ACCIDENT TO PAN-AM BOEING 747 N739PA AT LOCKERBIE ON 21 DECEMBER 1988

Baggage Container Examination

1.0 Introduction

During the wreckage recovery operation to CAD Longtown, it was decided decided to segregate any identifiable parts of the cargo hold baggage containers with the aim of re-constructing any that exhibited evidence of damage from an explosive device. As by the time this was commenced it appeared from the main wreckage layout that the location of such a device was in the forward cargo hold, only wreckage from this area was directly considered. Debris from the rear cargo hold was recovered mostly from area B and was characteristically diferent from that from the forward hold, in that it was generally severely crushed and covered in mud. The forward hold debris, by comparison, was mostly recovered from along the wreckage trail some distance from Lockerbie and had mainly been torn into relatively large sections and was thus fairly easily identified, ref. para 5.0.

2.0 Container Arrangement

Information supplied by Pan Am showed that this aircraft had been loaded with 12 baggage containers and two cargo pallets in the forward hold. The stated identification and position of each container is shown in figure 1.

3.0 Container Description

All the baggage containers installed in the forward cargo hold were of the LD3 type (lower deck container, half width - cargo) and designated by Pan Am with the codes AVE, for those constructed from aluminum alloy, and AVA and AVN for those constructed from glass fibre reinforced plastic. Each container is specifically identified with a four digit serial number followed by the letters PA, this nine digit identifier being present at the top of three sides of each container in black letters/numbers approximately 5" tall. Detail drawings and photographs of a typical metal container are shown in figure 2, it being essentially a 5 ft cube extended over its full length to the left of the access apperture by some 17 inches. In order to fit within the circular section of the lower fuselage this enlarged volume has a sloping face (45 deg) at its base which joins the edge of the container base to the left vertical sidewall some 20 inches up from the base. When in use, the access apperture is covered by a blue reinforced plastic curtain, fixed to the container at its top edge, braced by two wires and central and lower edge cross bars which engage with the apperture structure.

The strength of the container superstructure is provided by the various extruded section edge members, attached to a robust floor panel, with thin aluminum skinning providing baggage containment and weatherproofing.

From the Pan Am list, three were expected to be of the glass fibre type (those at positions 11L, 13L and 21L) with the remaining 9 of metal construction.

4.0 Container Reconstruction

In an area separate from the main aircraft layout at CAD longtown, all immediately identifiable parts of the forward hold containers were allocated to areas designated by their serial numbers. The items not identified at this stage were collected into piles of similar parts for later assesment. As a result of this two containers became of immediate interest, AVE 4041 PA and AVN 7511 PA, which, from the Pan Am records, were positioned at stations 14L and 21L respectively (adjacent positions, 4th and 5th from the front, left side).
Those parts which could be positively identified as being from these containers were re-assembled onto one of three simple wooden frameworks, one each for the floor and superstructure of AVE 4041 PA and the superstructure for AVN 7511 PA. Each item that was so placed was allocated a reference number by members of the police `production team' at Longtown, these numbers being present on the photographs and diagrams shown in figure 3. Approximately 85% of container 4041 was recovered and identified, the main missing sections being the aft half of the sloping face and all of the curtain. However, two items included in figure 3 , AI 100 and AK 29, could not be fracture or tear matched to container 4041 but the particular type of damage exhibited by these items strongly suggested that both had suffered from the blast.

Examination of all other component parts of the remaining containers did not reveal any evidence of blast damage similar to that found on 4041 or 7511. Photographs of the most severely damaged areas of 4041 are shown in figure 4.

5.0 Wreckage Distribution

Figure 7 shows the distribution across the ground of most of the items used in the reconstruction of containers 4041 and 7511. As may be seen, this trail is mainly confined to the southern edge of the main wreckage southern trail. With reference to the wind drift and wreckage plot report (CIT), this distribution would seem to confirm the belief that one of the early events in the aircraft break-up sequence was the blast damage to and ejection of (at least) these two containers.

6.0 Analysis

The general character of damage that could be seen, following the reconstructions, to the aft outboard lower quarter of container AVE 4014 PA and the forward face of AVN7511PA was of a type not seen on any of the other container wreckage. In particular, the reconstruction of the floor of 4041 revealed a localised area of severe distortion and tearing which, with preliminary results from RARDE's examination of the floor's outboard edge member (which established that this component had been damaged by a `detonating high explosive'), left little doubt that a device had exploded within this container. Assesment of the distortion to the left container skin and its lower stiffener section, the angled face skin, aft face skin and structure to the left of the access aperture indicated that the likely lateral position of the device was as shown in figure 5. In a longitudinal sense this same centre is assessed as being at station 705" on the aircraft structure. The best assessment of this position within container 4041 would seem to be approximately half way between its aft face and the mid point of the container. Figure 6 is a plan view showing the positions that containers 4041 and 7511 would normally adopt in the cargo hold, and shows a close proximity between the blast

damaged area on the airframe and the estimated position of the device in 4041.

The failure to recover the aft portion of the sloping face skin, with the possible exception of one fragment (AI 100), and the nature of the blast damage to the aircraft structure generally suggested that the main effect of the blast was downwards and slightly outboard.The lack of direct blast damage on most of the floor panel in the heavily distorted area, of the type seen on the floor edge member and lower portions of the aft face structural members, would seem to indicate that this had been protected by, presumably, a piece of luggage. However, the downward heaving of the floor in this area was sufficient to stretch the floor material far enough to be cut by cargo bay sub structure.
Advice from various organisations, the FBI explosives unit in particular, is such that the directions and hence direct effects of any blast can be modified by, as is likely in this case, surrounding baggage in addition to any natural preference for any particular direction as a result of, perhaps, a shaped charge.Therefore, where severe blast damage is observed on the aircraft structure this may not necessarily reflect the exact location of the device, Figure 5.

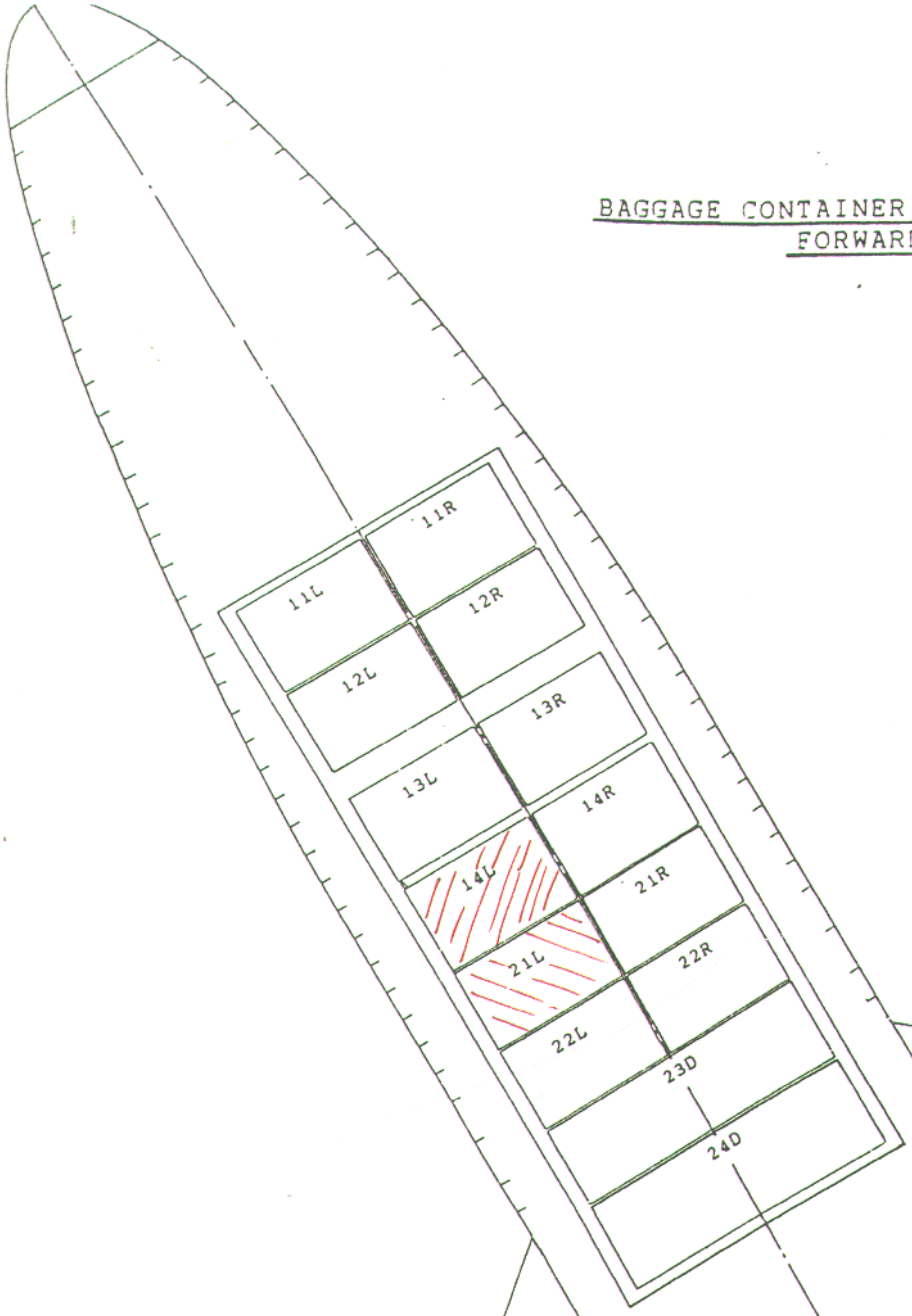
With the two container reconstructions placed together it became apparent that a relatively mild blast had exited 4041 through the rear lower face to the left of the curtain to impinge at an angle on the forward face of 7511. This had produced a hole approximately 8 inches square some 10 inches up from its base and removed the surface of this face inboard from the hole for some 50 inches. Radiating out from the hole were areas of sooting extending to the top of the container. Little signs were present of any similar damage on other external or internal faces of this or the immediately adjacent containers 14L, 14R or 21R.

7.0 Conclusions

Throughout the examination of the forward cargo hold baggage container wreckage, direct evidence of blast damage and associated characteristic distortion was only exhibited on pieces of containers AVE 4041 PA and AVN 7511 PA. There was little doubt from the pattern of this distortion that the major source of this had been centered within 4041, more specifically in its aft outboard quarter, with the blast damage to the forward face of 7511 being as a direct result of gasses escaping from 4041. Thus, there was also little doubt that the relative position of these two containers in the aircraft was as stated by Pan Am. Also, it seems, from figure 7, that by comparing the position of the blast damage on the airframe to that on 4041 that this container, and 7511, were indeed located at the stated positions of 14L and 21L.

P T Claiden **April 1989**

BAGGAGE CONTAINER IDENTIFICATION AND LOCATION
FORWARD CARGO HOLD



11R - AVE 3146 PA

12R - AVE 3929 PA

13R - AVE 9401 PA

14R - AVE 9621 PA

21R - AVE 4159 PA

22R - AVE 9394 PA

23D - Pallet PLP 0277 PAA

24D - Pallet PLP 0348 PAA

11L - AVA 2074 XT

12L - AVE 1721 PA

13L - AVN 8372 PA

14L - AVE 4041 PA

21L - AVN 7511 PA

22L - AVE 2360 PA

FIGURE 1

PAN AM (IATA) ID CODE...AVE

OTHER CODES...LD3

RATE CLASSIFICATION
International...8
US Domestic...LD3

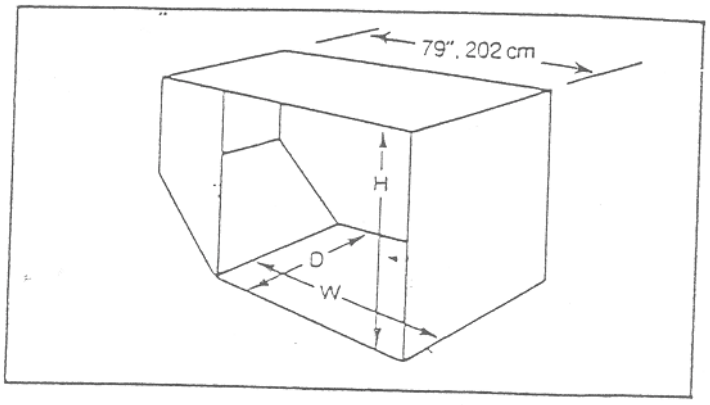
MAXIMUM GROSS WEIGHT (INCLUDES TARE)
3500 lb 1588 kg

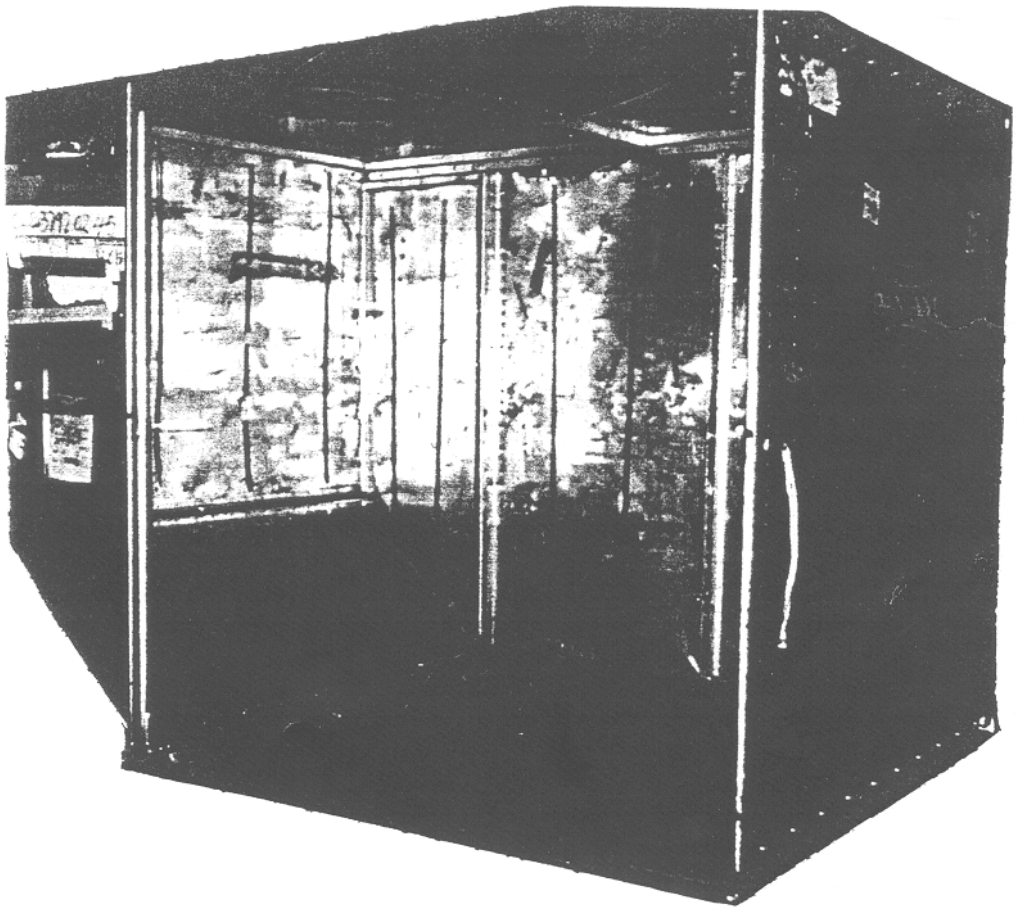
TARE
240 ± 20 lb 109 ± 9 kg
Weight varies. Check weight on unit.

USABLE INTERIOR VOLUME
139 cu ft 4 cu m

DIMENSIONS	INCHES	CENTIMETERS
Base Size	61 D x 62 W	153 D x 156 W
Maximum Height	64 H	163 H
Maximum Door Opening	57 W x 62 H	145 W x 157 H

- All dimensions and weights rounded off to nearest whole number.
- Inside dimensions are 3 to 7 inches (8 to 18 cm) less than base and maximum height.





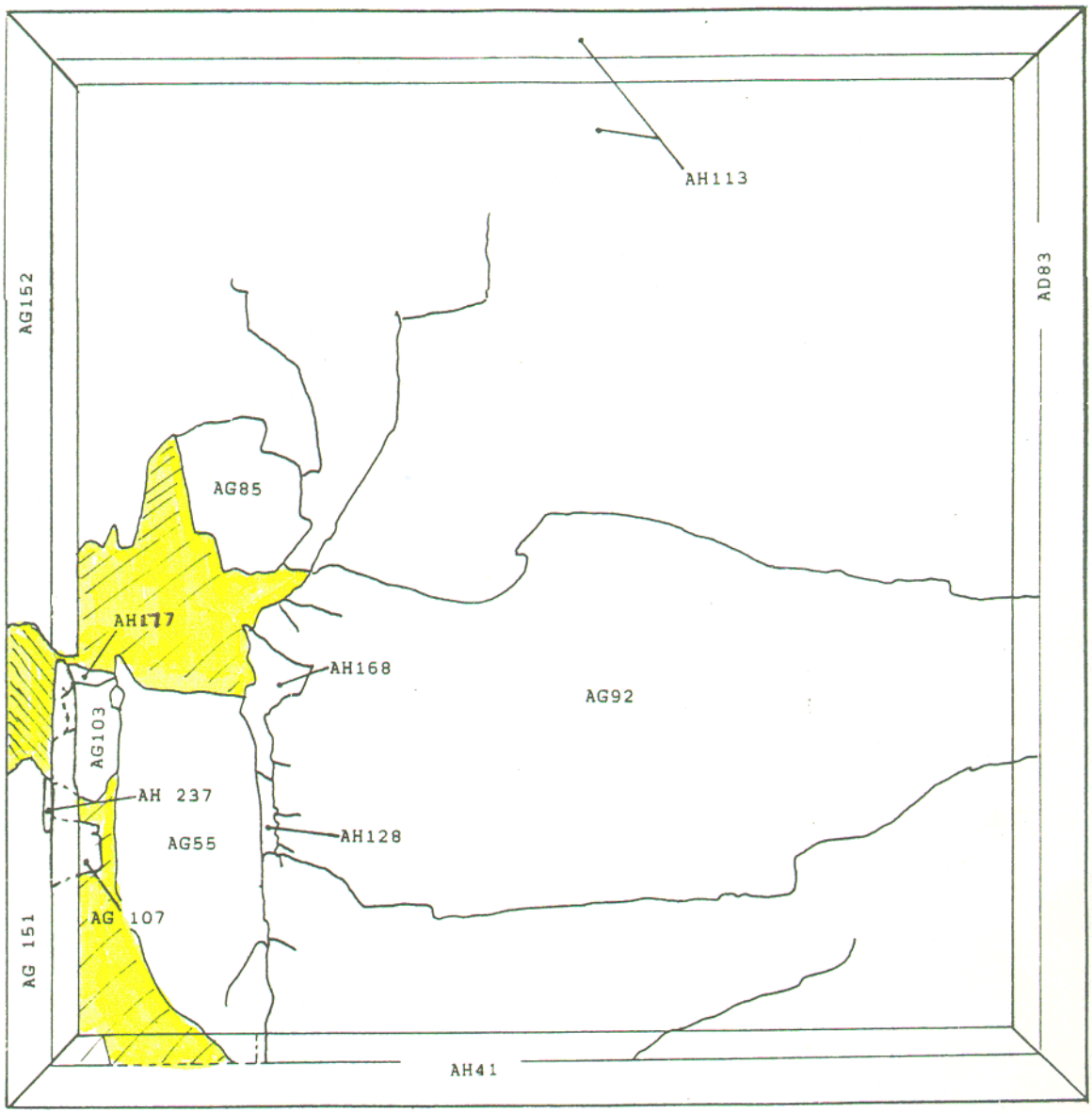
Lower Deck Container
Half Width—Cargo

AVE

FIGURE 2

FORWARD

OUTBOARD



AD83 Inboard side floor edge member

AG55 Dished floor panel section

AG85 Heavily distorted floor panel section

AG92 Floor panel section, distorted at outer edge

AG103 Distorted floor panel fragment

AH41 Aft floor edge member

AH113 Floor panel section attached to fwd edge member

AH117 Distorted floor panel fragment

AH128 Distorted floor panel fragment

AH168 Distorted floor panel fragment

AG 152 Forward section of blast damaged outboard edge member

AG 151 Aft section of blast damaged outboard edge member

AH 237 Blast damaged fragment from AG 151

AG 107 Floor fragment associated with AG 151

PLAN VIEW OF AVE 4041 PA FLOOR FIGURE 3.1

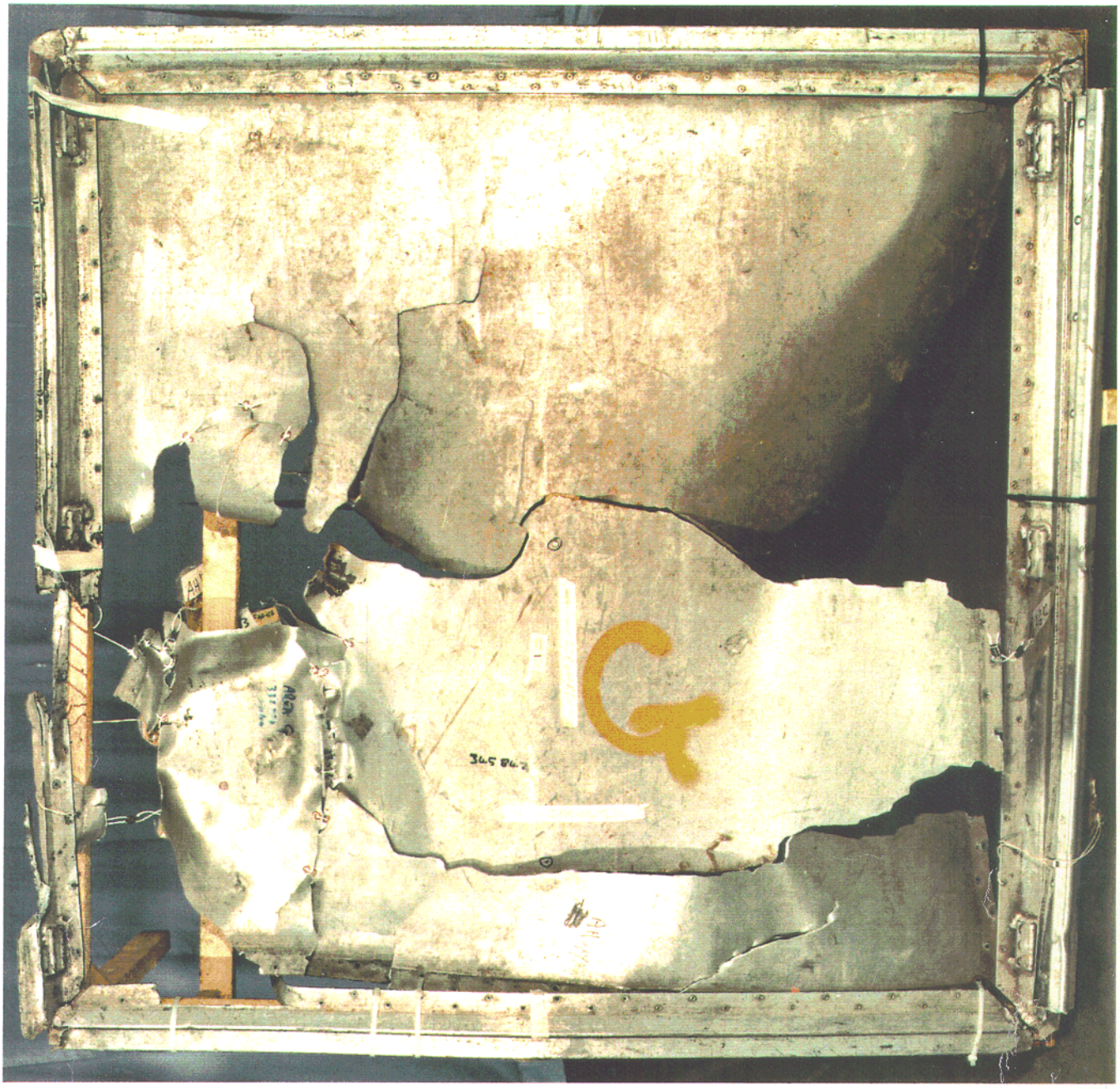
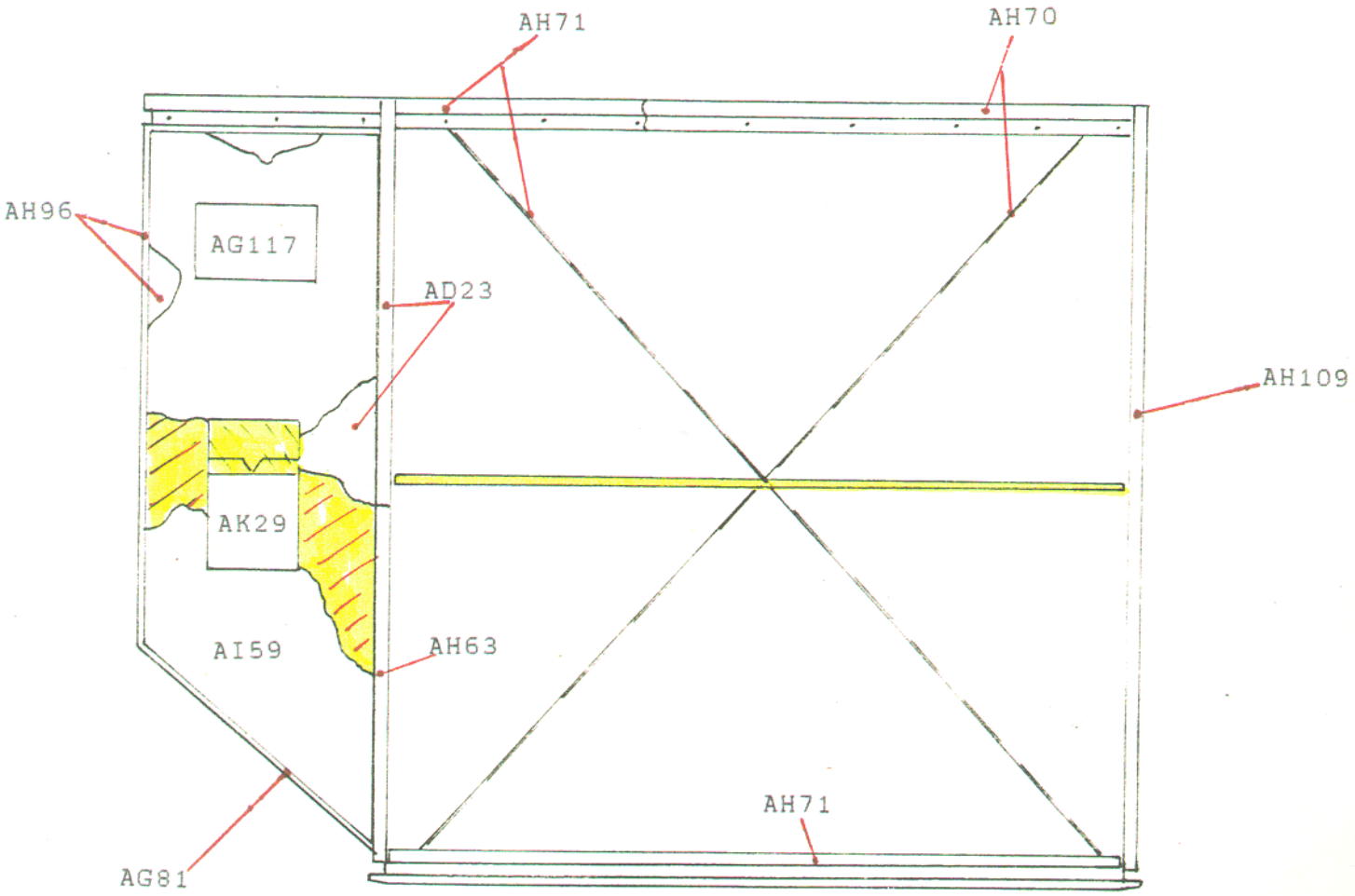


FIGURE 3.2



AD23 Curtain apperture left side vertical edge member, upper half

AG81 Sloping face edge member

AG117 Container manufacturers data plate containing AG145, burnt piece of material which itself contained a fragment of circuit board

AH63 Curtain apperture left side vertical edge member, lower half

AH70 Upper edge member, right half, attached to roof edge member and one curtain wire

AH71 Upper edge member, left half, attached to roof edge member, curtain wire and lower curtain bar

AH96 Left edge vertical member

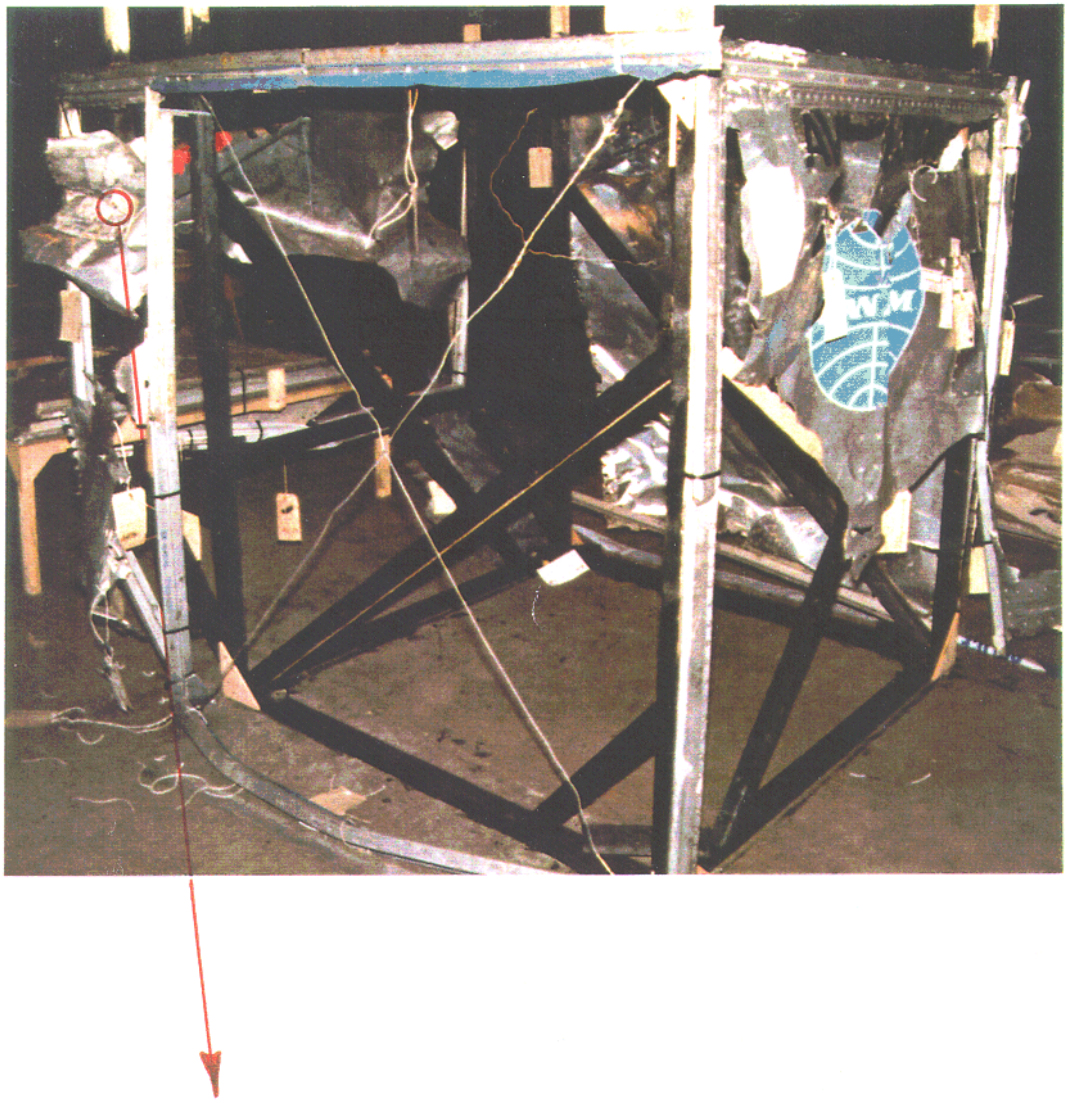
AH109 Curtain apperture right side vertical member

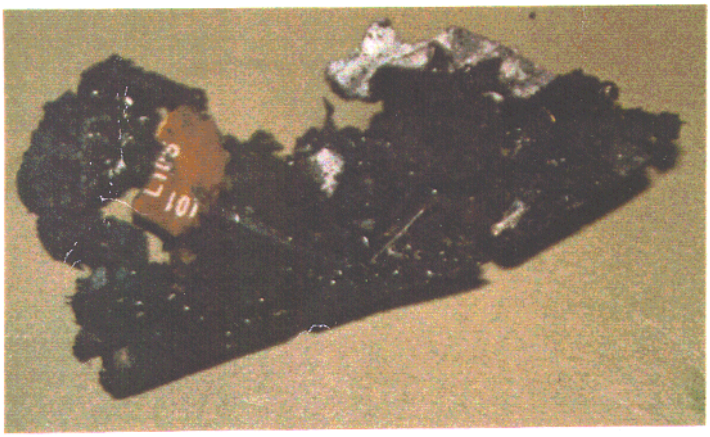
AI59 Left side lower skin section adjoining sloping face

AK29 Soot stained plastic sheet **(provisionally thought to have come from AVE 4041 PA)**

AFT FACE OF AVE 4041 PA, VIEW LOOKING FORWARD

FIGURE 3.3

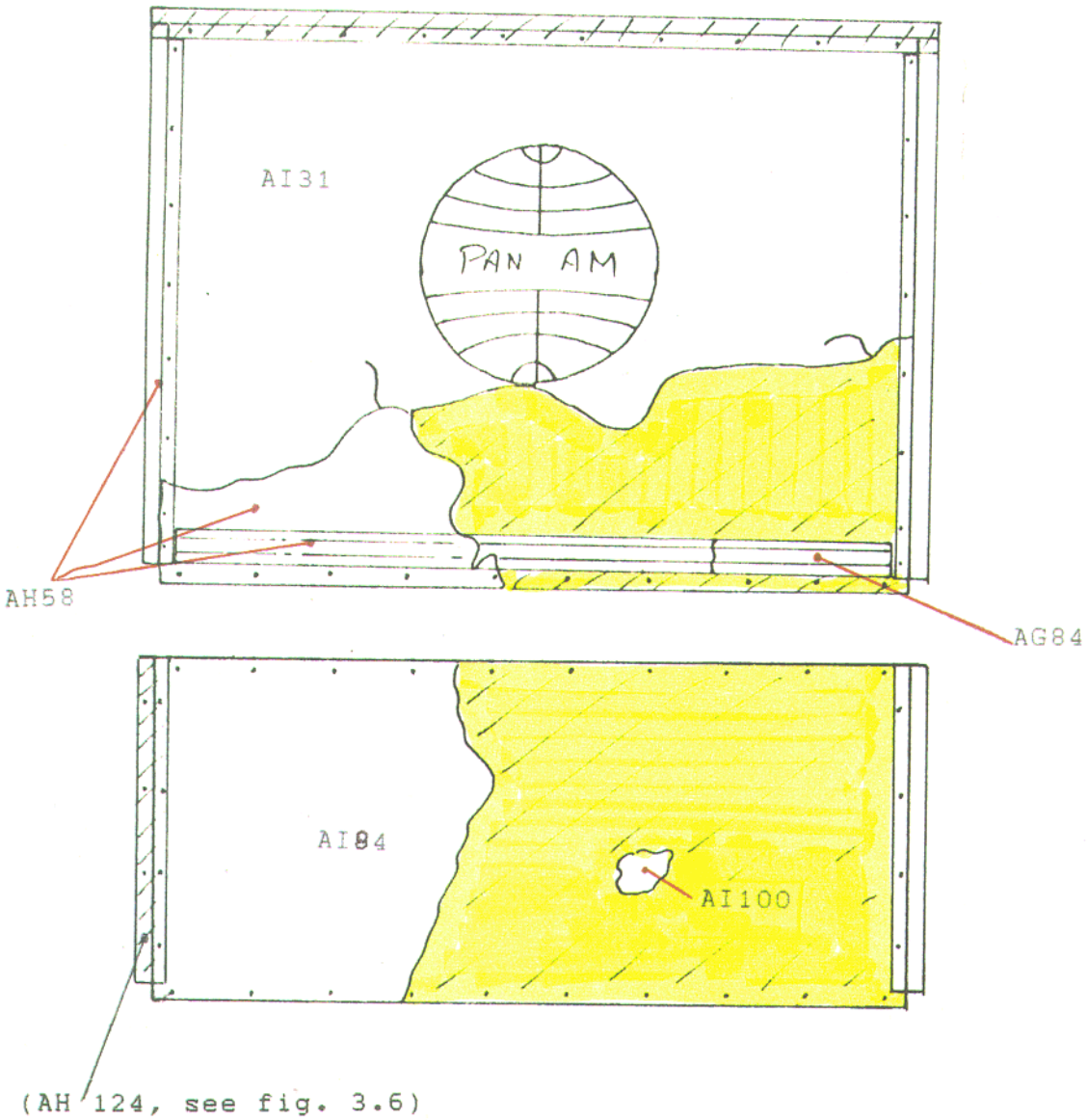




AG145 Showing fragment of circuit board

Approx 2X full size

FIGURE 3.4



AG84 Stiffener section from base of vertical face

AH58 Vertical face forward edge member, lower stiffener section and skin fragment

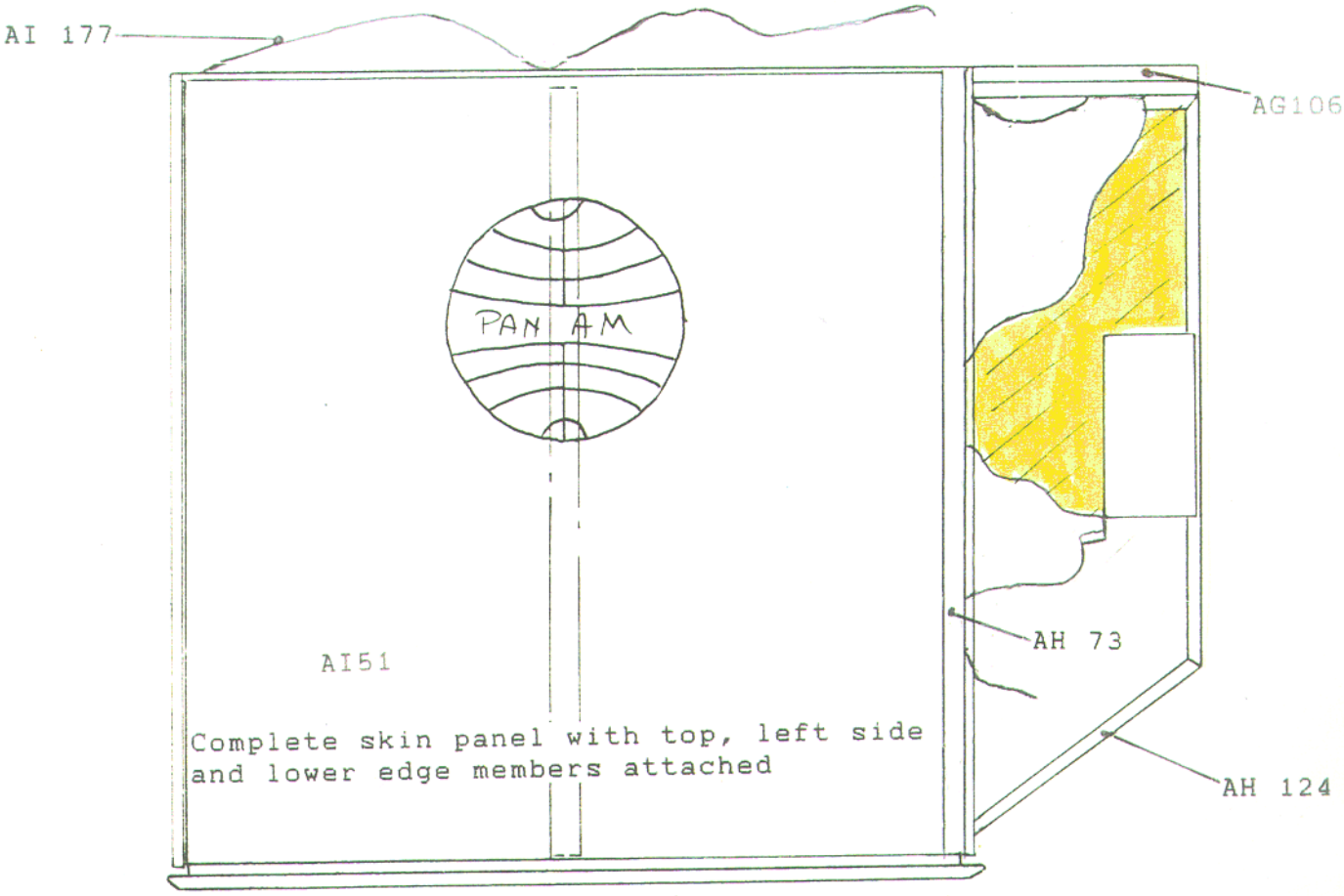
AI31 Distorted upper section of vertical face skin

AI84 Forward section of sloping face skin, severely distorted

AI100 Fragment of container skin, PROVISIONALLY thought to be part of sloping face skin. Fragment exhibited some evidence of blast damage

OUTBOARD FACES OF AVE 4041 PA, VIEW LOOKING INBOARD

FIGURE 3.5



AG 106 Outboard section of roof edge member

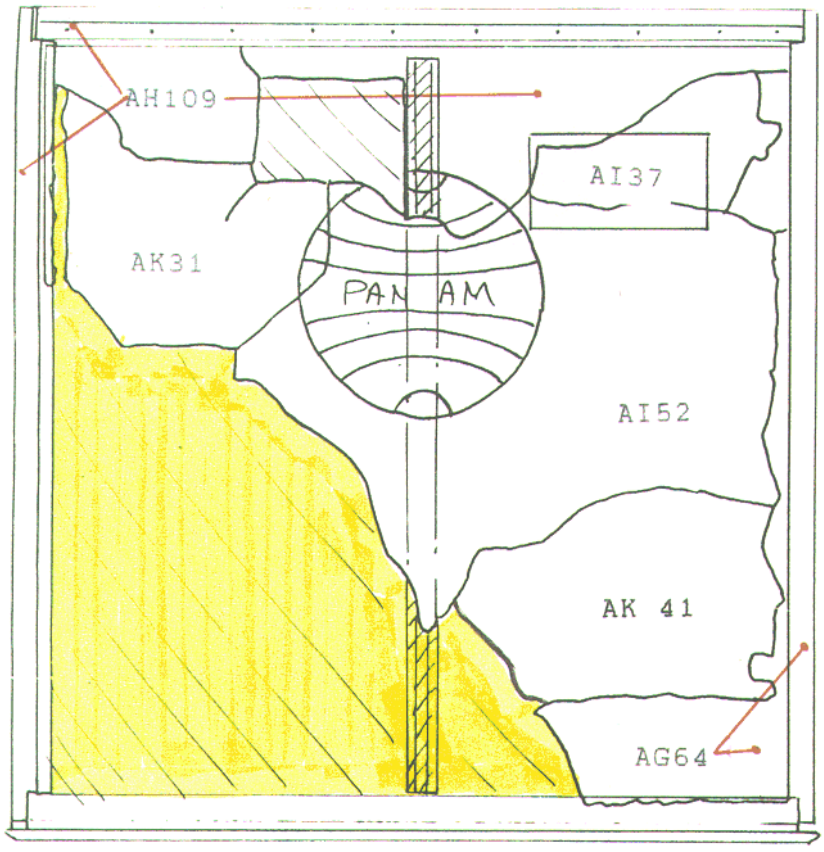
AH 73 Forward face skin, outboard of AI 51, attached to vertical edge members from AI 51

AH 124 Forward edge member of sloping face

AI 177 Roof skin panel, complete except for aft outboard corner section approx. 2 ft by 1.5 ft.

FORWARD FACE OF AVE 4041 PA, VIEW LOOKING AFT

FIGURE 3.6



AH109 Aft, top and roof edge members including upper section of skin

AI37 Repair patch from upper right side

AI52 Mid section of skin including stiffener section

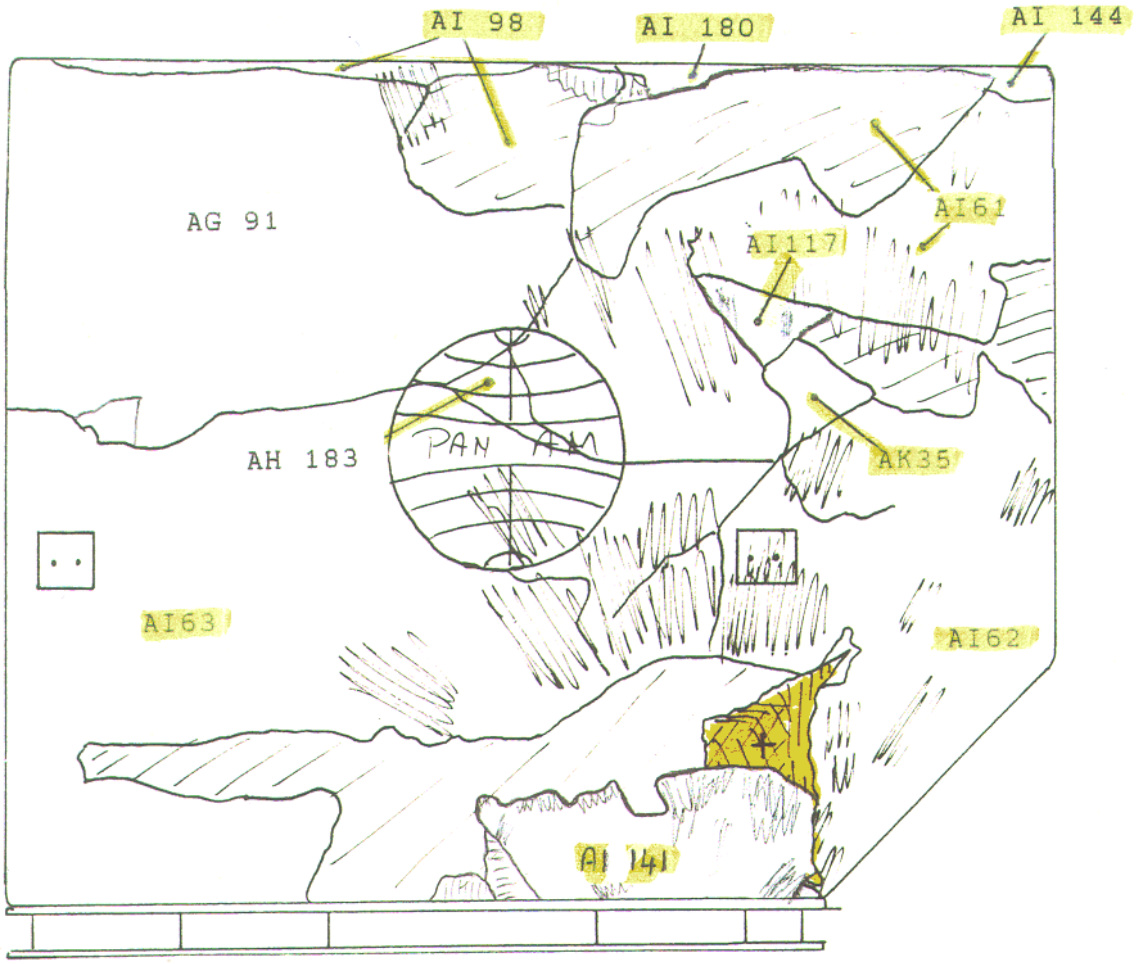
AK31 Upper skin section

AK 41 Lower skin section

AG64 Right side vertical edg member attached to lowe piece of skin

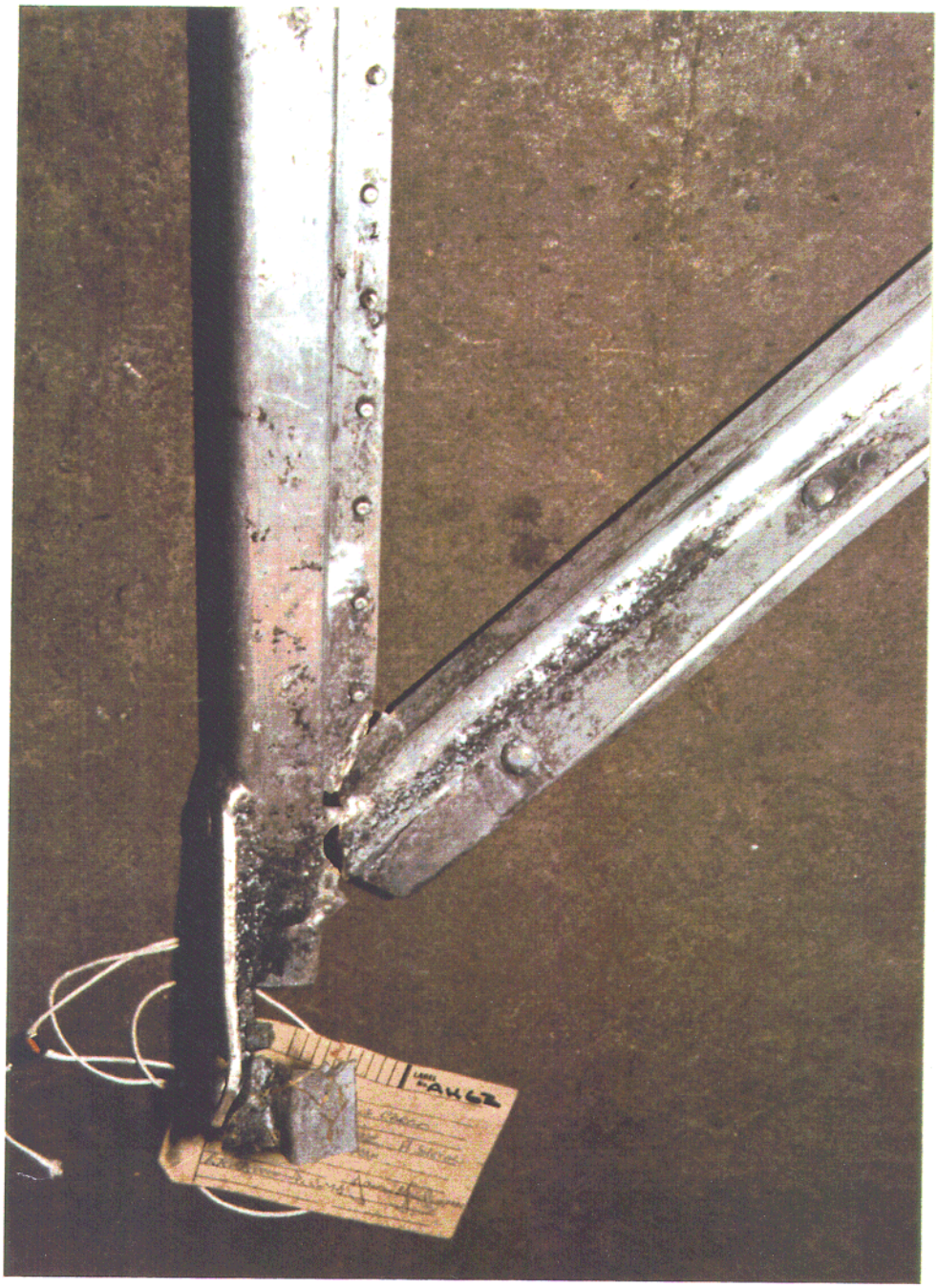
INBOARD FACE OF AVE 4041 PA, VIEW LOOKING OUTBOARD

Figure 3.7



Forward face of AVN 7511 PA, view looking aft

FIGURE 3.8

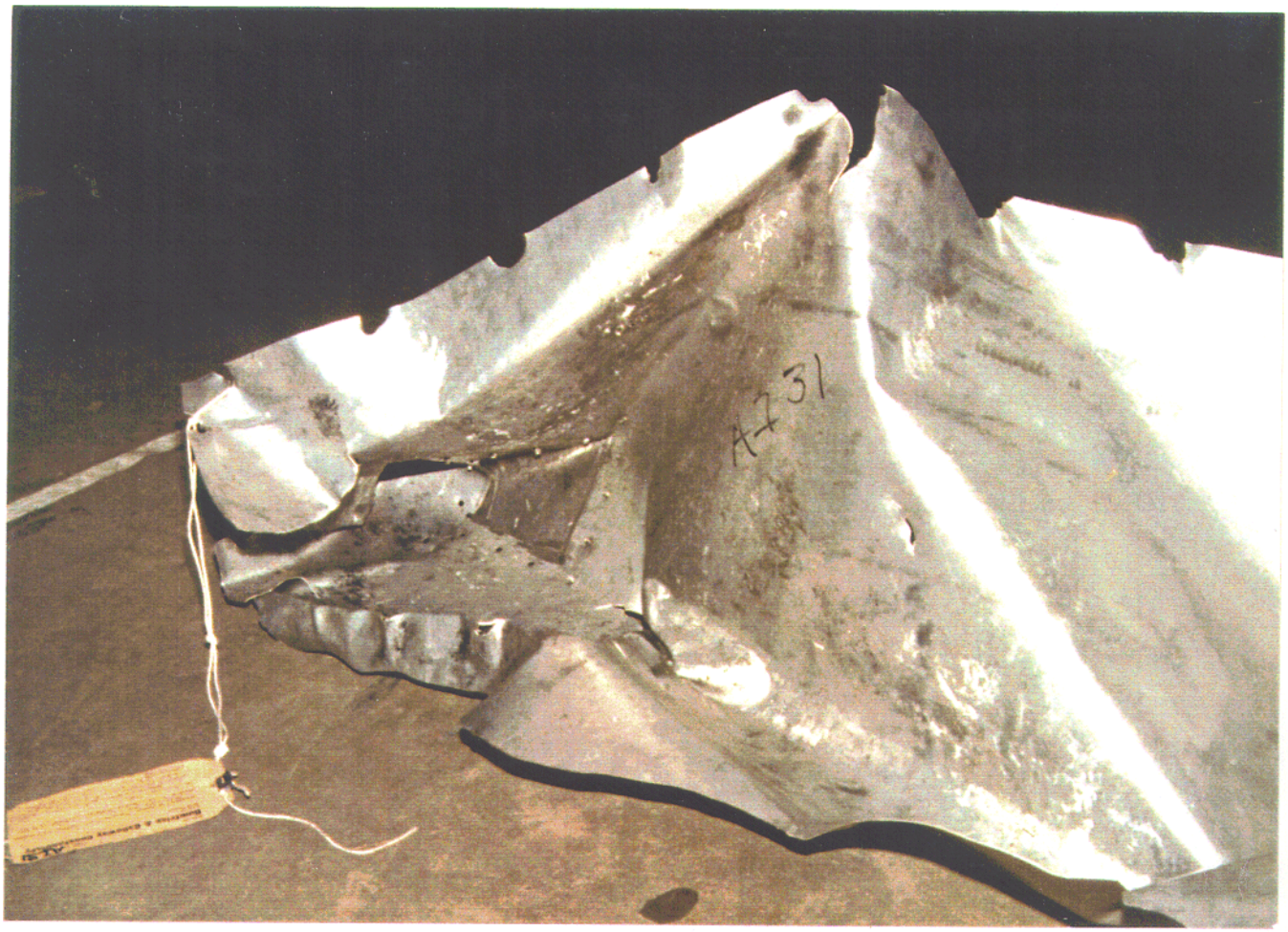


Detail of items AH63 and AG81 viewed from inside the container and showing evidence of blast damage

FIGURE 4.1

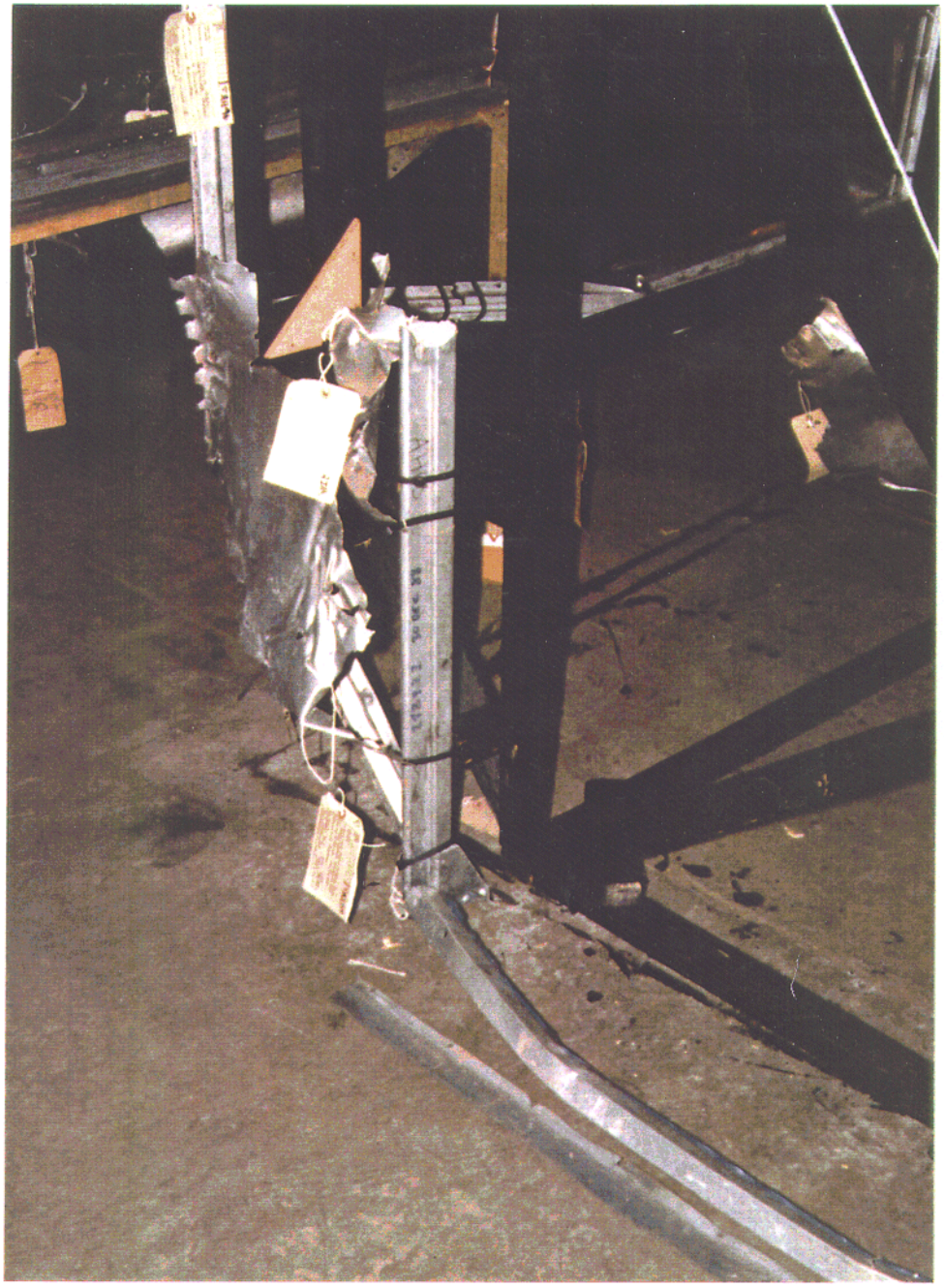
Detail of AI94, sloping face skin panel, showing severe distortion, double fold and imprint of fuselage stringer (S39L) on outer face *

FIGURE 4.2



Detail of AI31 outboard face skin section, viewed from inside, and showing some evidence of blast damage and severe local distortion along its lower forward edge

FIGURE 4.3



Detail of the container aft outboard corner showing blast damage to the lower skin panel and outward distortion of the lower curtain bar. To date none of the curtain itself has been recovered

FIGURE 4.4

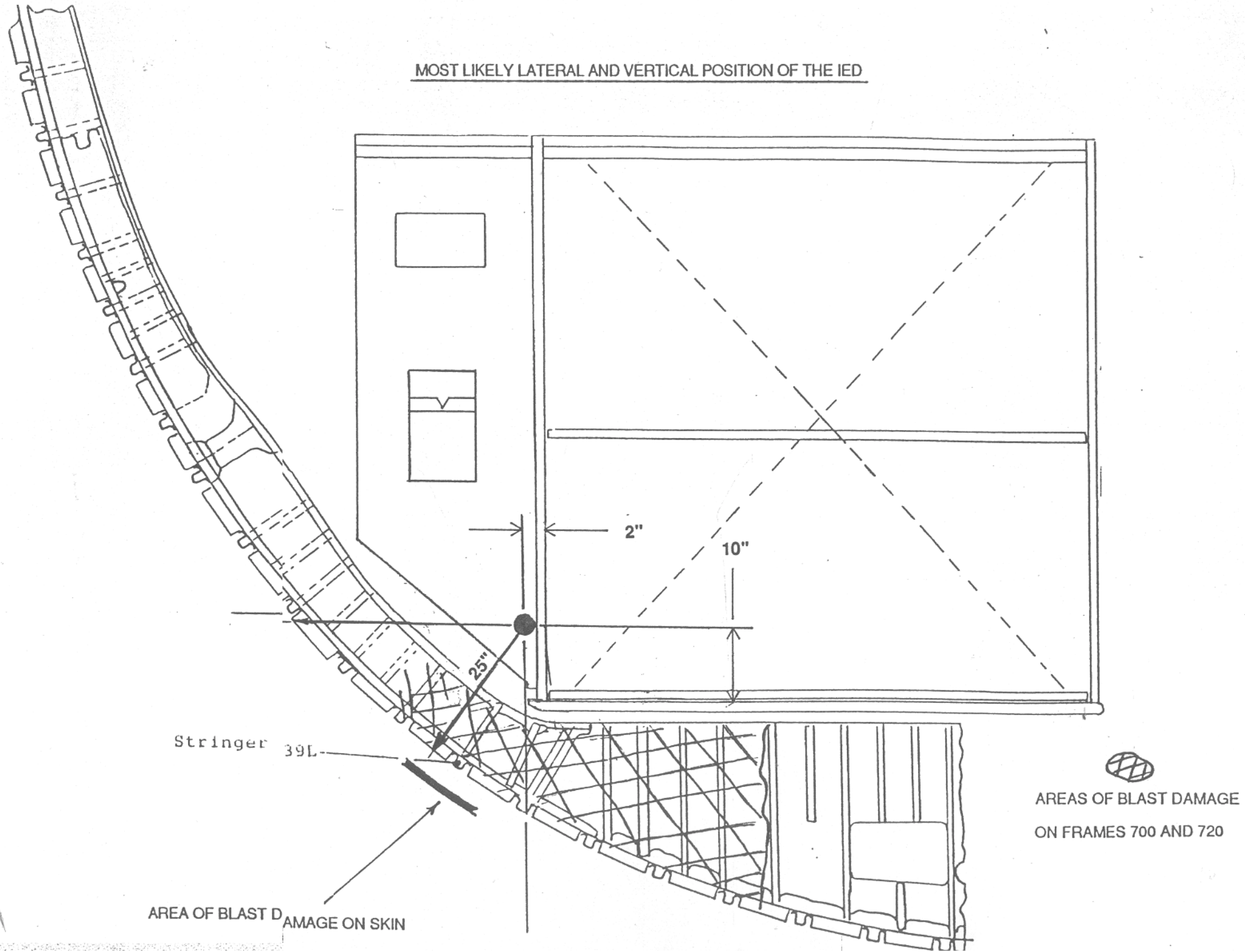
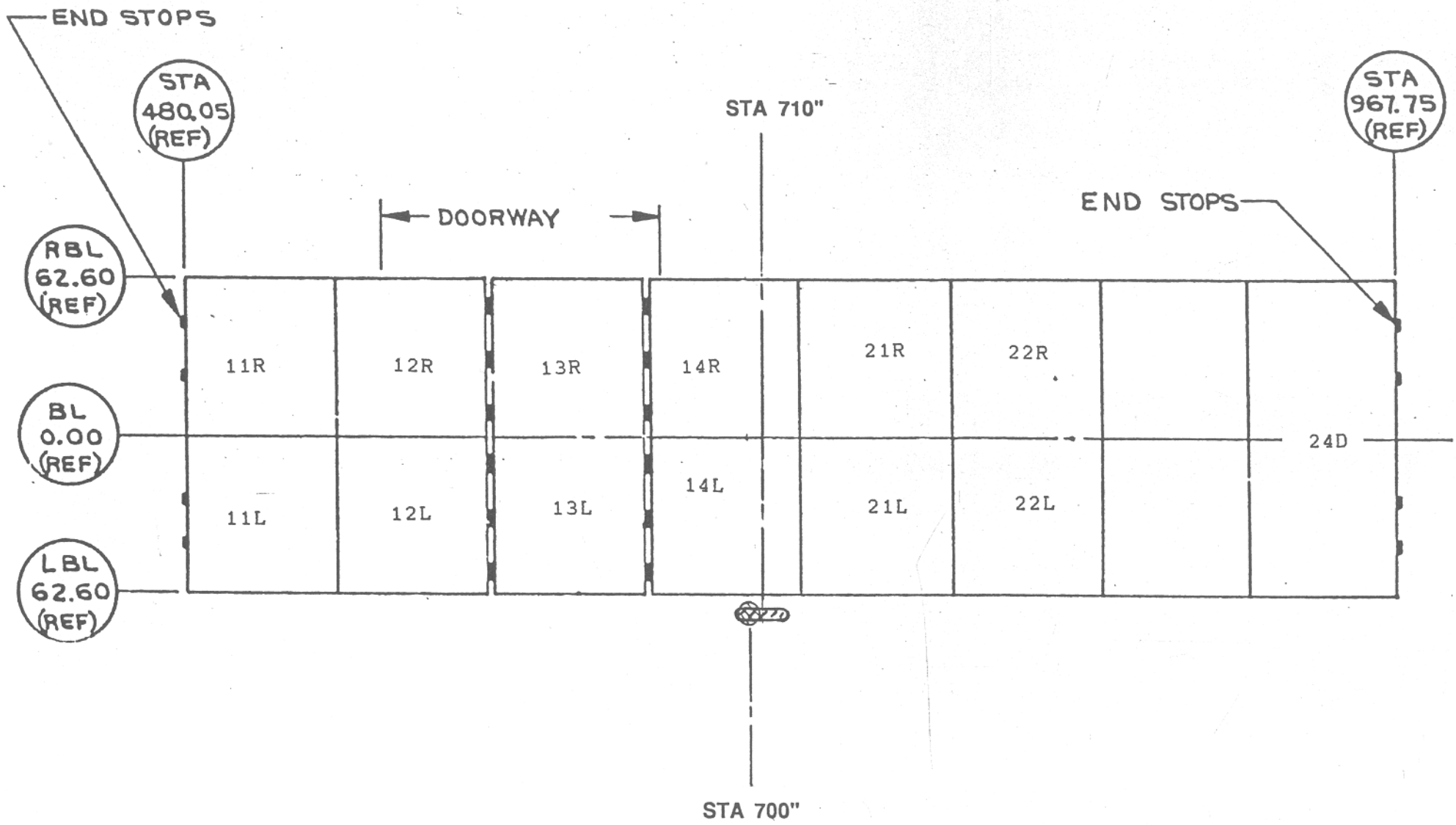
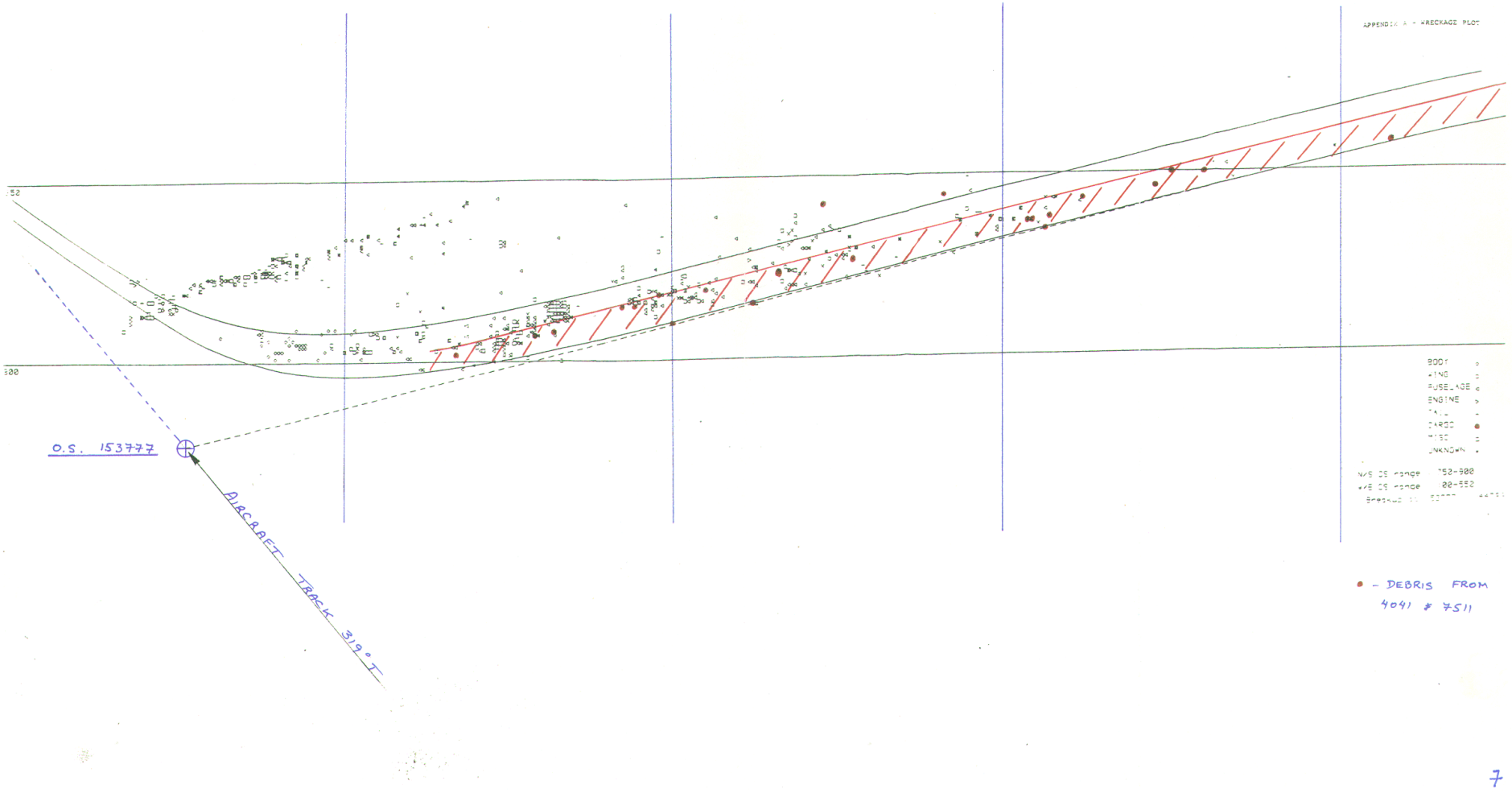

MOST LIKELY LATERAL AND VERTICAL POSITION OF THE IED
2"
10"
25"
Stringer 39L
AREA OF BLAST DAMAGE ON SKIN
AREAS OF BLAST DAMAGE
ON FRAMES 700 AND 720

Figure 69



Comparison of blast damage position on airframe with best estimate of blast centre in container AVE 4041 PA (14L)
Plan view

Figure 10



● - DEBRIS FROM 4041 & 7511

17.5.89.

17.5.89.

IN CONFIDENCE

Form 25b

LABEL NO AZ 11

Dumfries & Galloway Constabulary

CASE OF LOCKERBIE ENQUIRY
(Block Capitals)

DESCRIPTION OF ARTICLE AIR ACCIDENT INVESTIGATION BRANCH REPORT

FOUND IN PREPARED BY WITNESS PETER CAULDEN.

ON 17TH MAY 19 89

SIGNATURE(S) OF PERSON(S) IDENTIFYING ARTICLE

P Caulden

Bjmamanus DC