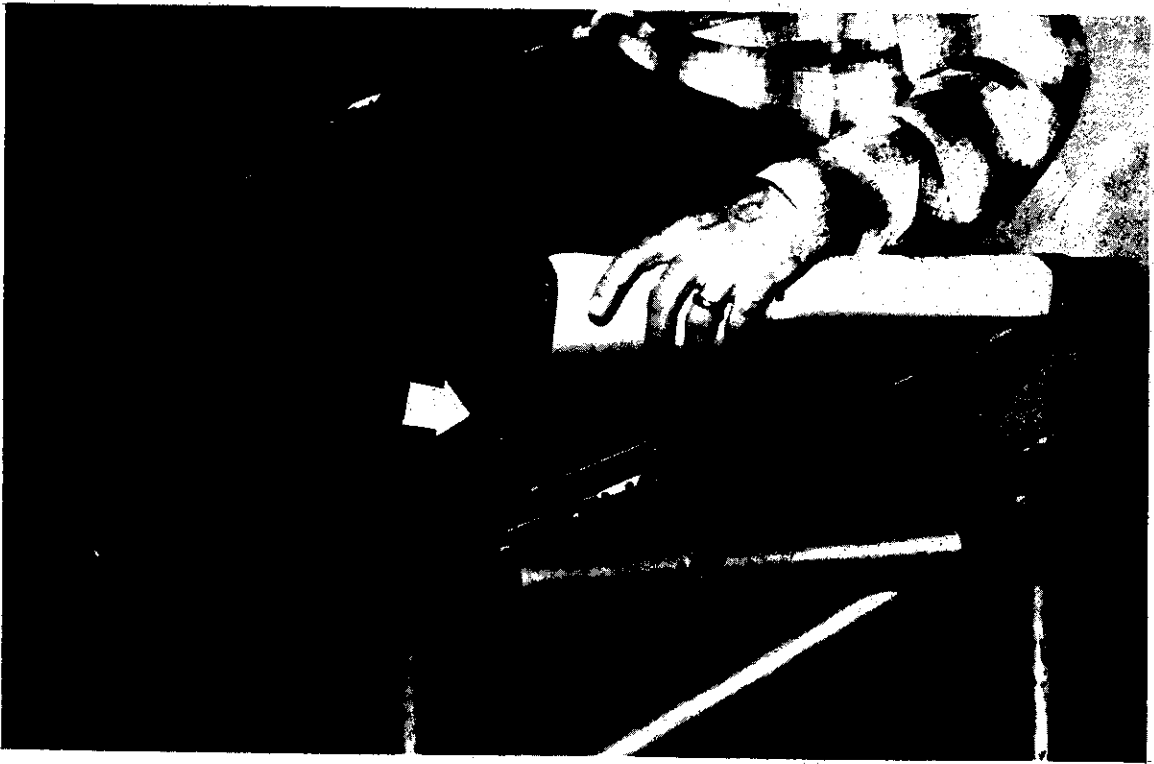


PHOTO 3

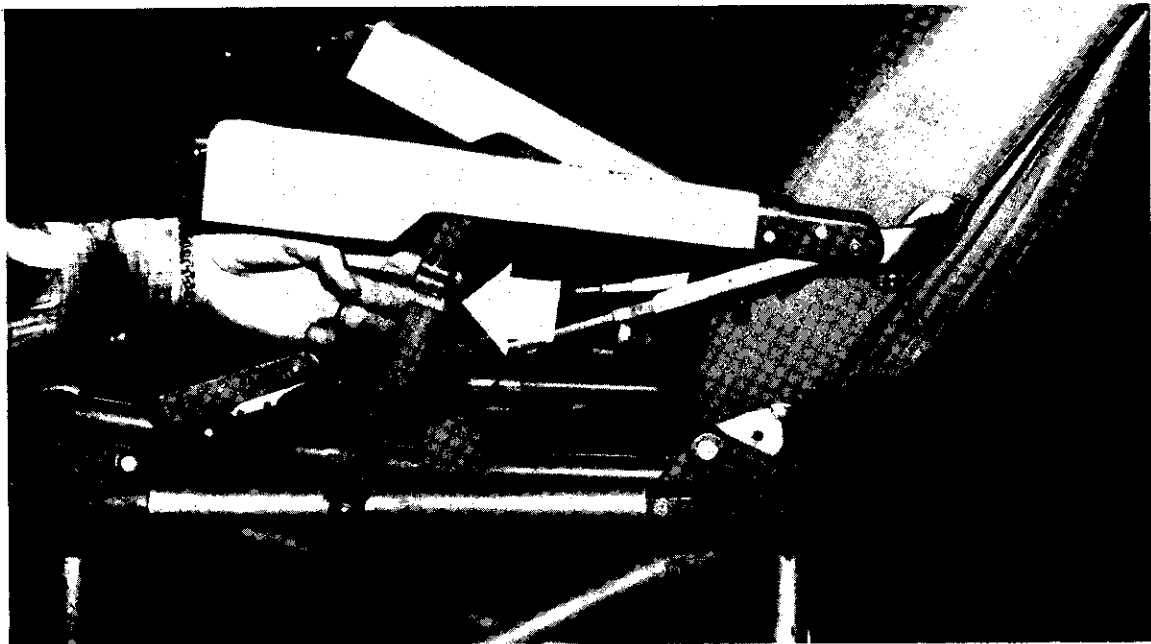


PHOTO 4

The armrest adjacent to, or below, the occupant's left was distorted and its cast support arms were fractured (arrow, photo No. 4) in an outward (toward the aisle) direction.

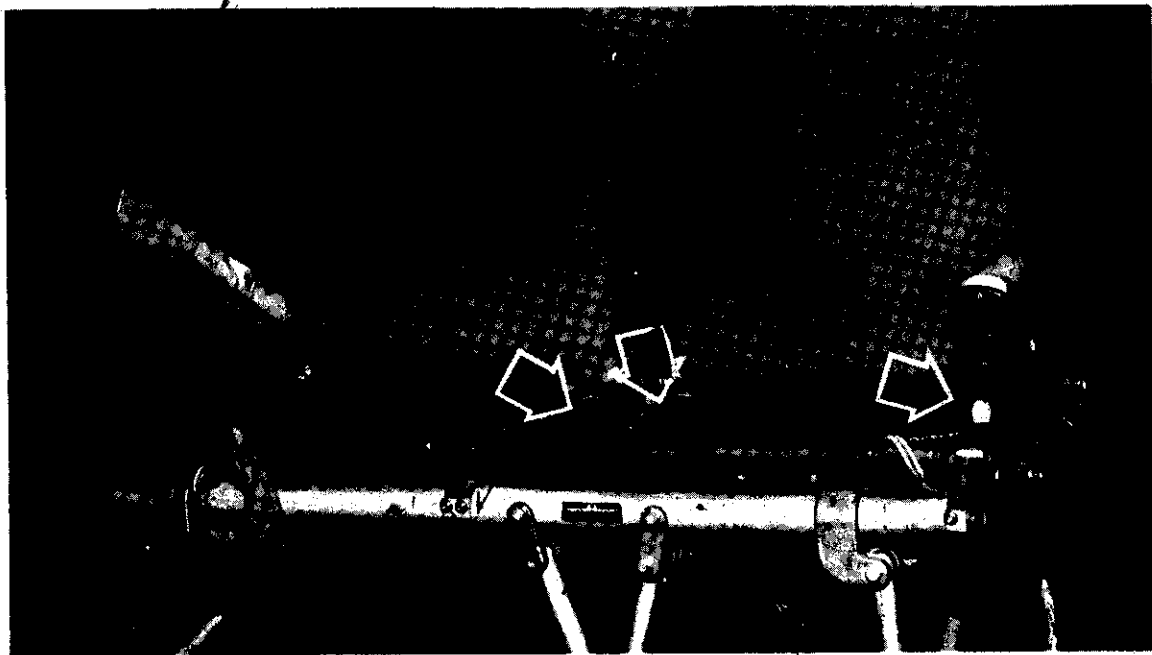


PHOTO 5

Three longitudinal tubes (arrows, photo No. 5) that carried the major vertical load imposed by the occupant during the impact were distorted downward.

Of the three armrests normally installed on these (two passenger) seats, two (2) are load bearing units, i. e., rearward acting loads on each seat-back are transmitted from one side

(arrows No. 1 and No. 2) of the seat-back structure to the main seat-bottom frame through the load bearing armrest (which also includes the recline mechanism).

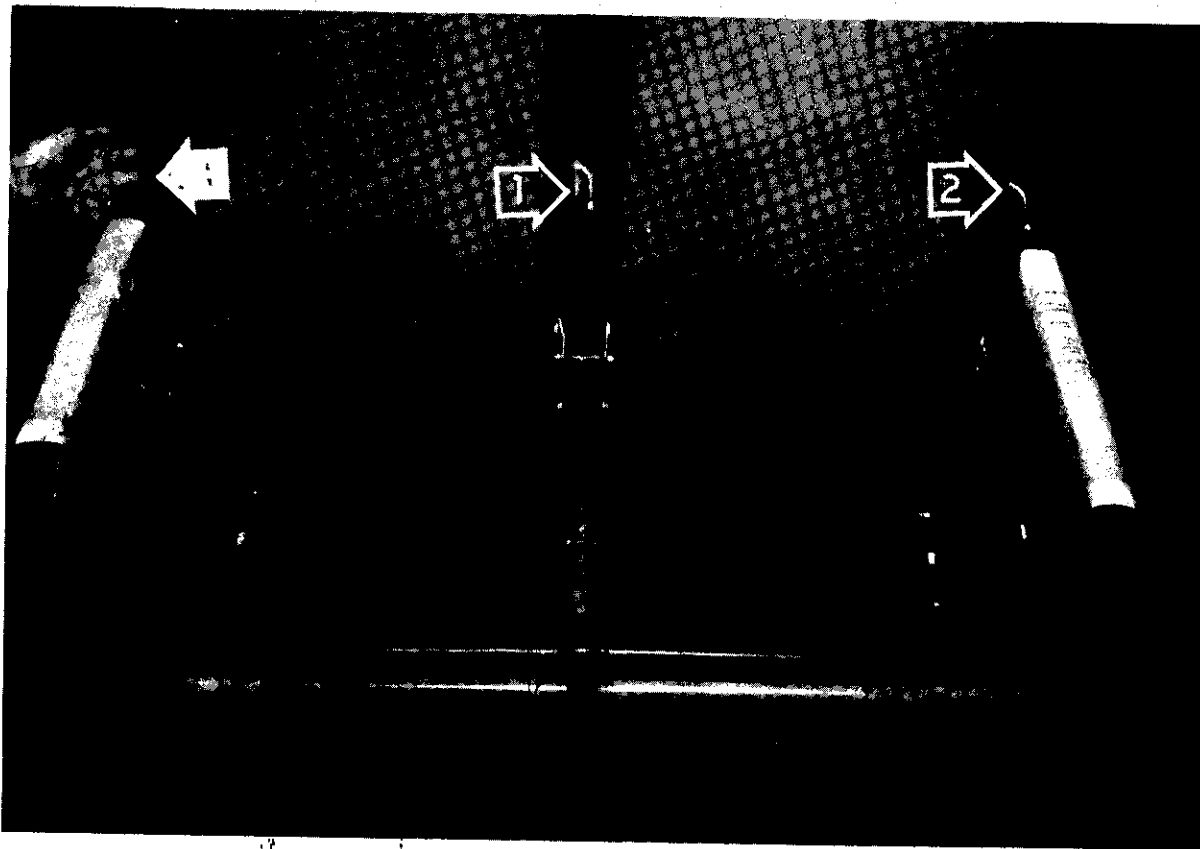


PHOTO 6

The third armrest (not shown in photo) is supposed to be a *non-load* bearing unit (it merely articulates with the seat-back) and provides no support for loads imposed against the seat-back by the occupant. Normally, it is installed at "A."

However, in the seat shown in photo No. 6, the load bearing armrest had been removed from its required position in the center of the seat and re-installed in place of a *non-load* bearing armrest at position "A." The seat-back/armrest attachment fitting at "A" failed (arrow) during the crash.



PHOTO 7

The seat-back/armrest attachment fitting (aluminum alloy casting) failed in two places; (a) at the point where it is bolted to the steel seat-back tube, and (b) at the armrest pin, (arrows). This fitting is *not* designed to support the seat-back loads imposed in a rearward direction; it is only designed for use with a non-load bearing armrest. It should be noted that this fitting normally has a boss of a width which prevents attachment to a load bearing

armrest. However, this boss was found to have been *filed* off to allow clearance for insertion into the load bearing armrest.

The two armrest attachment fittings shown in Photo 8 are dissimilar in strength and somewhat different in appearance. The one on the right (arrow No. 1) is steel and is welded to the lefthand steel seat-back tube. The one on the left (arrow No. 2) is an aluminum alloy casting and is bolted to the righthand seat-back tube.

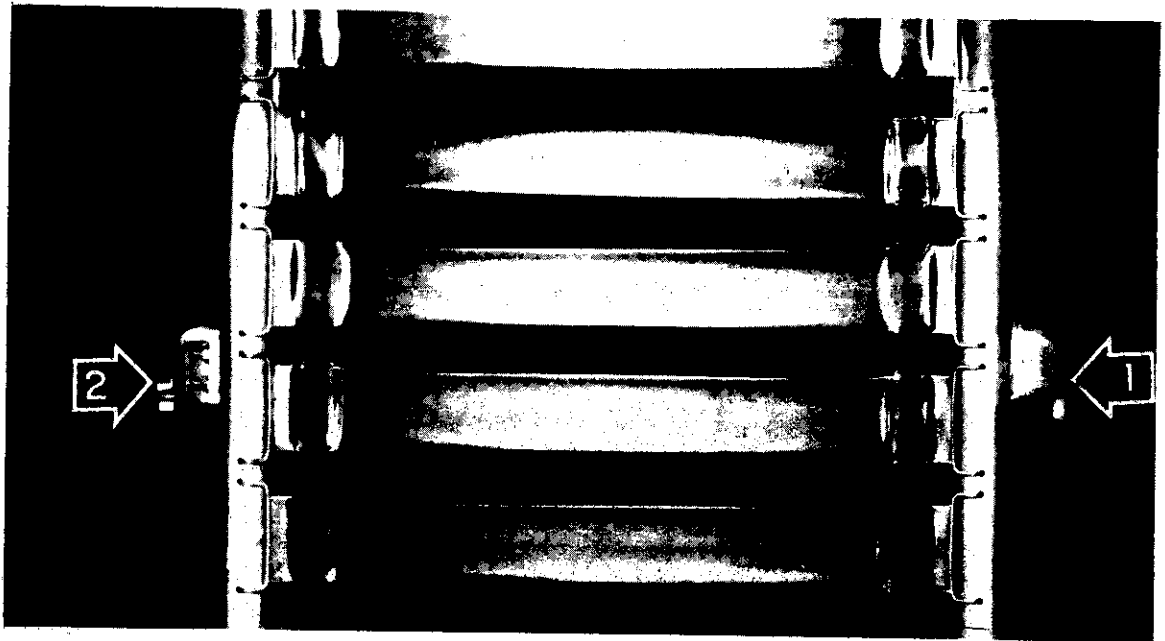


PHOTO 8

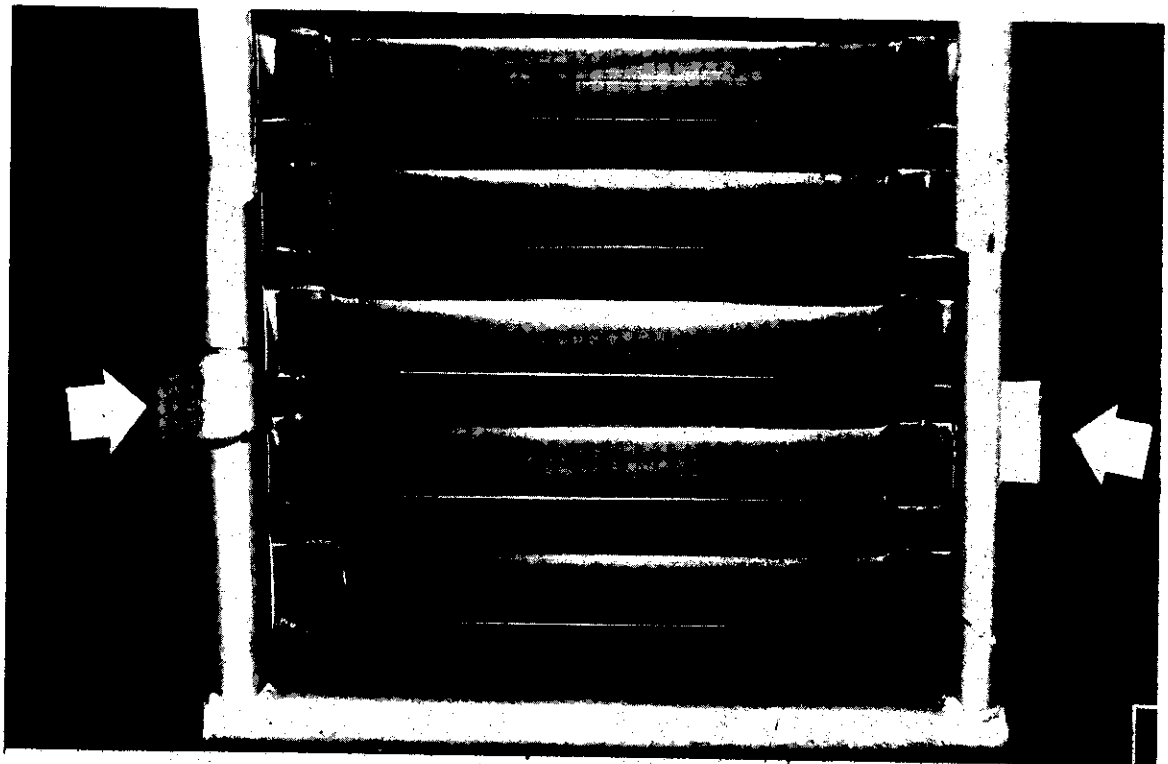


PHOTO 9

The difference of appearance of the fittings is obvious in this rear view of "bare" seat-back structure; however, upholstery tends to hide this difference.

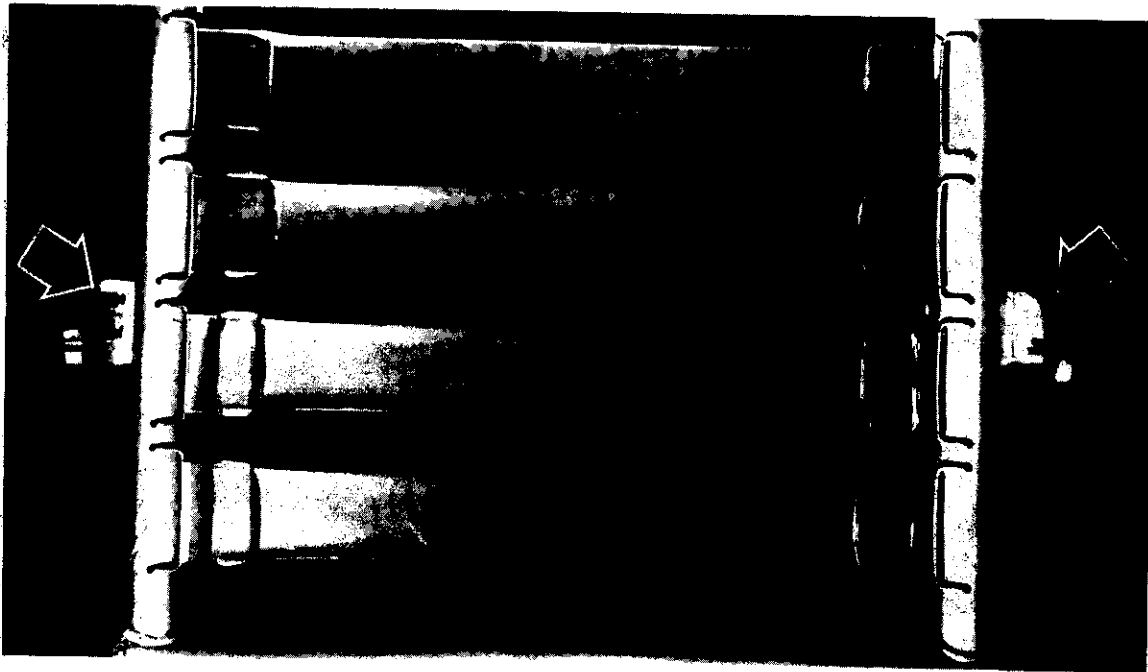


PHOTO 10

Difference of appearance of fittings (looking toward forward side of seat-back) can be seen easily on "bare" seat-back frame; however, upholstery makes close inspection necessary to note difference.

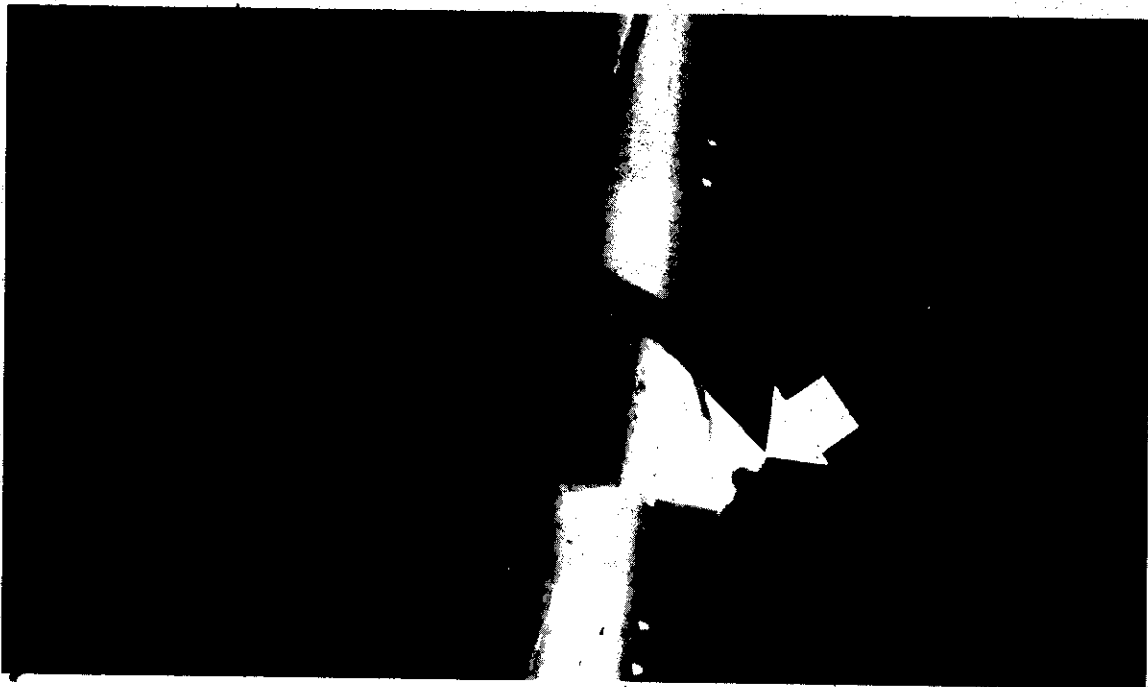


PHOTO 11

Side view of fractured aluminum alloy fitting (arrow) shows sharply defined edges on fitting; load bearing armrest is not supposed to be attached to this fitting.

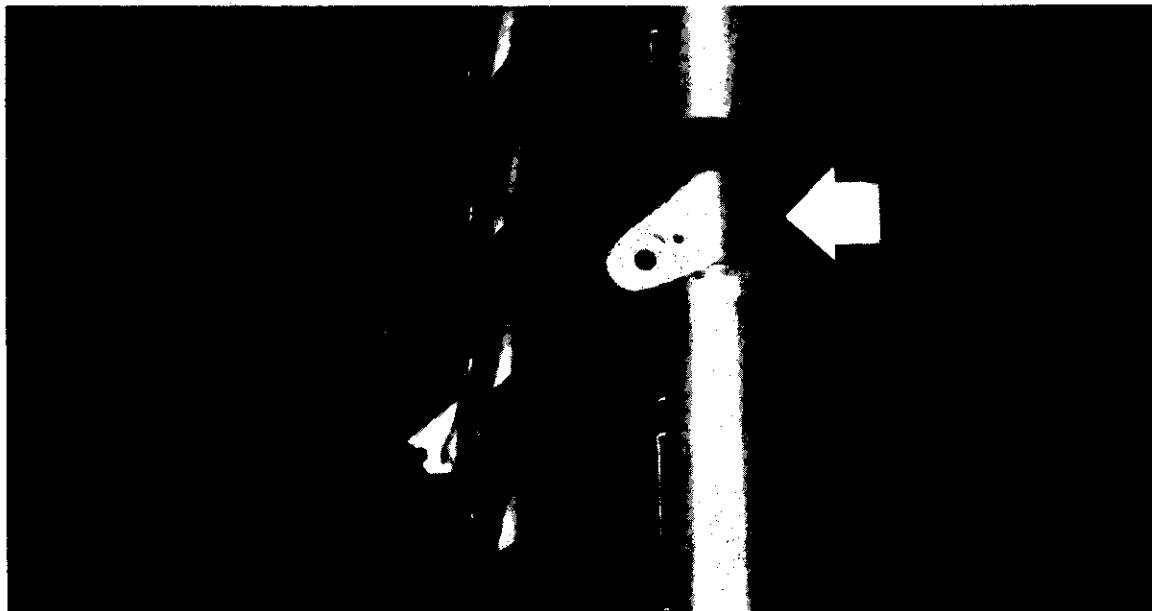


PHOTO 12

Side view of steel fitting (arrow) to which load bearing armrest (containing recline mechanism) should be attached.

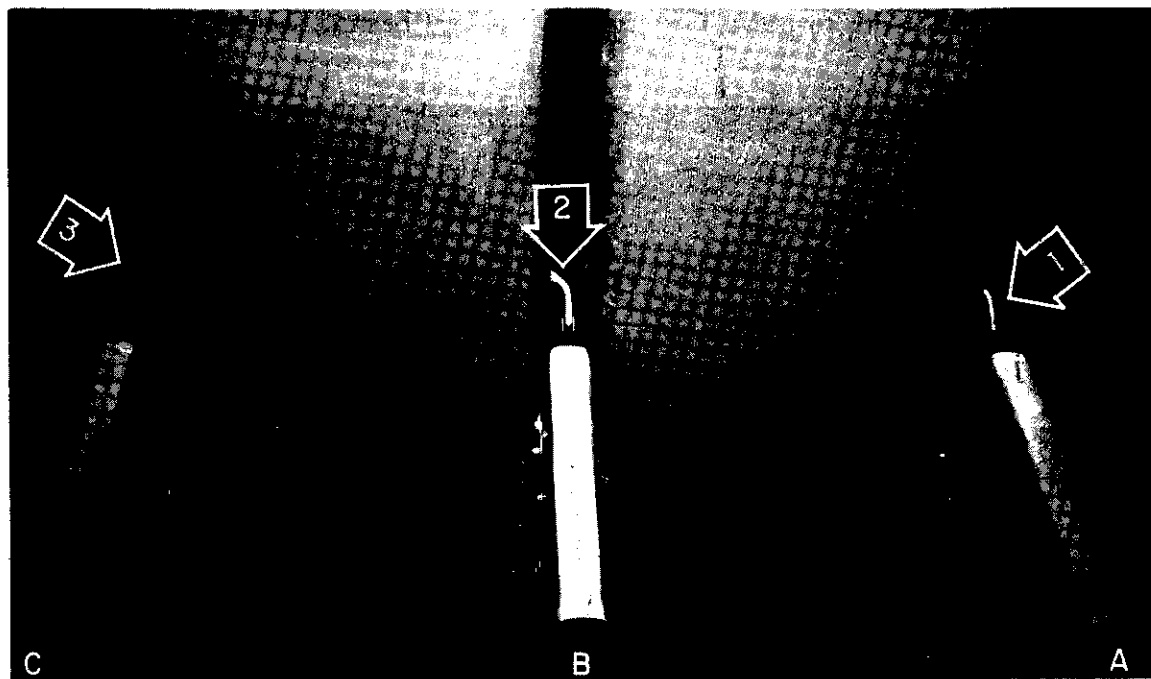


PHOTO 13

Proper installation of armrests is shown here; load bearing armrests "A" and "B" are attached to steel-welded fittings (arrows No. 1 and No. 2). Non-load bearing armrest "C" is attached to aluminum alloy fitting (arrow No. 3).

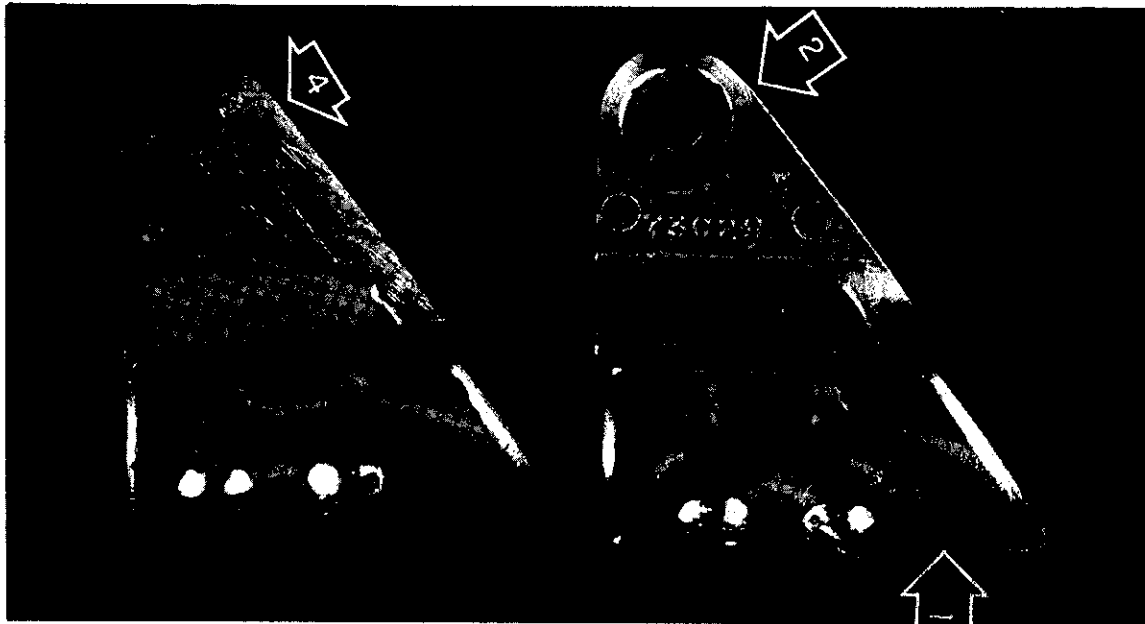


PHOTO 14

The aluminum alloy fittings, as originally delivered with the seats, are shown by arrows No. 1 in photos 14 and 15. The protruding boss on the original fittings is indicated by arrows No. 2. This boss is of sufficient width to prevent insertion into a load bearing armrest (arrows No. 3).

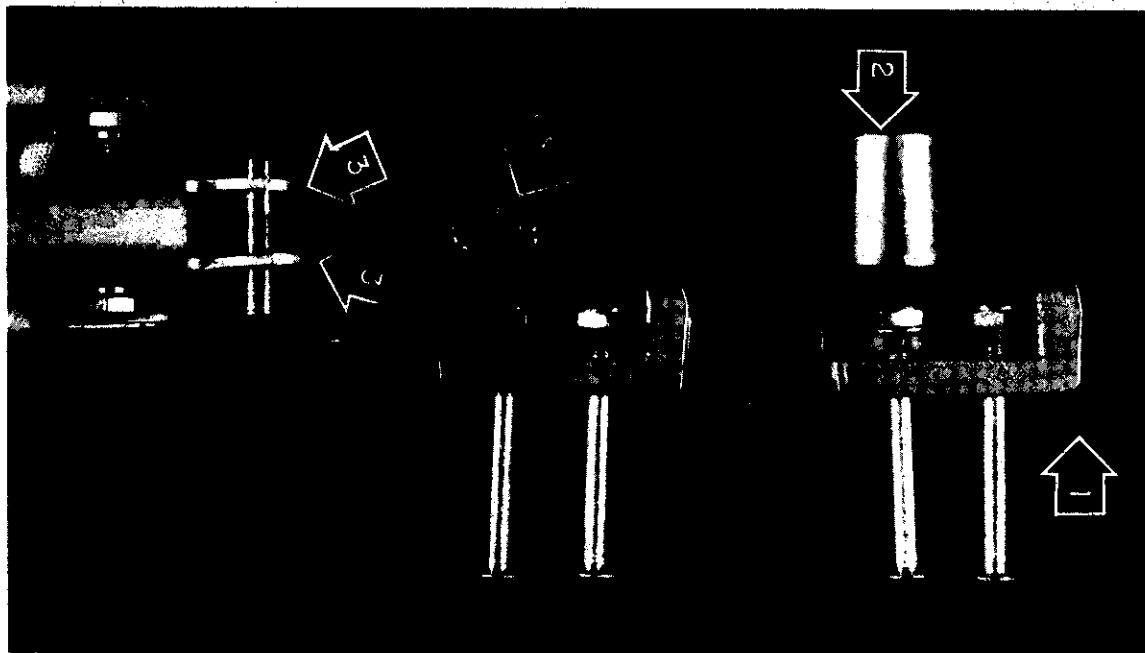


PHOTO 15

Field modification — filing — of these fittings (arrows No. 4) was apparently undertaken to permit attachment to the load bearing armrests.

SPINAL INJURIES

Each of the two persons occupying rearward facing seats — whose seat-backs failed — sustained spinal injury; one had a compression fracture of the 6th thoracic vertebra with anterior wedging; the other sustained a complete fracture through the body of the 3rd lumbar vertebra with involvement of the right articular process.

Of the other two persons who sustained spinal injury — in forward facing seats — one had compression fractures of the 8th and 9th thoracic vertebrae with slight anterior wedging and the second person sustained a compression fracture of the 11th thoracic vertebra with anterior wedging.

RECOMMENDATION

It is recommended that no field alterations be made to any aircraft equipment, including seats, without first obtaining approval of the manufacturer or authorized engineering personnel.