



Interim Report on aircraft accident

The investigation is still open and this report is released on interim basis

Information can change during publication of the final report

Case no: **20-014F001**

Date: **7. February 2020**

Location: **RWY 10 at Keflavik Airport**

Description: **Right Main Landing Gear collapsed during landing**

Investigation per Icelandic Law on Transportation Accident Investigation, No. 18/2013 shall solely be used to determine the cause(s) and contributing factor(s) for transportation accidents and incidents, but not determine or divide blame or responsibility, to prevent further occurrences of similar cause(s). This report shall not be used as evidence in court.

1. Factual information

Location and time	
Location:	RWY 10 at Keflavik Airport (BIKF)
Date:	7. February 2020
Time¹:	15:43:53

Aircraft	
Type:	Boeing 757-200
Register:	TF-FIA
Year of manufacture:	2000
Serial number:	29310
CoA:	Valid
Engines:	Two RB211-535E4

Other information	
Persons on board:	6 crew / 160 passengers
Injury:	None
Damage:	To be determined
Short description:	Aircraft right main landing gear collapsed during landing due to failure of swivel attachment to main strut
Type of flight:	Scheduled passenger flight

¹ All times in the report are Icelandic local times (UTC+0), unless otherwise stated

1.1. History of the flight

Aircraft TF-FIA was returning to Keflavik Airport as flight FI529. The Commander was the Pilot Flying (PF). The flight had been uneventful, although the flight crew was aware of unfavourable weather conditions in Keflavik. The last two METARs issued 43 and 13 minutes before landing were as follows:

BIKF 071500Z 13040G53KT 5000 -DZRA BR OVC010 07/06 Q0968

BIKF 071530Z 13042G56KT 6000 BR OVC013 07/06 Q0967

Flight FI529 was cleared direct to NONBO by Keflavik Approach. The Commander briefed his intentions to land a bit further down the runway than normal (3 white and 1 red on the PAPI), to avoid turbulence on short final.

When the airplane reached NONBO, it intercepted the localizer and the ILS was followed down towards RWY² 10.

The airplane encountered considerable turbulence at 1000 feet above MSL. The autopilot was disengaged between 600 and 700 feet above MSL and the airplane was then manually flown down towards the runway.

The airplane was flown with the nose into the wind on final approach due to crosswind conditions. Few seconds before touchdown the airplane was de-crabbed to line up with the runway heading.

The flare was normal and the airplane initially touched down on its right main landing gear. Then the left main landing gear touched the runway. Almost immediately thereafter, as the nose was gradually coming down, abnormal sound [like metal fracturing] was observed and the right side of the airplane sunk down.

The airplane speedbrake deployed momentarily and the right engine hit the runway. The airplane then leveled off again and the nose landing gear touched the runway.

² runway

The airplane wobbled as it continued down the runway, on the left main landing gear and the nose landing gear only, as the PF fought to keep the airplane level and centered on the runway, utilizing the aileron and rudder controls.

As the airplane speed decreased, the aerodynamics of the wings and the effectiveness of the rudder and aileron control diminished, until the PF could no longer keep the airplane wings level.

The right wing sunk down again and the right engine hit the runway again. The airplane skid on the runway until it came to stop, still on the runway but with a magnetic heading of 115°.



Figure 1: Airplane TF-FIA resting on its Right Engine at the accident site



Figure 2: Right Main Landing Gear collapsed behind the Right Engine



Figure 3: Right Main Landing Gear - Side Strut Swivel disconnected from the Shock Strut



Figure 4: Side Strut Swivel – Missing the Nut and the splined Washer



Figure 5: Right Main Landing Gear – Shock Strut lug for Swivel connection found unbroken, but bushing migration observed

During the ITSB³ on-site investigation it became clear that the NUT used to fasten the SWIVEL in the lug position on the MAIN LANDING GEAR SHOCK STRUT was missing along with its mating WASHER-SPLINED.

These parts were found close to the touchdown zone.

1.2. Damage to aircraft

To be released in the final report.

1.3. Personnel information

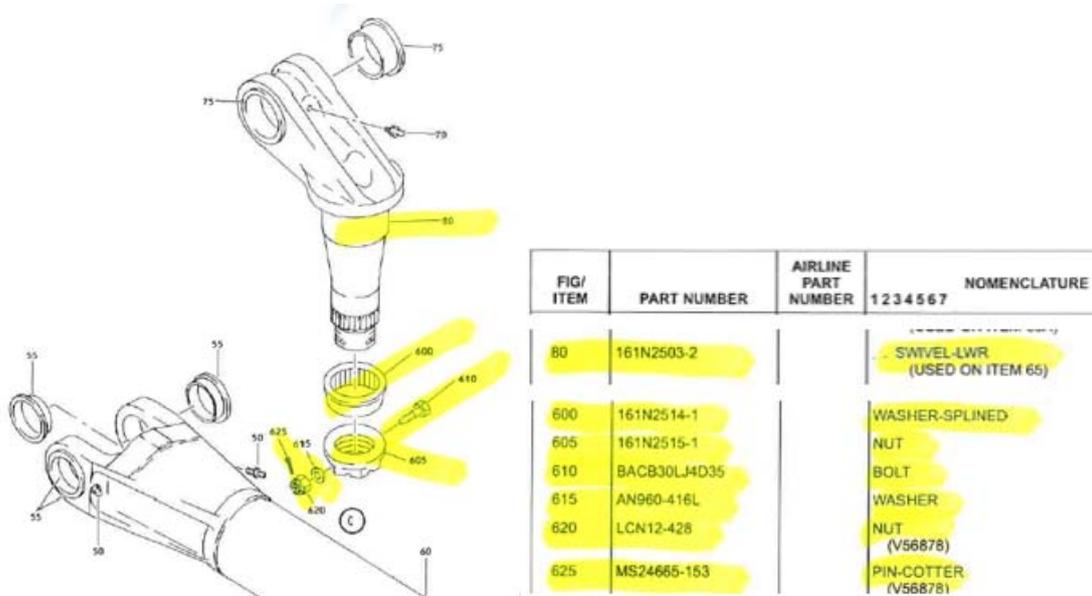
To be released in the final report.

³ Icelandic Transportation Safety Board (Rannsóknarnefnd samgönguslysa or RNSA in Icelandic)

1.4. Aircraft information

Inspection of the RIGHT MAIN LANDING GEAR on the accident site revealed the following:

- The attachment of the SWIVEL (P/N161N2503-2) in the lower part of the SIDE STRUT DOWNLOCK ASSEMBLY to be detached from the SHOCK STRUT
- The NUT (P/N 161N2515-1 or equivalent⁴) and WASHER-SPLINED (P/N 161N2514-1) were missing from this landing gear attachment
- The locking BOLT (P/N BACB30LJ4D35) for the missing NUT was sheared, with both its head and threaded section missing, but the shank section of the BOLT remained in its position in the SWIVEL
- The NUT (P/N LCN12-428) for the sheared locking BOLT threaded section was missing along with its PIN-COTTER (MS24655-153)



Search of the missing parts revealed the NUT (P/N 161N2515-1 or equivalent) and WASHER-SPLINED (P/N 161N2514-1) in other locations of the runway, close to the touchdown point of the aircraft during landing.

⁴ Rework of the swivel requires special NUT to be fabricated per CMM 32-11-72, Repair 4-3



Figure 6: The missing Nut located on RWY 10, close to the touchdown position



Figure 7: The missing Washer located just outside RWY 10, close to touchdown

The sheared off head and threaded end sections of the locking BOLT (P/N BACB30LJ4D35) along with its mating NUT (P/N LCN12-428) and PIN-COTTER (MS24655-153) were not located.

Visual inspection of the SWIVEL revealed only minor damage in one location of the threads.

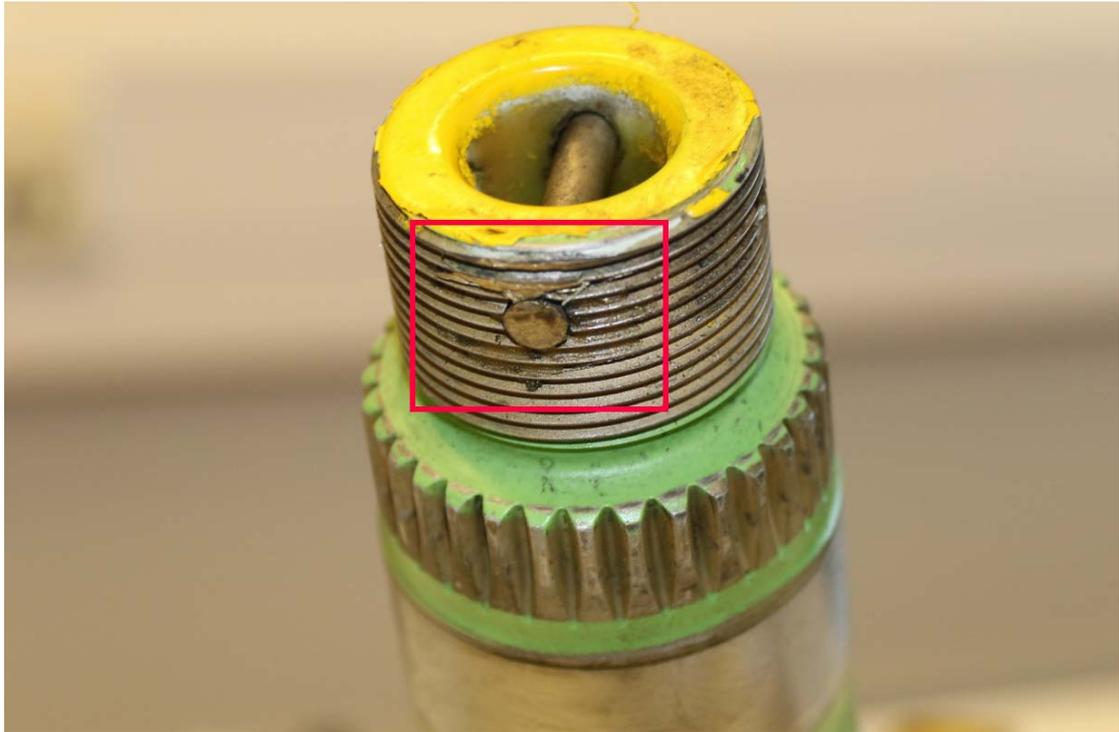


Figure 8: Swivel threads damage

Visual inspection of the NUT revealed only two minor damaged areas on the nut threads, 180° apart and across the threads, most likely caused by the sheared off head and threaded end section of the shank as the NUT came off the SWIVEL.

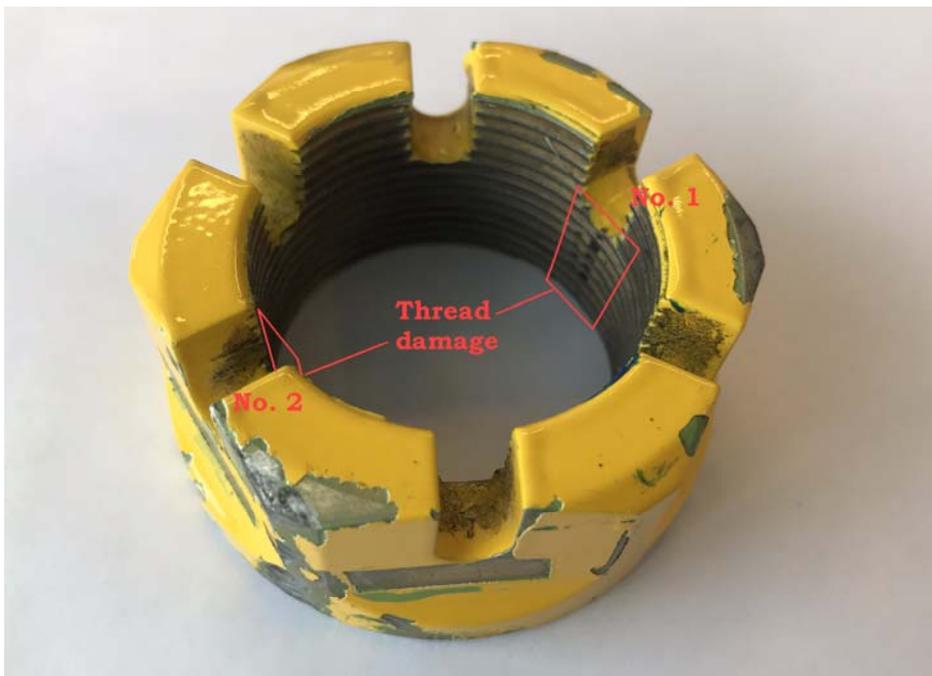


Figure 9: Thread damage located 180° apart on the NUT

This suggests that the NUT came off the SWIVEL without the NUT turning. This also suggest that the thread sizes of the SWIVEL and the NUT did not match.

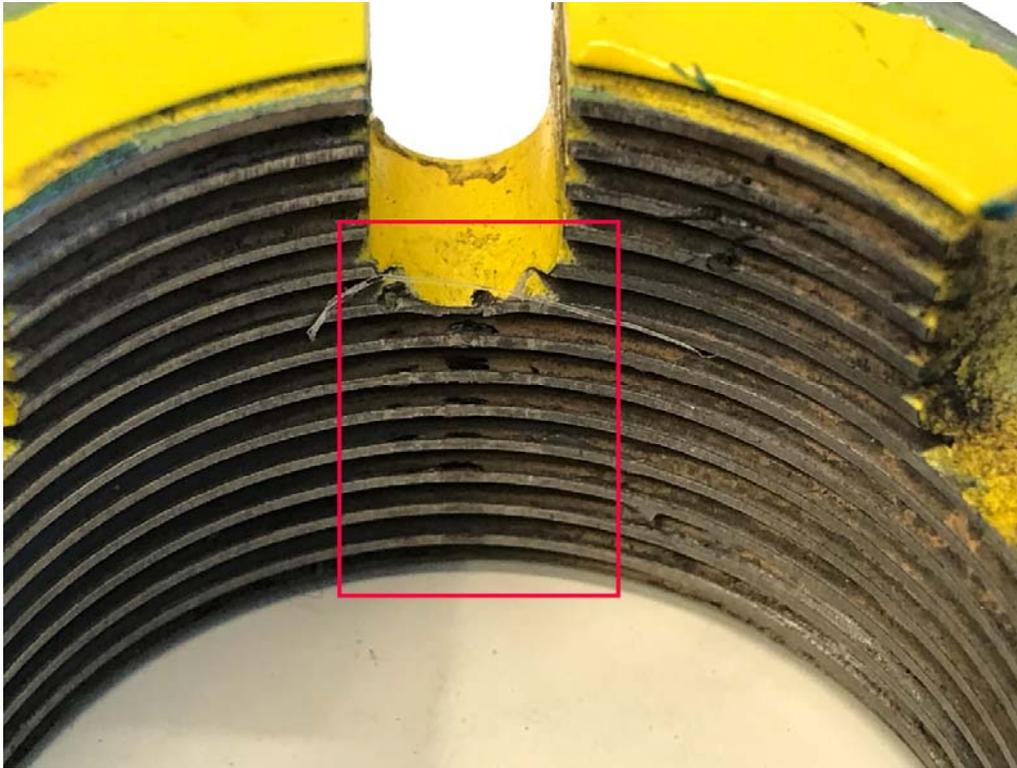


Figure 10: Thread damage No. 1

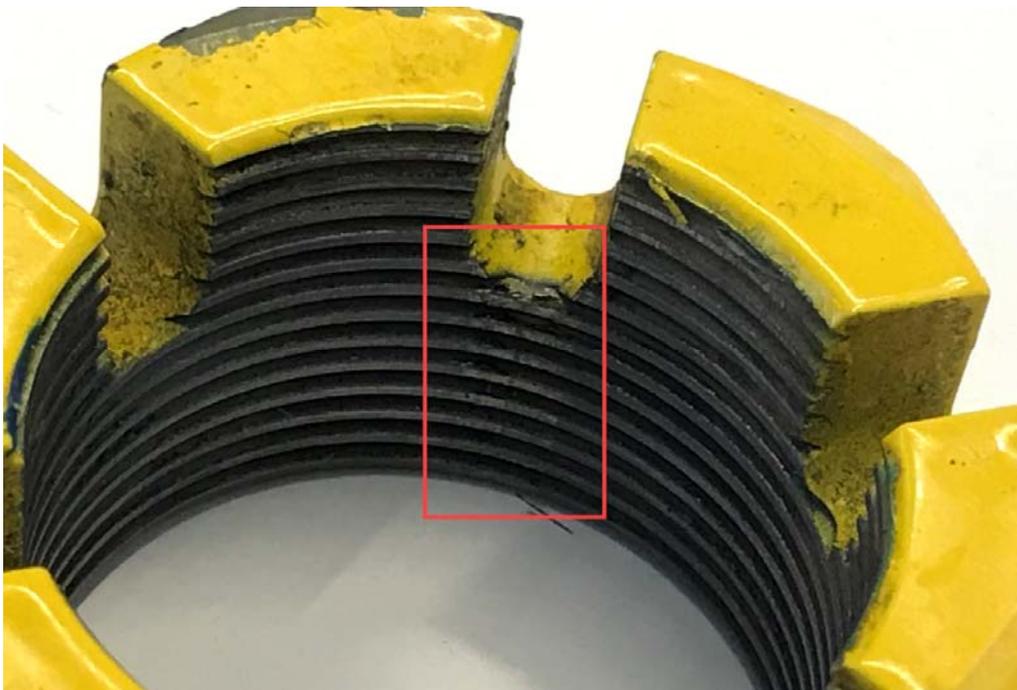


Figure 11: Thread damage No. 2

1.5. Meteorological information

METAR

BIKF 071400Z 13040G54KT 3000 -DZRA BR BKN008 OVC012 07/06 Q0970

BIKF 071430Z 13040G54KT 3000 -DZRA BR BKN008 OVC012 07/06 Q0970

BIKF 071500Z 13040G53KT 5000 -DZRA BR OVC010 07/06 Q0968

BIKF 071530Z 13042G56KT 6000 BR OVC013 07/06 Q0967

BIKF 071600Z 13042G55KT 8000 BR OVC013 07/06 Q0966

BIKF 071630Z 13039G54KT 4000 -RA BR SCT009 OVC013 07/06 Q0965

BIKF 071700Z 13042G58KT 6000 -RA BR SCT009 BKN013 BKN039 06/06 Q0965

1.6. Aids to navigation

The landing on RWY 10 at BIKF airport was performed using the runway's ILS. The investigation has not revealed any findings with regards to the ILS or the navigation.

1.7. Communications

The aircraft flight crew was in contact with the ATCO at Keflavik Airport. The investigation has not revealed any findings with regards to communications.

1.8. Aerodrome information

To be released in the final report.

1.9. Flight Recorders

The content of the flight recorders (CVR⁵ and FDR⁶) was downloaded successfully and analysed by the UK AAIB on February 18th and 19th, 2020.

The CVR revealed that the flight crew was not aware of any problems until the right landing gear collapsed and the right side of the airplane sunk down.

The FDR data was analysed using 8 bits per second resolution. The analysis of the FDR data does not show abnormal loading during the landing.

The FDR data highlights during the landing are as follows:

- 15:43:47 De-crab starts few seconds before touch-down
- 15:43:52:25 Right Main Landing Gear touchdown
- 15:43:52:375 1.28G-load max peak
 - Followed by a slight roll to the left
 - Which was corrected by right control wheel input
- 15:43:52:50 Left Main Landing Gear touchdown
 - Aircraft in Ground mode
- 15:43:52:875 Spoilers deploy
- 15:43:53:00 0.6G-load min peak
 - **Right Main Landing Gear Failure**
 - Aircraft goes to Air mode momentarily and then back to ground mode
 - This was followed by a roll to the right, as the right landing gear collapsed
- 15:43:54:25 Nose Landing Gear momentary touchdown
- 15:43:54:50 1.4G-load max peak
 - The roll to the right stopped
 - The right engine hit the runway
 - This was followed by left control wheel input
- 15:43:54:875 The spoilers have retracted
- 15:43:55:25 The aircraft goes back to Air mode

⁵ Cockpit Voice Recorder

⁶ Flight Data Recorder

- 15:43:55:50 The aircraft nose pitches up to 4.6°
- 15:43:57:00 The aircraft wings are in level position
 - Followed by the aircraft rolling to the left
 - Which was followed by right control wheel input
- 15:43:58:75 The airplane goes back to ground mode
- 15:44:00:75 The aircraft wings are in level position again
 - Pilot Flying managed to keep the airplane wing level for about 12 seconds with the Right Main Landing Gear collapsed while the airplane slowed down
- 15:44:01:75 Nose Landing Gear touchdown again
- 15:44:11 Right roll of the aircraft as the right wing sunk down
 - The Pilot Flying could no longer maintain the aircraft level
- 15:44:12:125 1.5G-load max peak
 - The right engine hit the runway again
- 15:44:59 The airplane came to rest on RWY 10



Figure 12: Significant points of the landing

1.10. Test and research

The SWIVEL threads were undersized 1/16 inch during an overhaul in December 2008. The SWIVEL threads were then undersized again during an overhaul in November 2019, bringing it to 1/8 inch undersize.

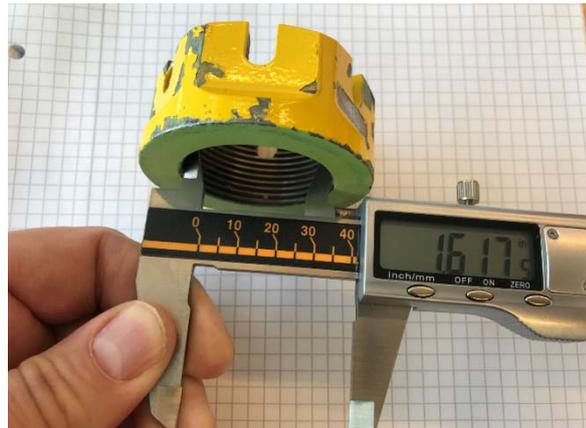
This brought the Major Diameter of the SWIVEL threads down to 1.6241 inch per the overhaul documents. Per Boeing CMM 32-11-72, Repair 4-3, such an undersize was allowed but required a special 1/8 undersized NUT to be fabricated and used.



**Figure 13: Swivel threads measured
(Major Diameter)**

Initial measurements by the ITSB after the accident has shown the Major Diameter of the SWIVEL threads to be 1.622 inch (Figure 13).

For 1/8 inch undersize, the Minor Diameter of the NUT was required to be in the range of 1.5439 to 1.5539 inch.



**Figure 14: Nut threads measured
(Minor Diameter)**

Initial measurements by the ITSB after the accident has shown the Minor Diameter of the NUT threads to be 1.617 inch (Figure 14).

The preliminary investigation therefore indicates the NUT to be too large for the 1/8 inch undersized SWIVEL threads.

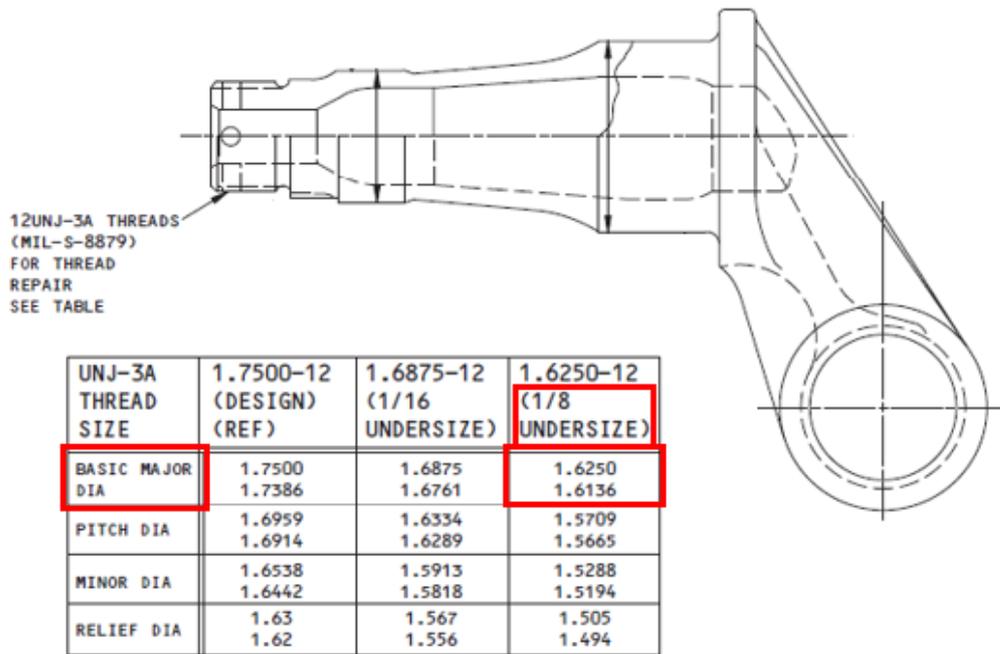


Figure 15: Major Diameter sizes of 1/8 inch undersized Swivel threads

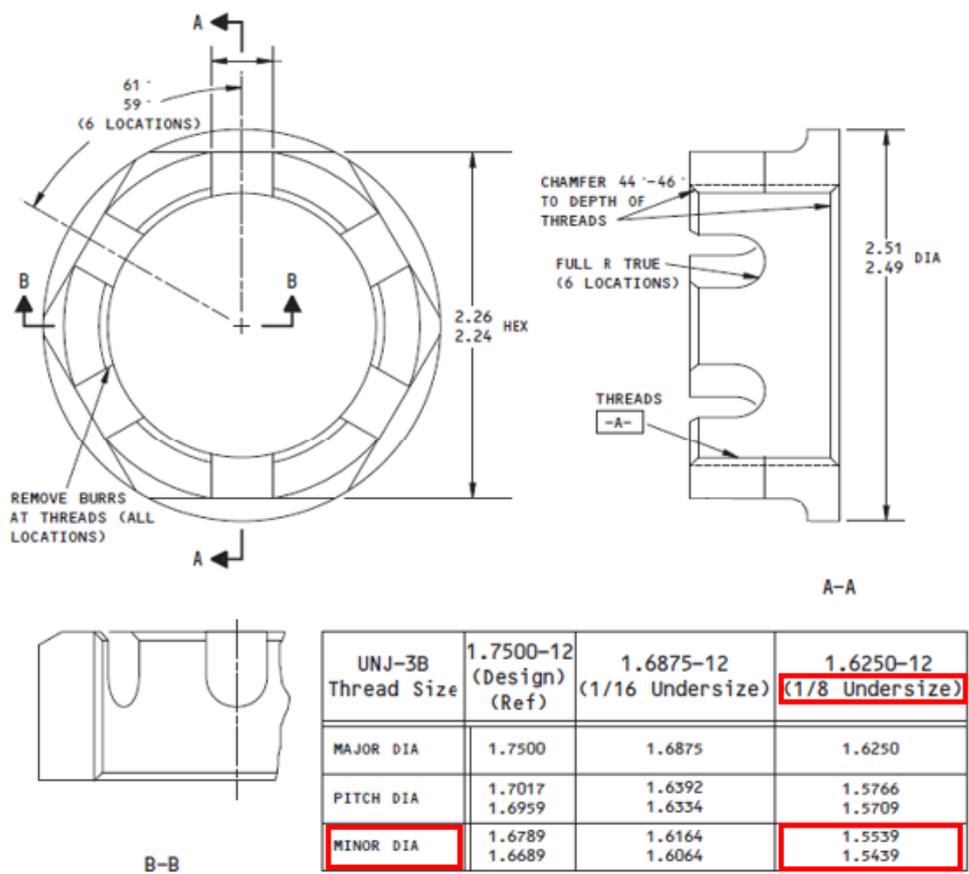


Figure 16: Minor Diameter sizes of 1/8 inch undersized Nut threads

1.11. Additional information

Due to possible consequences to other aircraft, this investigation has been assigned priority at the ITSB.

The following parties are supporting the investigation:

State of Occurrence and Registry – Iceland

- ITSB – Investigator In Charge (IIC)
- ICETRA – Regulator’s support
- Isavia – Keflavik Airport (BIKF) support
- EASA – Technical Advisor to the IIC
- Icelandair – Operator’s support

State of Design and Manufacture (aircraft) – United States

- NTSB – ACCREP and technical support
- FAA – Regulator responsible for Boeing 757-200 Type Certification
- Boeing – Technical advisors to ACCREP
- Landing Gear Technologies – Technical advisors to ACCREP

State of Manufacture (engines) – United Kingdom

- UK AAIB – ACCREP and flight recorders technical support

State of Design (engines) – Germany

- BFU – ACCREP
- Rolls-Royce – Technical advisor⁷ to ACCREP

State of Maintenance (last C-check where the landing gears were installed) – Canada

- TSB Canada – ACCREP
- Kelowna Flightcraft – Technical advisor to ACCREP

⁷ Due to Brexit, Rolls-Royce has transferred the certification of the equipped engines from the UK to Germany

2. Continued investigation

The investigation is still open and will continue. The next steps in the investigation are as follows:

- a) Detailed analysis of the SWIVEL and NUT dimensions and damage at the NTSB
- b) Review of the landing gear overhaul facility and its procedures
- c) Review of the landing gear installation
- d) Possible further airworthiness requirements

The work in items a) and b) was scheduled for the last week of March 2020. Due to travel restrictions from Europe by the United States, due to COVID-19, this work has been postponed.

3. Interim Safety Recommendations

Due to the postponing of the SWIVEL and NUT investigation, due to COVID-19 travel ban to the United States, the Icelandic Transportation Safety Board issues the following interim safety recommendation to Icelandair and Cabo Verde Airlines.

20-014F001 T1

For aircraft that have received overhauled landing gears from Landing Gear Technologies, registered as TF-ISS, TF-FIA, TF-ISY and D4-CCG, inspect the landing gears and the landing gears records as follows:

1. Inspect the landing gears. If the landing gears contain fastening component and a mating part of painted yellow color, then inspect the landing gear overhaul records to verify that the parts have been undersized.
2. If the landing gear overhaul records indicate that the parts have been undersized by Landing Gear Technologies, jack up the airplane per the Aircraft Maintenance Manual instructions, disassemble the undersized parts and measure the threaded portion of the undersized parts to verify that their sizes are mating and per the relevant Component Maintenance Manual (CMM) for undersize parts.
3. If, the undersized parts sizes are as required per the CMM, re-assemble per the relevant CMM instructions. Otherwise take the necessary maintenance action to replace with the required parts.



Reykjavík, 2. Apríl 2020

On behalf of the Icelandic Transportation Safety Board

Ragnar Guðmundsson
Investigator-In-Charge