FROM-DE
SUBJECT AIRCRAFT ACCIDENT

SUB-SUBJECT 16 JUNE 1987

FILE TITLE DOUGLAS DC-4 C-GPFG
HIDDEN BAY, SASKATCHEWAN
MR. JAMES SMITH
MR. GILES DESHAIES

02-0122

TO - À
SUJET

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SOUS-SUJET

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NO. 825-87-C70039 VOL.

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23-0084

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ENGINEERING REPORT
RAPPORT TECHNIQUE

FI 127/87

FIELD INVESTIGATION - CALM AIR

DC-4, C-GPFG
17 June 1987

Canada

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ENGINEERING BRANCH | SERVICE TECHNIQUE

ENGINEERING REPORT

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File Reference / Numéro de dossier	Number of Pages / Nombre de Pages	Appendices / Annexes		RELEASE OUTSIDE CASB SUBJECT TO REVIEW BY THE ACCESS TO INFORMATION OFFICER.	YES / OUI	
825-87-C70039	2	Figures / Chiffres	NIL / 35	PUBLICATION HORS DU BCSA SOUMISE À LA RÉVISION DU COORDONNATEUR DE L'ACCÈS À L'INFORMATION.	NO / NON	X

ENGINEERING REPORT / RAPPORT TECHNIQUE FI 127/87

FIELD INVESTIGATION - CALM AIR

DC-4, C-GPFG
17 June 1987

Prepared – Préparé

[redacted]

D.J. Langdon, P. Eng. (Chief, Systems Engineering)

Reviewed – Revisé

Approved – Approuvé

[redacted]

R.G. Hayman, P. Eng.

Director of Engineering – Directeur du service technique

Date Completed – Terminé le

23-0022 . (4-86)

FI 127/87

1.0 INTRODUCTION

1.1 DC-4 aircraft C-GPFG suffered damage during landing at Hidden Bay, Saskatchewan on 17 June 1987 at 1630 hours CDT. The aircraft landed short, undershooting the threshold of Runway 36. The wind was from the east at 8 to 12 knots. As this aircraft had on a recent flight experienced difficulty with the right main gear oleo blocked in the over-extended position by the scissors, and a consequent stiff-leg landing, there was concern that the accident was consequent to minor earlier damage, and might reflect a problem of fleet-wide significance.

2.0 PURPOSE

2.1 The assistance of an aeronautical engineer was requested to determine:

2.1.1 the extent and cause of the damage to C-GPFG.

2.1.2 the relationship, if any, that the damage bore to any structural weakness present before the short landing of 17 June.

3.0 OBSERVATIONS & ANALYSIS

3.1 Inspection of the aircraft was carried out on 23 June 1987 at Hidden Bay by D. Langdon and C. Fidler for CASB, and by [redacted] and [redacted] for the insurance company. Mr. [redacted] is the Transport Canada Design Approval Representative (DAR) and [redacted] is Claims Representative for Canadian Aviation Insurance Managers Ltd.

3.2 Extensive damage was found in the right wing between the #3 engine nacelle and the wing root. The damage is photographically recorded in Figures 3 to 31 which follow. The aircraft landed short striking the cliff-like threshold on Runway 36 with the right main gear. It was clear from an examination of the threshold, see Figures 32 to 35, that the right main gear was low, hitting several feet below the lip. The right main gear was probably low in response to a cross-wind from the east at 8 to 12 knots. The right gear acquired a permanent set backwards estimated at 8^{o}. To acquire this degree of permanent set the gear would have to have been bent considerably further back on impact than it presently shows in Figure 14. Springback on release of the impact force would have put the gear in the final position shown.

3.3 Fresh scrapes and gouges on the bottom of the right outside brake caliper show that it made contact with the sandy gravel of the threshold lip. The result, given the landing

speed of the aircraft, was an extreme rearwards and up impact load on the axle. While the oleo leg was able to react to some of the upload component, the rearwards load had to be and was reacted by deformation of the structure to which the gear pivot points are attached, see Figure 1.

3.4 Considering the right main gear leg as a free body, the loads applied to it by impact and pivot reactions had to be approximately as shown in Figure 1 by the vectors. It is then apparent that the resultant loads imposed on the wing section consisted of a large nose-down moment on the wing box and a compression load on the chordwise structural members between E and D. Figure 15 shows the results of this compression load imposed by the oleo leg trunnion and drag brace - the chordwise reinforcing members are buckled. Figure 18 shows how the load at D of Figure 1 buckled the rib-web at the bottom and tore it at the top. Figures 22 and 23 show classic evidence of wing nose-down moment torsional failure with compression buckling of the centre spar web and tensile failure at 90 degrees to the buckle.

3.5 Figures 3 to 6 depict torsional buckling of the wing lower surface again reflecting the nose-down sense of the moment on the wing generated by the right main gear impact.

3.6 All of the damage found fitted the loading scenario of Figure 1. The evident wing twist and structural damage suggest that even if it were possible to make temporary repairs strong enough for a "one flight" ferry under ideal conditions to a repair base, the aircraft would be unbalanced in the aerodynamic sense to the point of probably being uncontrollable in roll. Even minimal temporary repairs would be exceedingly difficult to make at Hidden Bay, as there is absolutely nothing at the runway - no power, no buildings, no people.

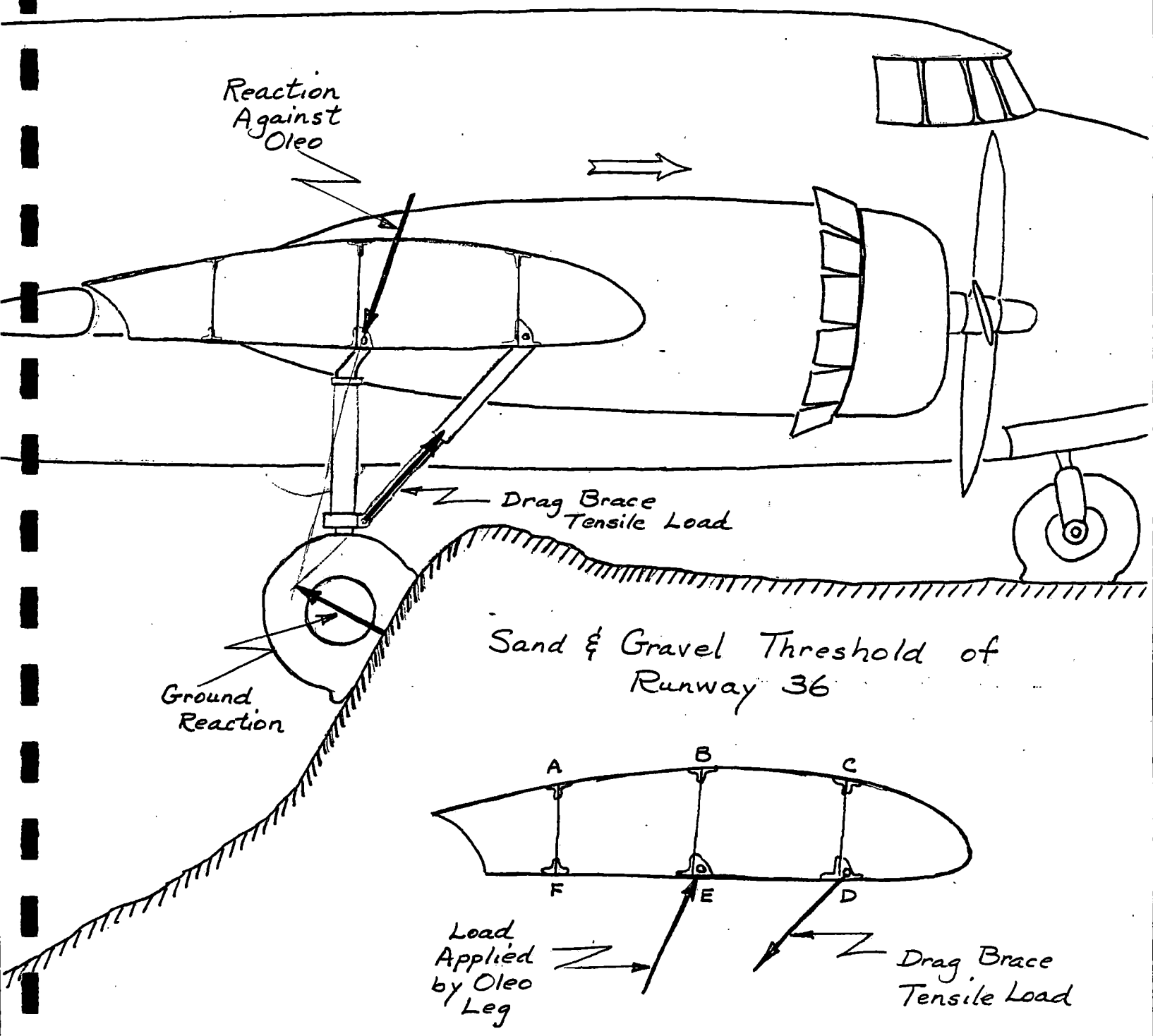
4.0 CONCLUSIONS

4.1 It is concluded that:

4.1.1 striking the threshold of Runway 36 at Hidden Bay with the right main gear caused the structurally significant damage to C-GPFG;

4.1.2 there was no discernible relationship between the accident and any previous damage;

4.1.3 C-GPFG is not economically repairable.



Right Main Gear Impact Loading & Wing Twist

Figure 1

Calm Air DC-4 C-GPFG
At Hidden Bay, Saskatchewan

Figure 2

Right Wing Spanwise View of Underside Looking towards Fuselage

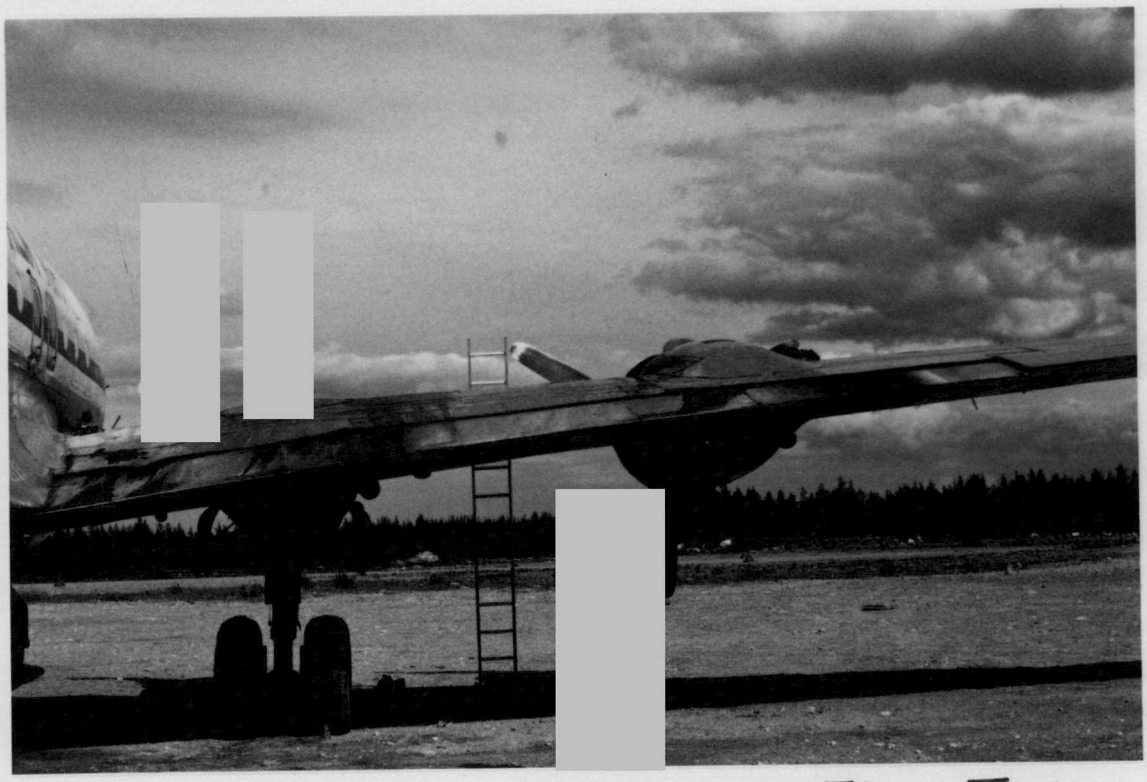
Figure 3

Close-up of Damage to Right Wing Undersurface and Flap Fairing

Figure 4

Underside of #3 Engine Nacelle
Looking Forwards
Figure 5

A Closer View
Figure 6



Upper Surface Buckles at Flap Fairing
Figure 7

Buckle Reflecting Nose Down Twist of Right Wing
Figure 8

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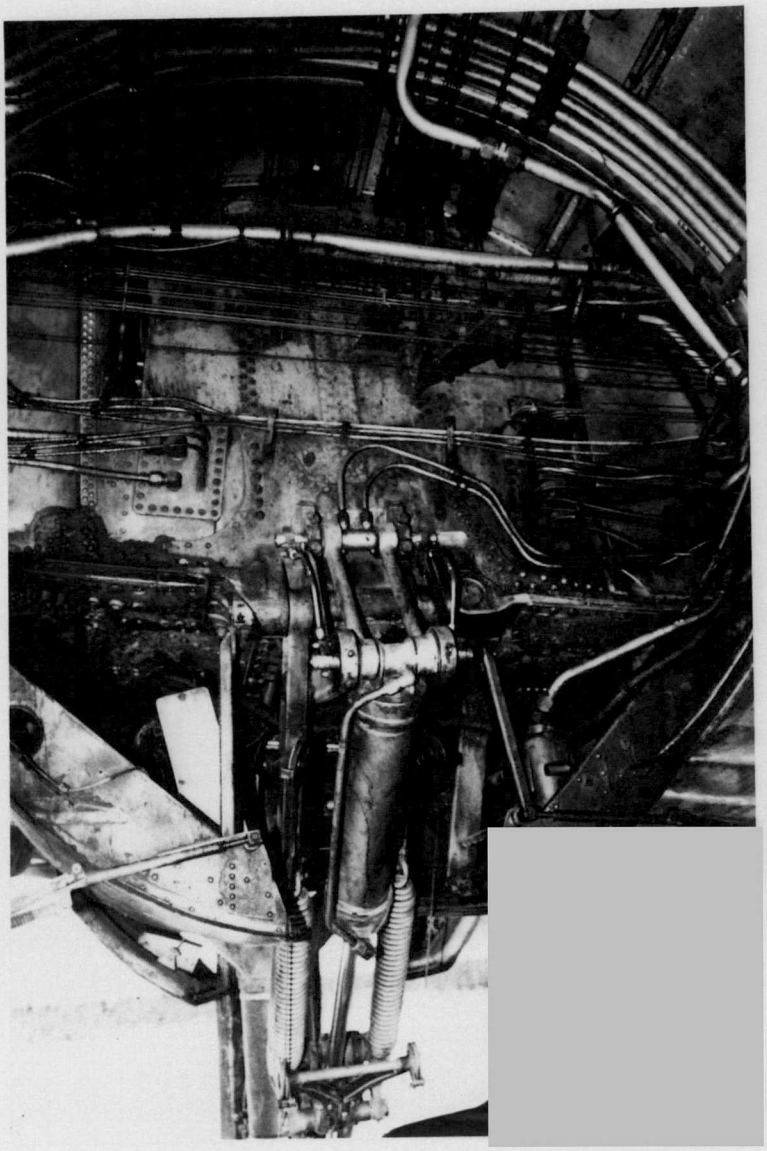
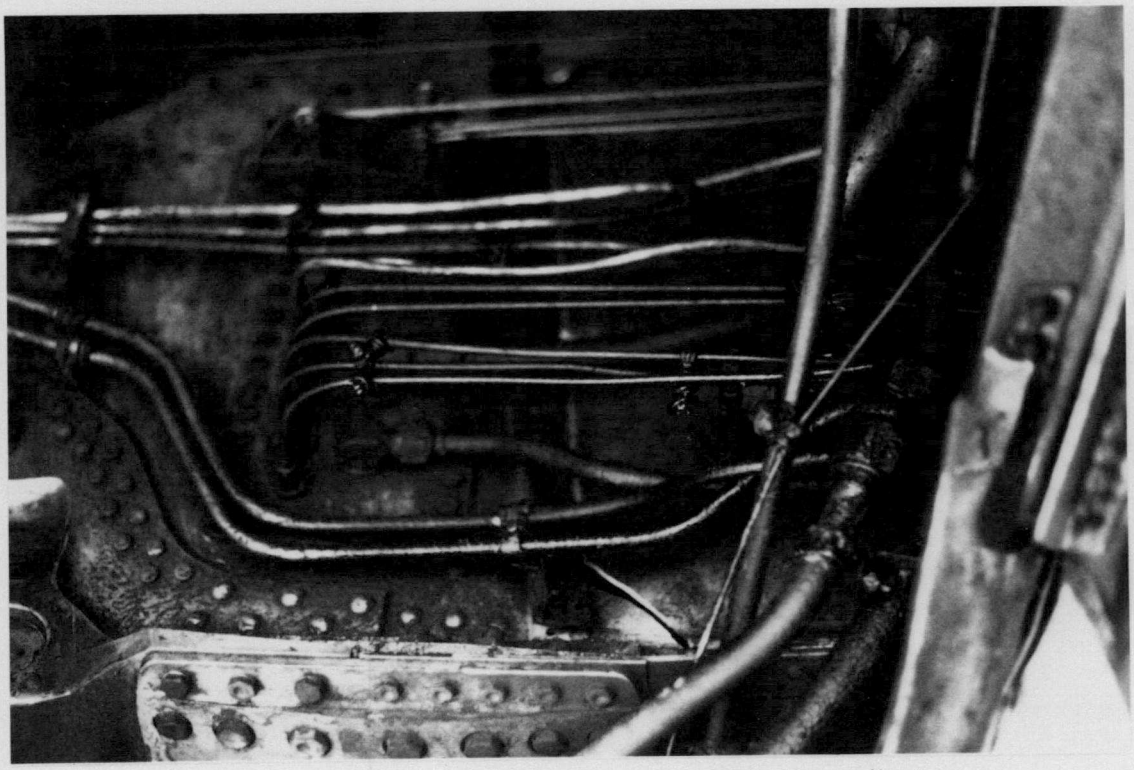
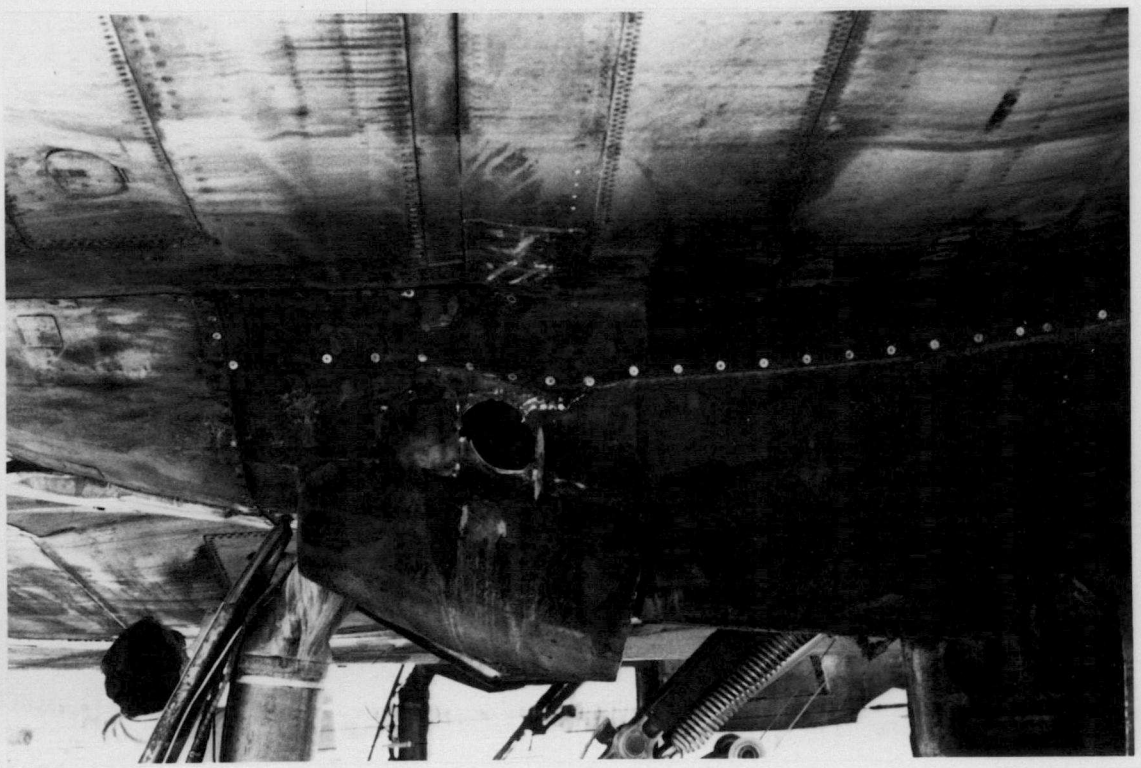


Right Main Gear Drag Brace
Connection to Front Spar

Figure 9



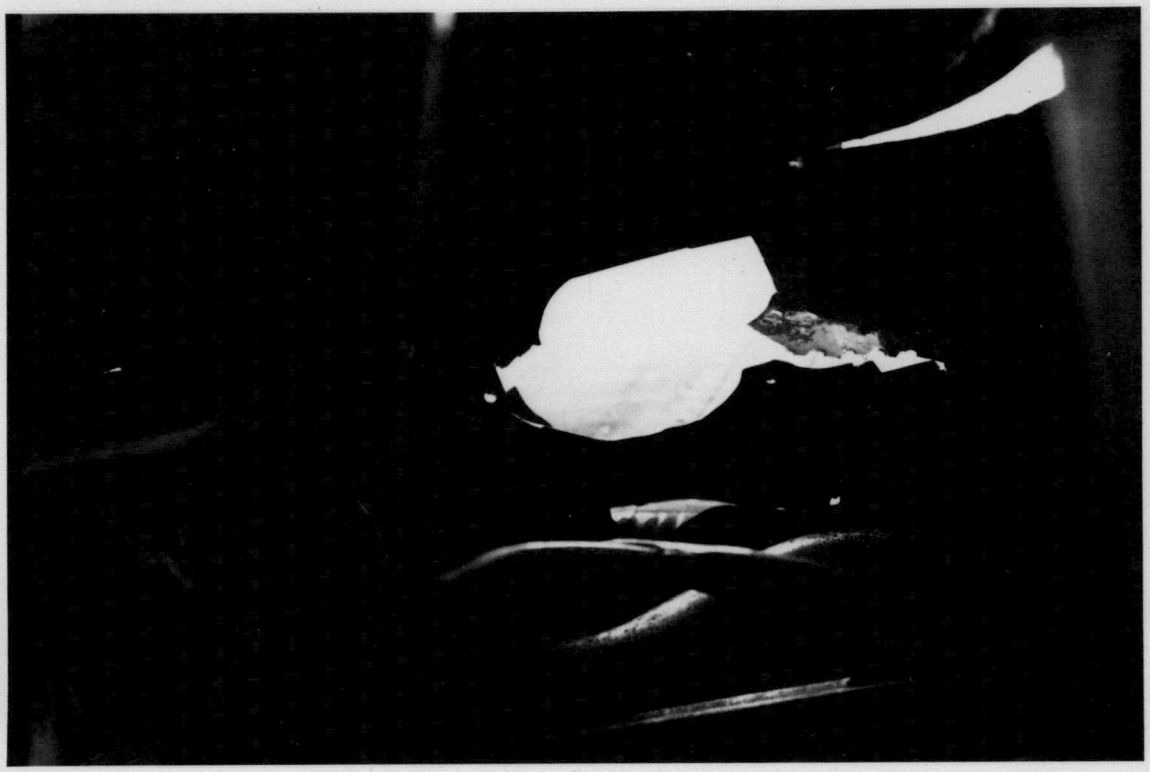
Front Spar Web of Right Wing
Just Inboard of Main Gear Drag Brace
Figure 10



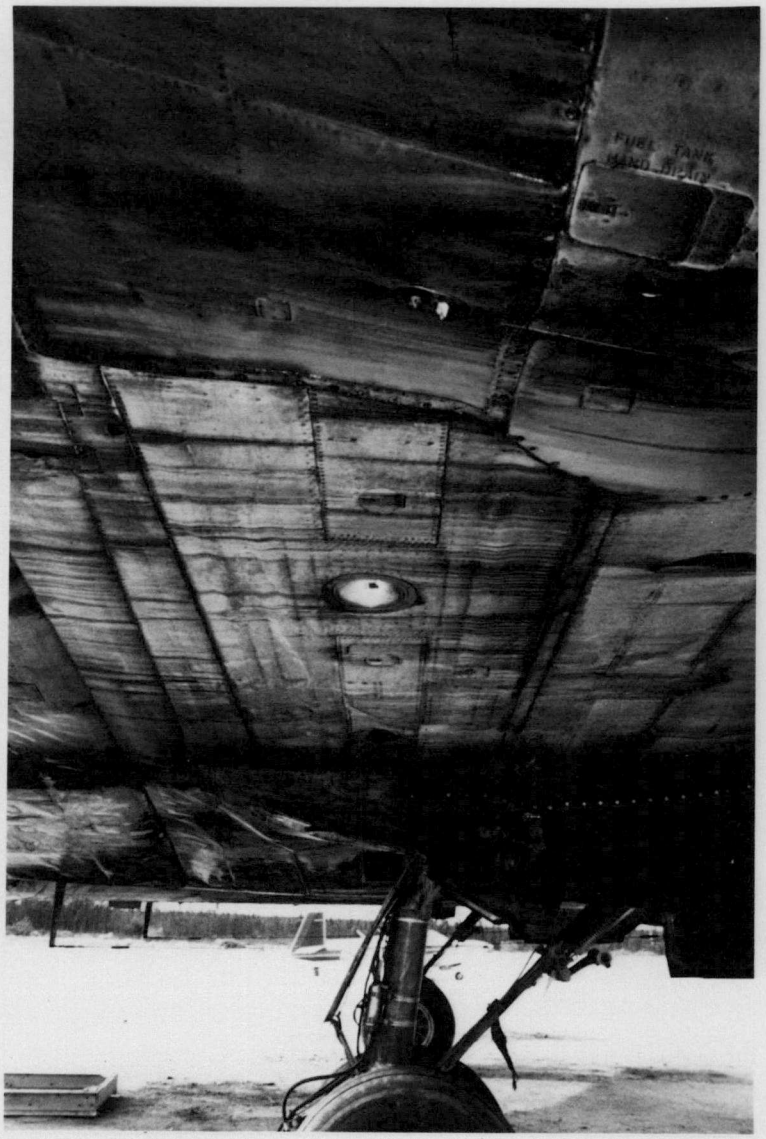
Outboard Underside of #3 Nacelle

Figure 11

#3 Engine Nacelle Rear
Figure 12



Same Location Viewed from
Inside Wheel Well
Figure 13



Right Main Gear Exhibiting Rearwards Inclination

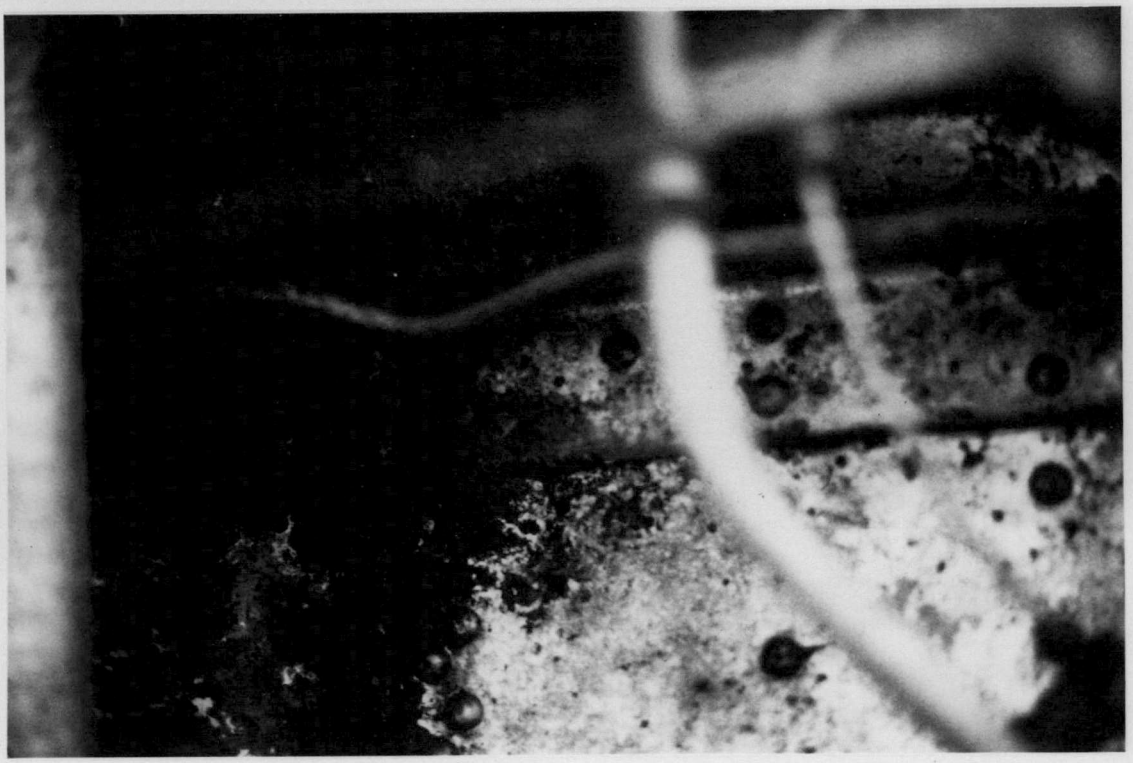
Figure 14

Right Wheel Well Just Ahead of Oleo Leg Trunnion

Figure 15

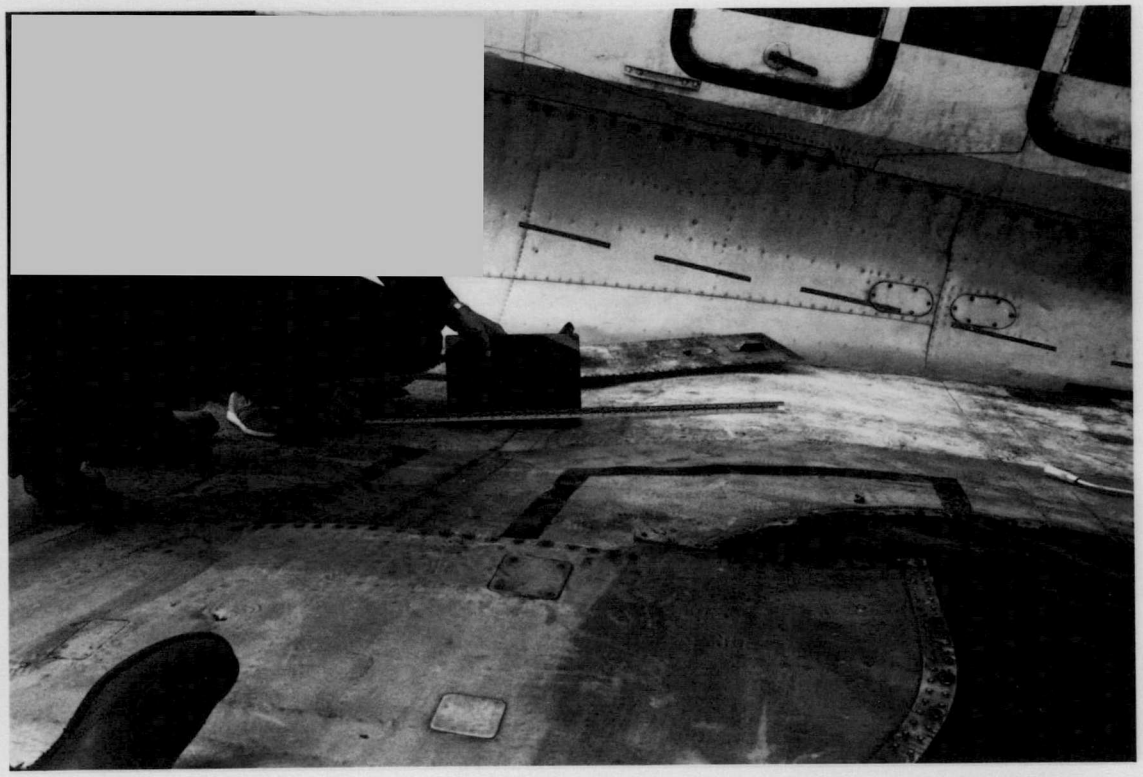
Fwd →

Outboard Side of Trunnion

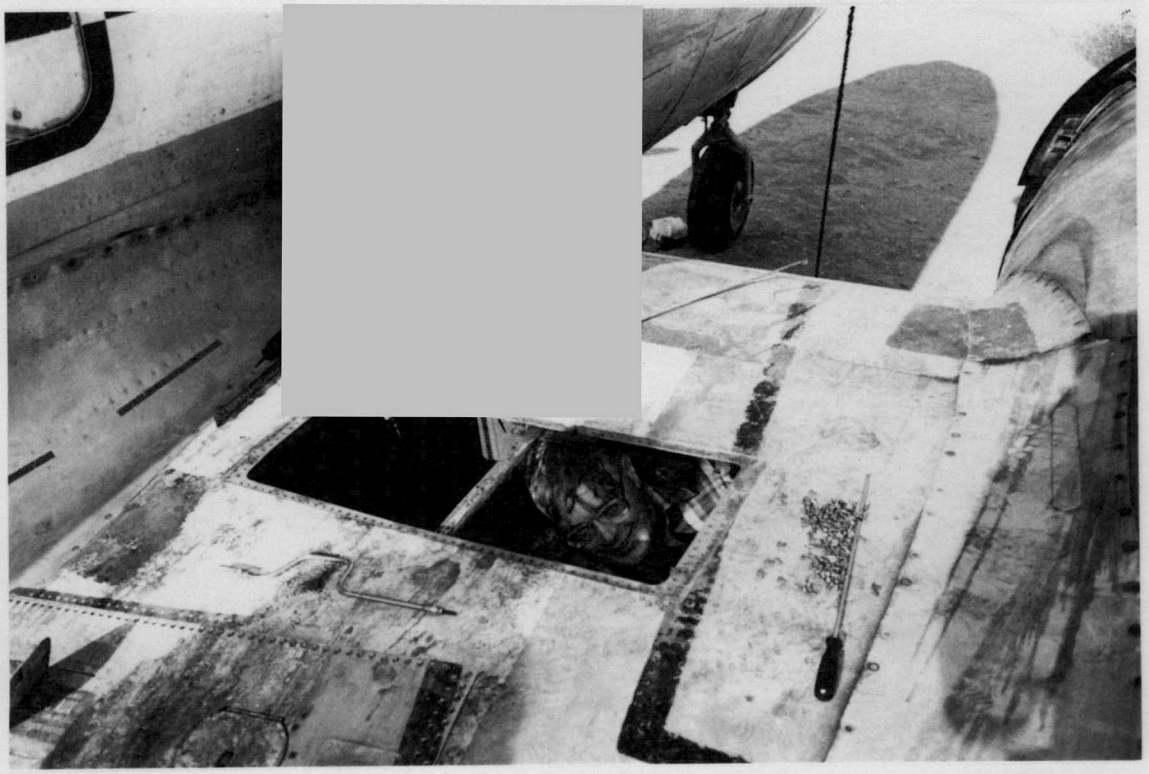


Fwd →

Inboard Side of Trunnion



Deformation of Upper Surface of Right Wing Inboard of #3 Nacelle
Figure 16



Inside Auxiliary Tank Bay of Right Wing for Photography
Figure 17

View of Front Spar Web from Inside Auxiliary Tank Showing Sheared Rivets, Buckles and Torn Rib

Figure 18

Note: Arrows on Figures 18 and 19 Correspond

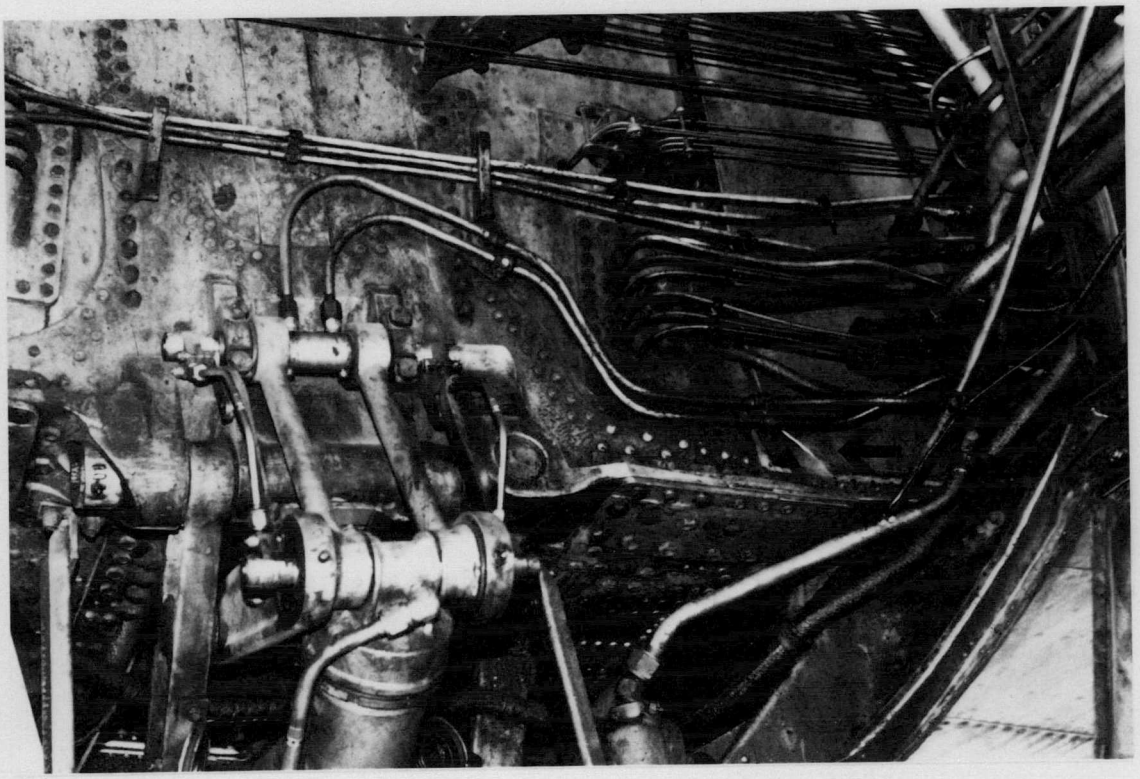
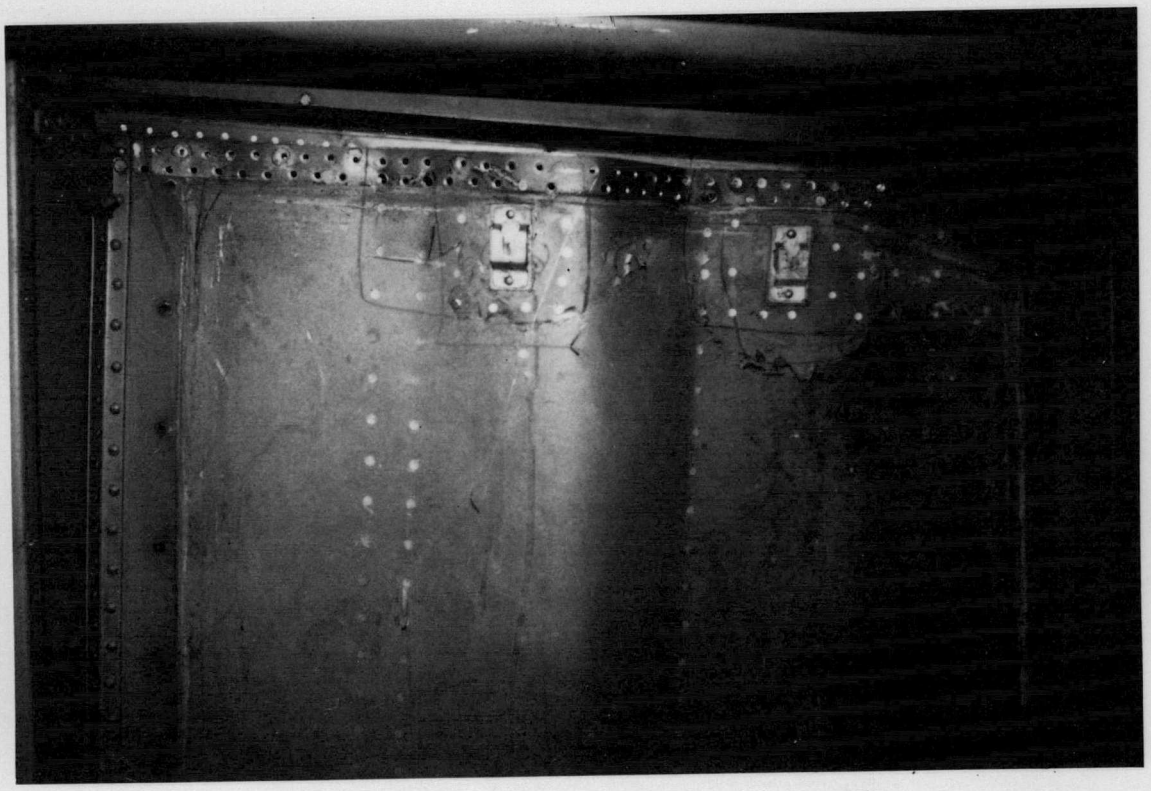
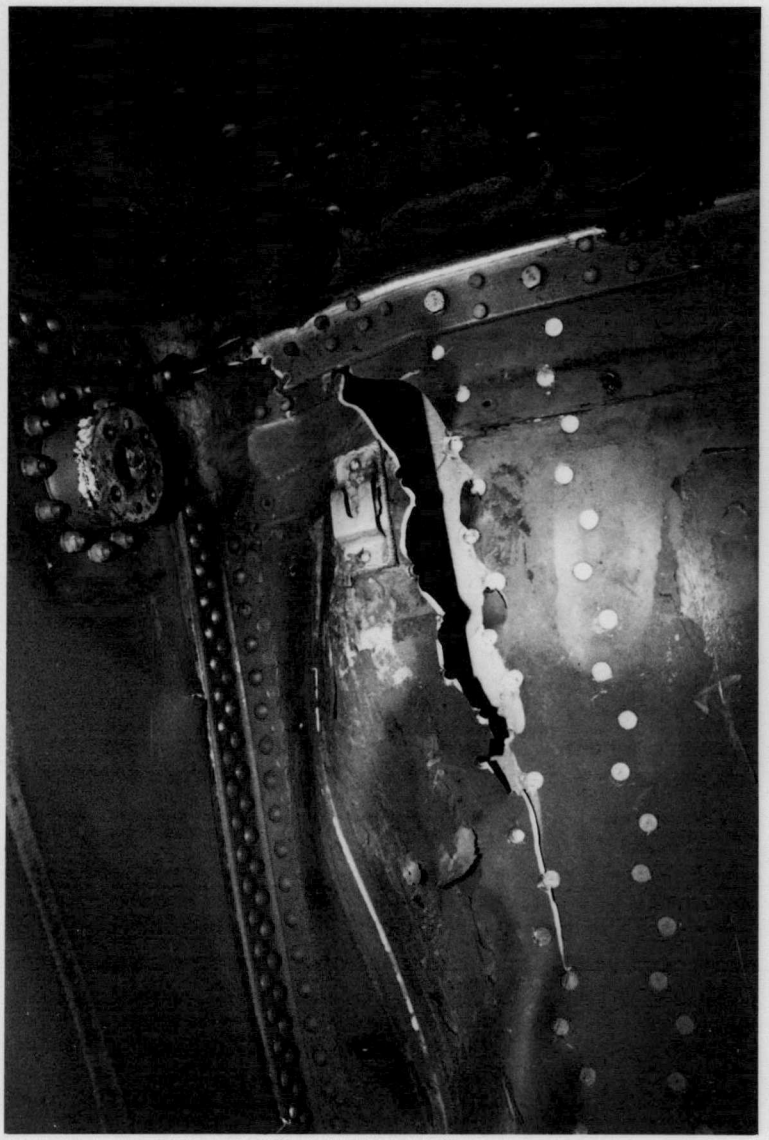


Figure 19



Inboard Wall of Auxiliary Tank Bay

Figure 20



Outboard Wall of Auxiliary Tank Bay

Figure 21

Note: Rib Cap is Broken

View of Centre Spar Web Forming
Rear of Auxiliary Tank Bay

Figure 22

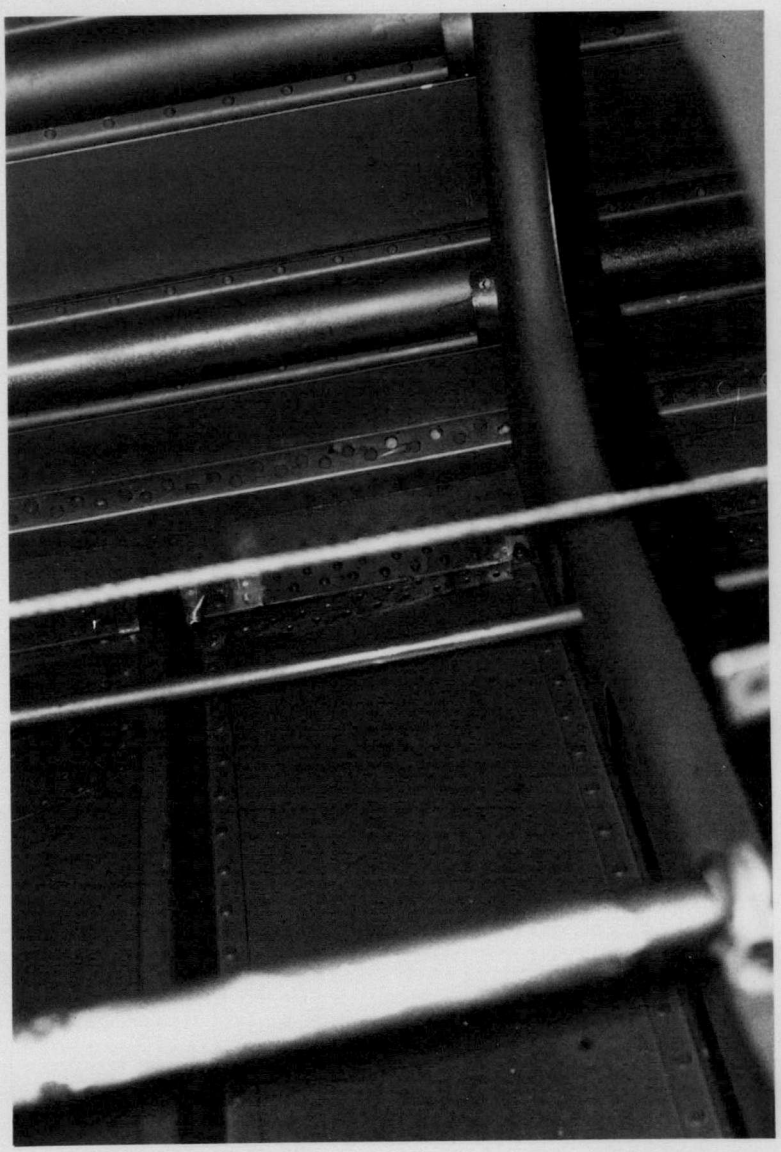
Another View Showing Torsional Failure of Centre Spar Web

Figure 23

Note: Corner by photographer's foot has been driven upwards by force at E in Figure 1.

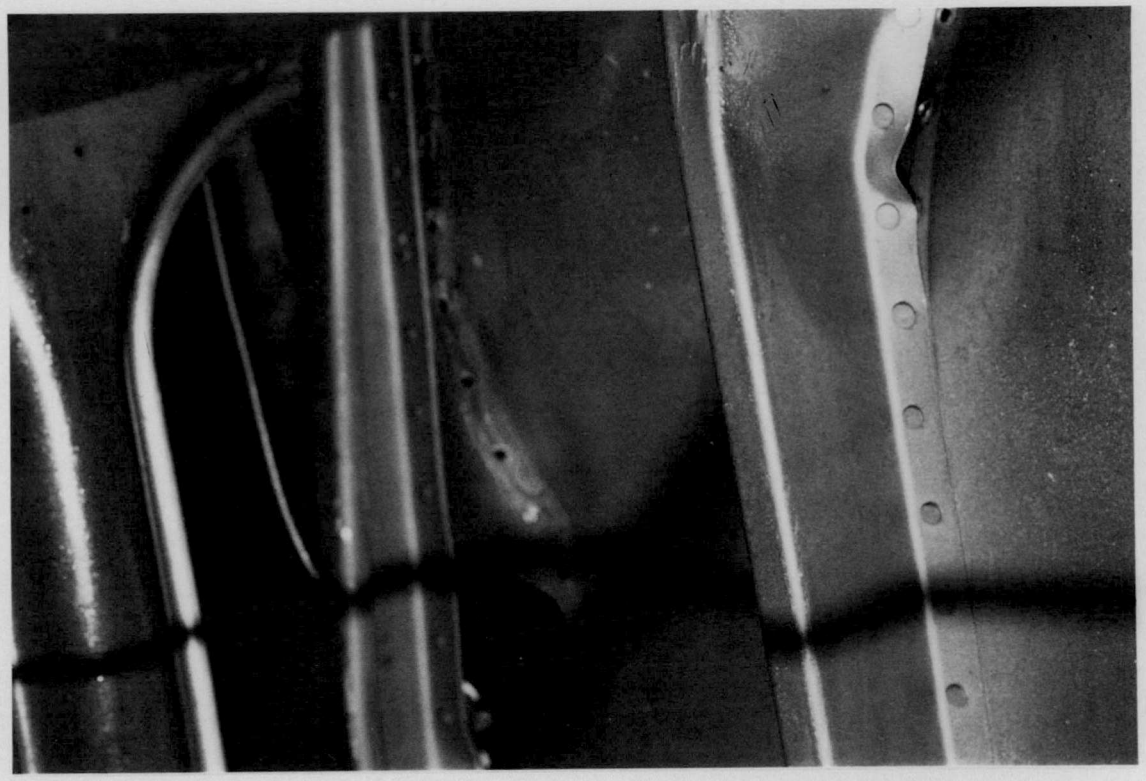
View of Centre Spar at Figure 23 from Behind

Figure 24



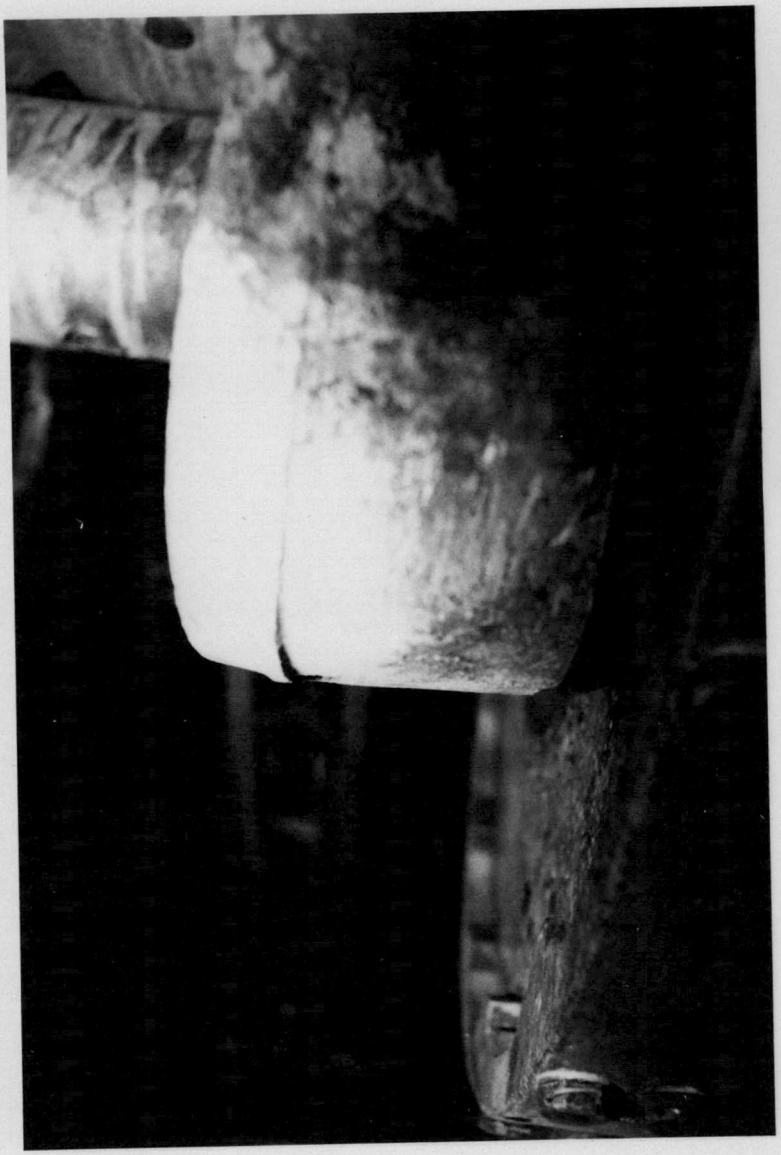
Centre Spar Rivet Shear

Figure 25



Photograph Through Access Panel of Area between Centre and Rear Spars
Figure 26

Right Main Gear Outboard Brake Caliper Showing New Gouging on Front
Figure 27



Right Main Gear Outboard Brake Caliper Showing Scrape Marks on Bottom

Figure 28

Bend in the Rear Spar Cap

Figure 29

A Better View of the Buckles
Figure 30

Same Area Viewed from On Top
of the Wing
Figure 31

Threshold of Runway 36, Hidden Bay.
Groove Marks Right Gear Passage
Figure 32

Looking Over the Edge of the Threshold
from the Runway
Figure 33

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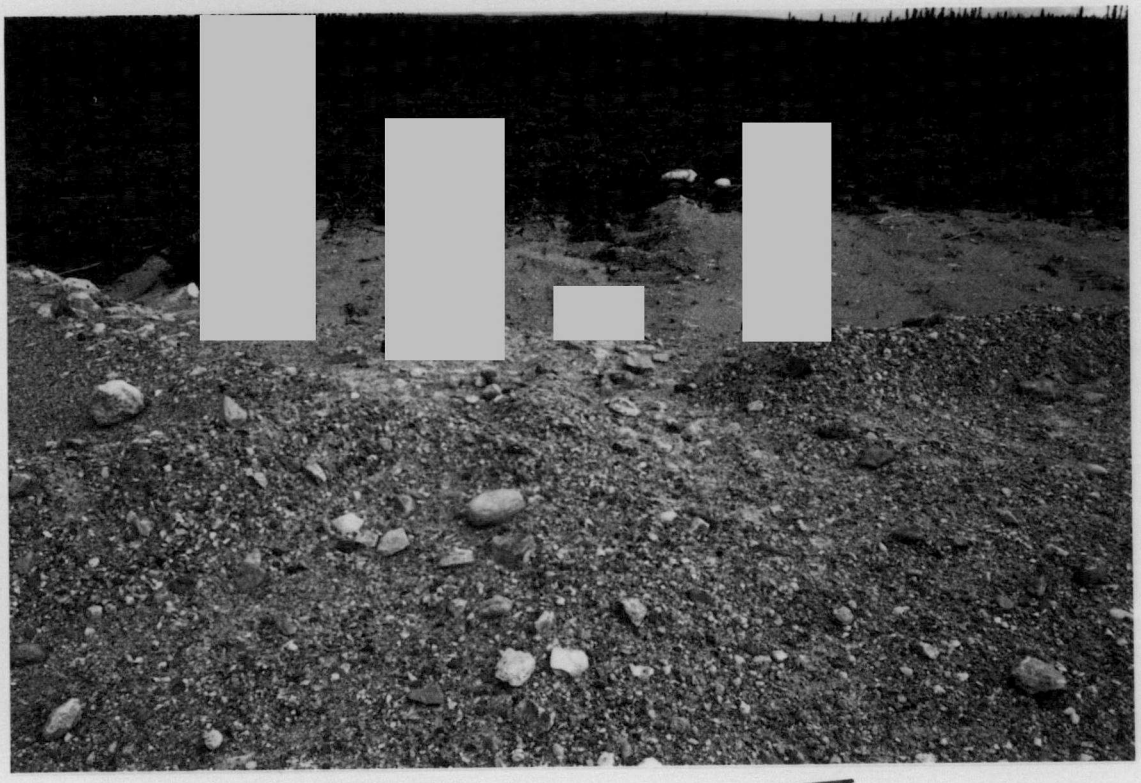

Close-Up Views of the Threshold
Of Runway 36
Figure 34

Figure 35

Canadian Aviation Safety Board | Bureau canadien de la sécurité aérienne

The Canadian Aviation Safety Board investigated this occurrence for the purpose of advancing aviation safety. It is not the object of the Board to determine or apportion any blame or liability.

AVIATION OCCURRENCE REPORT

CALM AIR INTERNATIONAL
DOUGLAS DC-4 C-GPFG
HIDDEN BAY AIRSTRIP, SASKATCHEWAN
16 JUNE 1987

REPORT NUMBER 87-C70039

SYNOPSIS

During a visual approach and landing in cross-wind conditions at Hidden Bay Airstrip, Saskatchewan, the aircraft's right main landing gear struck the lip of the runway. The aircraft bounced slightly, continued onto the runway, and was brought to a safe stop. The aircraft was substantially damaged.

The Canadian Aviation Safety Board (CASB) determined that the crew misjudged the altitude of the aircraft while landing in a cross-wind.

Canada

TABLE OF CONTENTS

		Page
1.0	**FACTUAL INFORMATION**	1
1.1	History of the Flight	1
1.2	Injuries to Persons	1
1.3	Damage to Aircraft	2
1.4	Other Damage	2
1.5	Personnel Information	2
1.6	Aircraft Information	2
1.7	Meteorological Information	3
1.8	Aids to Navigation	3
1.9	Communications	3
1.10	Aerodrome Information	3
1.11	Flight Recorders	3
1.12	Wreckage and Impact Information	4
1.13	Medical Information	4
1.14	Fire	4
1.15	Survival Aspects	4
1.16	Tests and Research	4
1.17	Additional Information	5
1.17.1	Approach Procedures	5
2.0	**ANALYSIS**	6
2.1	General	6
3.0	**CONCLUSIONS**	7
3.1	Findings	7
3.2	Causes	7
4.0	**SAFETY ACTION**	8
5.0	**APPENDICES**	
	APPENDIX A - GLOSSARY	

1.0 FACTUAL INFORMATION

1.1 History of the Flight

On 16 June 1987, a Calm Air International Douglas DC-4 aircraft, C-GPFG, was chartered to move cargo from Hidden Bay, Saskatchewan to Kasba Lake in the Northwest Territories. The aircraft and crew of four were on the return flight under visual flight rules (VFR)* and were conducting an approach and landing to runway 36 at the Hidden Bay Airstrip, in a cross-wind from the right. The pilot flying was the first officer, who was in the right seat.

After the landing gear and full flap were lowered, the aircraft's speed was reduced to 100 knots.** As the aircraft crossed the threshold, the crew heard a thump, and the aircraft skipped 40 to 50 feet and then touched down on the runway. As the weight of the aircraft came onto the landing gear, the right main gear unsafe light illuminated. The captain took control of the aircraft, completed the landing roll, and taxied to the parking area. During shutdown, fuel was seen leaking onto the right main gear assembly. The shutdown check was completed, and the aircraft was evacuated.

The accident occurred at 1450 central daylight time (CDT)*** during the hours of daylight, at lat 58°08'N, long 103°47'W, at an elevation of 1,444 feet above sea level (asl).

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	–	–	–	–
Serious	–	–	–	–
Minor/None	4	–	–	4
Total	4	–	–	4

* See Glossary for all abbreviations and acronyms.

** Units are consistent with official manuals, documents, reports, and instuctions used by or issued to the pilot.

*** All times are CDT (Coordinated Universal Time (UTC) minus five hours) unless otherwise stated.

1.3 Damage to Aircraft

The aircraft was substantially damaged.

1.4 Other Damage

There was no other damage.

1.5 Personnel Information

	Pilot-In-Command	Co-Pilot
Age	[redacted]	
Pilot Licence	Airline Transport	Airline Transport
Medical Expiry Date	27/08/87	19/11/87
Total Flying Time	9,500 hr	5,540 hr
Total on Type	1,680 hr	1,040 hr
Total Last 90 Days	305 hr	280 hr
Total on Type Last 90 Days	305 hr	280 hr
Hours on Duty Prior to Occurrence	12 hr	12 hr
Hours off Duty Prior to Work Period	8 hr	10 hr

The captain and first officer held valid Class 1 Group 1 instrument ratings. Both pilots had completed all mandatory checks and were qualified for the flight.

The first officer conducted the approach and landing from the right-hand seat. The captain took control after the occurrence. Both pilots were familar with the Hidden Bay Airport and environs.

1.6 Aircraft Information

Manufacturer	Douglas
Type	DC-4
Year of Manufacture	1946
Serial Number	42917
Certificate of Airworthiness	Valid
Total Airframe Time	66,023.9 hr
Engine Type	Pratt & Whitney R-2000
Propeller Type	Hamilton Standard
Maximum Allowable Take-off Weight	73,000 lb
Recommended Fuel Type	100/130 octane

Records indicate that the aircraft was maintained in accordance with approved maintenance schedules. The aircraft was registered in the commercial category. The aircraft weight and centre of gravity were within the prescribed limits.

1.7 Meteorological Information

The weather was suitable for the flight with clear skies and excellent visibility. On the runway in use, there was a 90-degree cross-wind from the right at 12 knots. The crew had received a weather briefing prior to the flight.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

Not applicable.

1.10 Aerodrome Information

The Government of Saskatchewan operated the unlicensed and unattended airport at Hidden Bay. The gravel runway was 3,940 feet long and 60 feet wide, oriented in a north/south direction. A bell-shaped area was constructed at the button of runway 36 to accommodate larger aircraft; the area was built up using gravel and landfill, and there was a 10-foot deep lip at the threshold. This type of landing strip construction is common in remote regions of Canada.

1.11 Flight Recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder, nor was either required by regulation.

1.12 Wreckage and Impact Information

The right main landing gear struck the landfill at the deep lip of the runway threshold several feet below the level of the runway surface. The impact caused a heavy load on the gear aft and upwards, and the load was transmitted to the right wing; this load resulted in torsional failure and compression buckling of the centre span web and tensile failure at 90 degrees to the buckle. The structural damage was such that the aircraft was not economically repairable.

1.13 Medical Information

There was no evidence that incapacitation, physiological, or psychological factors affected the crew's performance.

1.14 Fire

There was no evidence of fire either before or after the occurrence.

1.15 Survival Aspects

The accident was survivable.

1.16 Tests and Research

The company had recently experienced difficulty with the aircraft's right main landing gear oleo when it became stuck in the overextended position by the scissors, resulting in a stiff-leg landing. There was concern that this incident may have contributed to the accident and might reflect a problem of fleet-wide significance. However, a representative from the CASB Engineering Laboratory examined the aircraft and found no evidence of a relationship between this accident and the previous occurrence.

1.17 Additional Information

1.17.1 Approach Procedures

The speeds selected for the approach and threshold crossing were appropriate for the conditions. The crew were familiar with the runway environment and had operated from the strip that day. The fact that the first officer was conducting the approach and landing was not considered to be a factor, as he had done this many times before and the practice was in keeping with company policy. Both pilots stated that the approach appeared to be normal.

The 3,940-foot long runway was long enough for the aircraft type, but pilots normally tried to touch down close to the threshold of the runway to have maximum stopping distance.

2.0 ANALYSIS

2.1 General

As the aircraft was found to be serviceable, the investigation concentrated on the operational aspects of the occurrence.

Both pilots were experienced on the aircraft type and were familiar with the runway environment. The aircraft was landing in good visual conditions with a 90-degree cross-wind from the right at 12 knots. The fact that only the right main landing gear struck the lip at the runway threshold indicated that the right wing was low at the time of impact; this attitude was consistent with the landing technique required to counter a cross-wind. During the approach, both pilots were satisfied with the attitude and altitude of the aircraft.

The investigation concluded that the pilots misjudged the aircraft's altitude while landing in a cross-wind, and the right main landing gear struck the lip at the threshold of the runway.

3.0 CONCLUSIONS

3.1 Findings

1. The lip at the threshold of the runway was 10 feet deep.

2. The right main wing landing gear struck the lip at the threshold of the runway.

3. The flight crew was certified and qualified for the flight in accordance with existing regulations.

4. The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

5. There was no evidence found of any airframe failure or system malfunction prior to or during the flight.

6. The weight and centre of gravity were within prescribed limits.

3.2 Causes:

The Canadian Aviation Safety Board determined that the crew misjudged the altitude of the aircraft while landing in a cross-wind.

4.0 SAFETY ACTION

The Board has no safety recommendations to issue at this time.

APPENDIX A

GLOSSARY

asl	above sea level
CASB	Canadian Aviation Safety Board
CDT	central daylight time
hr	hour(s)
lat	latitude
lb	pound(s)
long	longitude
UTC	Coordinated Universal Time
VFR	visual flight rules
N	north
W	west
°	degree(s)
'	minute(s)

Pages 43 to / à 154

are not relevant

sont non pertinentes