FINAL

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NATIONAL TRANSPORTATION SAFETY COMMITTEE

Aircraft Serious Incident Investigation Report

Merpati Nusantara Airline

Boeing Company 737–400 ; PK–MDO

Sultan Hasanuddin Airport, Makassar, South Sulawesi

Republic of Indonesia

20 October 2008

NATIONAL TRANSPORTATION SAFETY COMMITTEE
MINISTRY OF TRANSPORTATION
REPUBLIC OF INDONESIA
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This Final Report was produced by the National Transportation Safety Committee (NTSC), Ministry of Transportation Building 3rd Floor, Jalan Merdeka Timur No. 5 Jakarta 10110, Indonesia.

The report is based upon the investigation carried out by the NTSC in accordance with Annex 13 to the Convention on International Civil Aviation Organization, the Indonesian Aviation Act (UU No. 1/2009) and Government Regulation (PP No. 3/2001).

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GLOSSARY OF ABBREVIATIONS

AD	Airworthiness Directive
AFM	Airplane Flight Manual
ALAR	Approach-and-landing Accident Reduction
ALS	Aircraft Landing System
AOC	Air Operator Certificate
ATC	Air Traffic Control
ATPL	Air Transport Pilot License
ATS	Air Traffic Service
Avsec	Aviation Security
BOM	Basic Operation Manual
°C	Degrees Celsius
CAMP	Continuous Airworthiness Maintenance Program
CASO	Civil Aviation Safety Officer
CASR	Civil Aviation Safety Regulation
CMM	Component Maintenance Manual
CPL	Commercial Pilot License
COM	Company Operation Manual
CRM	Cockpit Recourses Management
CSN	Cycles Since New
CVR	Cockpit Voice Recorder
DFDAU	Digital Flight Data Acquisition Unit
DGCA	Directorate General of Civil Aviation
DME	Distance Measuring Equipment
EFIS	Electronic Flight Instrument System
EGT	Exhaust Gas Temperature
EIS	Engine Indicating System
FL	Flight Level
F/O	First officer or Copilot
FDR	Flight Data Recorder
FOQA	Flight Operation Quality Assurance
GPWS	Ground Proximity Warning System
HGW	High Gross Weight

hPa	Hectopascals
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
Kg	Kilogram(s)
Km	Kilometer(s)
Kt	Knots (NM/hour)
Mm	Millimeter(s)
MTGW	Maximum Taxi Gross Weight
MTOW	Maximum Take-off Weight
NDT	Non Destructive Test
NM	Nautical mile(s)
KNKT / NTSC	*Komite Nasional Keselamatan Transportasi* / National Transportation Safety Committee
PIC	Pilot in Command
QFE	Height above aerodrome elevation (or runway threshold elevation) based on local station pressure
QNH	Altitude above mean sea level based on local station pressure
RESA	Runway End Safety Area
RPM	Revolution Per Minute
SCT	Scattered
S/N	Serial Number
SPM	Standard Practices Manual
TS/RA	Thunderstorm and rain
TAF	Terminal Aerodrome Forecast
TSN	Time Since New
TT/TD	Ambient Temperature/Dew Point
TTIS	Total Time in Service
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

INTRODUCTION

SYNOPSIS

On 20 October 2008, a Boeing B 737-400 aircraft, registered PK-MDO, was being operated under Instrument Flight Rules (IFR) scheduled for passenger service from Sultan Hasanuddin Airport Makassar as flight MZ 762,with an intended destination of Moses Kilangin airport, Timika, Papua. There were 172 people on board; two pilots, five flight attendants, 165 passengers including 9 infants.

The flight was the second flight sector of the day for both pilots as well as the aircraft, after the first departure from Soekarno Hatta Airport, Jakarta to Makassar. No abnormality was observed on the first sector. The actual aircraft turn around time at Makassar was about 50 minutes prior the next departure.

At 0205 UTC the aircraft started to roll for takeoff. The PIC heard a call “80” from the co-pilot as the aircraft’s speed passed 80 knots. At approximately 130 knots, and before the PIC heard the co-pilot call “V1”, he noticed a blast noise followed by the aircraft veering to the left. The PIC elected to abort the take off by retarding both thrust levers to idle and activate the thrust reverser and subsequently the co-pilot reported that he noticed the speed brake lever extended and the auto-brake disarm light illuminate as the aircraft decelerated through 80 knots.

The PIC controlled the aircraft to keep it on the centreline by used the rudder pedals. When the aircraft reached the normal taxi speed, the PIC turned the aircraft to the left onto the runway turning area. He intended to taxi the aircraft back to the apron.

An airport security officer, who was close to the aircraft and witnessed the incident, gave a hand signal to the PIC indicating that the aircraft should stop.

The PIC stopped the aircraft on the runway turning area.

None of the aircraft’s occupants was injured during this serious incident.

1 FACTUAL INFORMATION

1.1 History of the flight

On 20 October 2008, a Boeing B 737-400 aircraft, registered PK-MDO, was being operated under Instrument Flight Rules (IFR) scheduled for passenger service from Sultan Hasanuddin Airport Makassar[1] as flight MZ 762,with an intended destination of Moses Kilangin airport, Timika, Papua. There were 172 people on board; two pilots, five flight attendants, 165 passengers including 9 infants.

The Pilot in Command (PIC) was the handling pilot on this sector and the copilot was the monitoring pilot.

The flight was the second flight sector of the day for both pilots as well as the aircraft, after the first departure from Soekarno Hatta Airport, Jakarta to Makassar. No abnormality was observed on the first sector. The actual aircraft turn around time at Makassar was about 50 minutes prior the next departure.

The aircraft had a take off weight of 62,400 kg and was configured for take off with flap 5 degrees. The V1 speed for this flight configuration was 148 knots[2].

At 0205 UTC[3] the aircraft started to roll for takeoff. The PIC heard a call "80" from the co-pilot as the aircraft's speed passed 80 knots. At approximately 130 knots, and before the PIC heard the co-pilot call "V1", he noticed a blast noise followed by the aircraft veering to the left. The PIC elected to abort the take off by retarding both thrust levers to idle and activate the thrust reverser and subsequently the co-pilot reported that he noticed the speed brake lever extended and the auto-brake disarm light illuminate as the aircraft decelerated through 80 knots.

The PIC controlled the aircraft to keep it on the centreline by used the rudder pedals. When the aircraft reached the normal taxi speed, the PIC turned the aircraft to the left onto the runway turning area. He intended to taxi the aircraft back to the apron. An airport security officer, who was close to the aircraft and witnessed the incident, gave a hand signal to the PIC indicating that the aircraft should stop.

The PIC stopped the aircraft on the runway turning area. Both left main-wheel tires had been severely damaged. Both right main-wheel tires deflated as the fuses had melted by overheat. Part of the left main landing gear door detached.

1 Sultan Hasanuddin Airport, Makassar will be named Makassar for the purposes of this report.
2 V1 is maximum safety speed to decide continue or abort the take off.
3 The 24-hour clock used in this report to describe the time of day as specific events occurred, is in Coordinated Universal Time (UTC). Local time, Centre Indonesian Standard Time (WITA) is UTC + 8 hours

None of the aircraft's occupants was injured during this serious incident.

Figure 1: The aircraft after the incident being prepared to be towed to apron.

1.2 Injuries to Persons

Injuries	Flight crew	Passengers	Total in Aircraft	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	7	165	172	-
TOTAL	**7**	**165**	**172**	**-**

1.3 Damage to aircraft

Both tires on left main wheel (position number 1 and 2)[4] were seriously damaged and only a small portion of the tires remained attached to the wheel hubs. Both tires on the right main landing gear (tires 3 and 4) had deflated as a result of the safety fuse melting

The left outer main landing gear door was detached from the aircraft.

[4] Main landing gear wheels are numbered from left to right, with the left outer wheel being number 1 and the right outer wheel number 4

1.4 Other damage

Two parallel scrape lines from the left main wheel hub were found on the runway.

1.5 Personnel Information

The pilots held valid licenses and ratings for the operation of the aircraft. This section covering flight crew is not relevant to this serious incident.

1.6 Aircraft Information

1.6.1 General Aircraft Data

Registration Mark	:	PK-MDO
Manufacturer	:	Boeing Company
Country of Manufacturer	:	United States of America
Type/ Model	:	Boeing 737-400
Serial Number	:	24069
Date of manufacture	:	November 1988

The aircraft was within weight and centre of gravity limits at the time of the serious incident.

1.6.2 Wheels Data

All four wheel hubs of the main landing gear installed in the aircraft were applicable for Boeing 737 – 200 and 737-300/400*/500.

ALS CMM (Aircraft Landing System Component Maintenance Manual) stated that both wheel assembly types must be overhauled every 24 months or 1800 Cycles whichever occur first.

ALS (Aircraft Landing System) recommends operators adopt a life-limit replacement plan for the machine bolts (60) in an effort to reduce inspection time and potentially reduce in-service failure rates. ALS initially recommends that the life limit be set at 8,000 landings. Adjustments to the life limit may be made, depending on the individual operator's acceptable in-service failure rate. If a life-limit replacement plan is adopted, NDT inspections of machine bolts are optional. Refer to ALS SPM (ATA 32-49-01), check section for more detailed information regarding implementation of a life-limit replacement plan.

Cadmium plating should be restored on the machine bolt after 10 nut installations to maintain joint lubricant, critical to achieving proper joint preload during installation. Instruction for re-plating the machine bolts is found in the rear section. As an alternative, if the self-locking nuts (50B) are replaced after 10 uses, the machine bolts do not need to be re-plated. Refer to ALS SPM (ATA 32-49-01). Check section for additional information regarding ALS recommendation for maintaining cadmium plating in the joint through a self-locking nut replacement plan

1.7 Meteorological information

Not relevant to this serious incident.

1.8 Aids to navigation

Not relevant to this serious incident.

1.9 Communications

There was no radio communications considered to be relevant to this serious incident.

1.10 Aerodrome information

Airport Name	:	Sultan Hasanuddin
Airport Address	:	Makassar PO BOX 90552
Airport Authority	:	PT. Angkasa Pura I (Persero)
Coordinate	:	05º 03’ 39” S 119º 33’ 16” E
Elevation	:	47 feet
Runway Length	:	2,500 meters
Runway Width	:	45 meters
Azimuth	:	13 – 31 (127 degrees / 307 degrees magnetic)
Surface	:	Asphalt
Strength	:	12,500 lbs

1.11 Flight Recorders

1.11.1 Digital Flight Data Recorder (DFDR)

Manufacturer	: Allied Signal
Type/Model	: Digital Flight Data Recorder
Part Number	: 980-4100-DXUN
Serial Number	: 9832

This section was not relevant to this serious incident.

1.11.2 Cockpit Voice Recorder (CVR)

Manufacturer	:	Fairchild
Type/Model	:	A100
Serial Number	:	683

This section was not relevant to this serious incident.

1.12 Wreckage and impact information

1.12.1 Wheel failure examination

Examination of wheel hub number 1 revealed that 4 of 16 bolts on the wheel hub had broken (Figure 2). One bolt which was still attached adjacent to the four failure bolts was found cracked. These five broken bolts and three nuts that were attached to the broken bolt which were collected at Makassar were sent to the Laboratory of Mechanical Metallurgy of the Faculty of Mechanical and Aeronautical Engineering of Institute of Technology, Bandung (ITB).

Figure 2: Wheel number-1 hub with four of sixteen bolts that were broken

1.12.2 Bolt failure examination

The fracture surfaces of the four bolts clearly indicate characteristics of fatigue failure. For the clarity of discussion, the four bolts which were "missing" from the wheel hub are labeled as A, B, C and D.

The sequence of failure can be described as follows. The bolts with broader fatigue fracture surfaces areas were the bolts that failed first. In this discussion, this bolts identified as bolts B (Figure 3) and followed by bolt C (Figure 4), which were located between bolts A and D.

Following the failure of bolts B and C, the adjacent bolts - in this discussion identified as bolts A (Figure 5) and D (Figure 7) received higher load and subsequently failed with narrower area of fatigue crack or broader area of final failure.

Another bolt which was located adjacent to the D position has crack on the thread root, although it was not totally disintegrated.

Figure 3: Bolt B; Fracture surface with a fatigue crack of 14mm long. (circumferentially)

Figure 4: Bolt C; Fracture surface with a fatigue crack of 11mm long. (circumferentially)

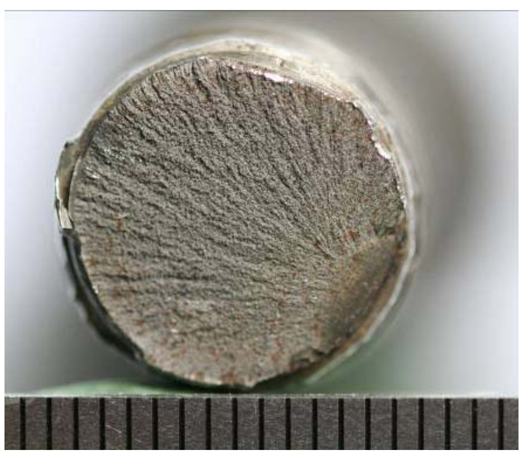


Figure 5: Bolt A: Fracture surface with a fatigue crack of 7mm long (circumferentially).

Figure 6: Nut & broken bolt A

Figure 7: Bolt D: Fracture surface with a fatigue crack of 6mm long (circumferentially).

Figure 8: Nut & broken bolt D

The bolt examination concluded that the fatigue cracks on all 4 fail bolts were originated from the thread roots. The fatigue cracks of bolts B and C were present before the take off in Makassar. Most likely the disintegration of both bolts (B and C) occurred during the initial phase of take off followed by disintegration of bolts A and D. The disintegration of four bolts caused the seal between the two wheel halves extruded and release the tire pressure.

The fatigue fracture of bolts A and D were initiated and propagated in the take-off phase. The circumferential length of the fatigue crack of bolt A and D were approximately 7mm and 6mm respectively. The development of fatigue crack during the take off is in average 6.5mm. The final fatigue crack length of bolt B and C are 14mm and 11mm respectively. Using a simplified calculation, the crack length on bolt B and C before take off at Makassar can be estimated to be (14-6.5)= 7.5mm and (11-6.5)= 5.5mm respectively.

All 4 bolts that failed were due to fatigue. The company bolt management may have failed to detect a fatigue bolt.

1.13 Medical and pathological information

Not relevant to this serious incident.

1.14 Fire

There was no pre and post- impact fire.

1.15 Survival aspects

Not relevant to this serious incident.

1.16 Tests and research

Not relevant to this serious incident.

1.17 Organizational and management information

1.17.1 PT. Merpati Nusantara Airlines

PT. Merpati Nusantara Airlines is government own company. The company was based in Jakarta and operates since 1962. PT. Merpati Nusantara Airlines hold AOC number 121/002.

The company operated 1 Boeing B 737-400, 5 B737-300 and 3 B737-200, also operated 2 Fokker F 100, 1 Fokker F-28, 1 Fokker F-27, 2 MA60, 2 CN 235, 3 CASA C212-200 and 6 DHC6 Twin Otter.

The company operated domestic flight within Indonesia and also regional flight to Dilli and Kuala Lumpur.

1.17.2 Company bolt management

For wheel assembly, the company refer to Component Maintenance Manual revision April 30, 2004, for B 737-200/300/400/500 wheel assembly. P/N 2606671 (see appendix B).

For the hardware inspection, including bolt, the company refer to this manual, page 518, Attachment Hardware Inspection. On this page the manual stated:

NOTE: ALS (Aircraft Landing System) recommends operators adopt a life-limit replacement plan for the machine bolts (60) in an effort to reduce inspection time and potentially reduce in-service failure rates. ALS initially recommends that the life limit be set at 8,000 landings. Adjustments to the life limit may be made, depending on the individual operator's acceptable in-service failure rate. If a life-limit replacement plan is adopted, NDT inspections of machine bolts are optional. Refer to ALS SPM (ATA 32-49-01), check section for more detailed information regarding implementation of a life-limit replacement plan.

NOTE: Cadmium plating should be restored on the machine bolt after 10 nut installations to maintain joint lubricant, critical to achieving proper joint preload during installation. Instruction for re-plating the machine bolts is found in the rear section. As an alternative, if the self-locking nuts (50B) are replaced after 10 uses, the machine bolts do not need to be re-plated. Refer to ALS SPM (ATA 32-49-01). Check section for additional information regarding ALS recommendation for maintaining cadmium plating in the joint through a self-locking nut replacement plan.

The bolts installed on the aircraft were self-locking nuts, the company refer to the note number 2 (bottom) to be applied as the procedure.

Investigation revealed a Boeing Service Letter number 737-SL-32-111-A with subject establishing a life limit for wheel tie bolts on Bendix (Honeywell) 737 wheels, issued on 30 October 2007.

This service letter suggested that to operator whether or not experiencing tie bolt fracture, to adopt ‘hard time” life limit on all main wheel tie bolts as the bolts accumulate cycles, fatigue fractures will eventually occur.

It was found that the operator did not perform the cadmium re-plating to the tie bolts as instructed in the CMM.

1.18 Additional information

Both tires of the left main landing gear were damaged and most of the tires were torn-away during take off roll. This result only a small portion of the tire attached to wheel hubs at the rims.

The inner side of wheel number-1 hub (as shown at figure 2) was found in a clean condition. There was no indication of tire over heating. This indicated that there was no slippage between the tire and the wheel rim. The outer side of this tire was extensively damaged.

The detailed visual inspection of tire number two showed evidence of excessive heat at the tire rim, due to a relative rotation (slip) between tire and wheel hub. The slippage occurred with the brake application during the aborted takeoff. This indicated that during the aborted takeoff when the brakes were applied, appropriate air pressure was in the tire. The slippage generated extreme heat at the tire to wheel rim and caused decolouration at rim area and became light magenta colour as a result of polymerization. When the tire became loose on the wheel pressure was lost, causing the tire to explode. The damage to tire number two resulted from the rejected take off

1.19 Useful or Effective Investigation Techniques

The investigation was conducted in accordance with NTSC approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

2 ANALYSIS

2.1 Sequence of wheel failure

The investigation determined that tire number one had deflated prior to the aborted take off.

The deflation of wheel number one was due to loosening of wheel hub halves as four of sixteen bolts were broken.

The tire number two was then suffering an overload situation led to tire burst.

The aircraft was then veered to the left. The flight crew executed an aborted take off. Severe braking resulted in overheating of wheel number three and four, and the wheel fuses melted.

2.2 Bolts failure

All four bolts failed due to premature fatigue. The bolts disintegration occurred during the take off roll at Makassar airport. This fact was supported by the bolt pieces were recovered at the runway of Makassar airport.

The sequences of bolt failure were identified. The first failure was characterized by relatively large fatigue area. It suggested that the fatigue crack propagation occurred sometimes before. However during the operation, the crack on the bolt was very difficult to detect.

When a bolt disintegrated the neighbouring bolts will carry excessive load lead to a series of bolt fatigue failure.

In the light of such a phenomenon, following bolt fatigue failure, the remaining bolts shall be rejected.

2.3 Wheel hub load rating

The wheel hubs installed in the aircraft (P/N 2606671) were applicable to Boeing 737-200 and as well as Boeing 737-300/400[5]/500. There is another type of wheel hub (P/N 2609801) which is designated to Boeing 737-400 that is applicable to higher load rating (B737-400 HGW (High Gross Weight)). The higher load rating to the HGW wheel hub was due to a large dimension of wheel hub bearings.

[5] Maximum Taxi Gross Weight (MTGW) limitation of 144,000 pounds (65,318 Kg)

The fatigue crack initiation on the bolts was most likely due to damage of cadmium plating. The CMM instructed to perform cadmium re-plating after ten times of wheel hub assembling. However it was not done, so that initial corrosion to the bolt thread may lead to the fatigue crack initiation.

2.4 Maintenance aspect in wheel management

ALS CMM (Aircraft Landing System Component Maintenance Manual) state that both wheel assembly types must be overhauled every 24 months or 1800 Cycles whichever occur first.

The inspection of all bolts may refer to paragraph 1.17.1.

The operator did not perform as per Component Maintenance Manual, more specifically on the cadmium re-plating after ten times of wheel hub assemblies.

3 CONCLUSIONS

3.1 Findings

- The aircraft was certified as being airworthy at the time of serious incident.
- The aircraft was within weight and centre of gravity limits at the time of the serious incident
- Both pilots held valid licenses and ratings for the operation of the aircraft.
- The investigation determined that tire number one had deflated prior to the aborted take off, while tire number two deflated during the aborted take off due to overload.
- Failure of number one and number two tires caused severe aircraft dragging to the left.
- During the aborted take off, the wheel number three and four became over heated and the tire fuses were melted.
- There are two types of wheel hubs applicable for B 737. The wheel hub installed in the aircraft were applicable to Boeing 737-200 and as well as Boeing 737-300/400*/500. Another type of wheel hub is designated to Boeing 737-400 and applicable to higher load rating.
- The sequences of bolts failure were identified as a series of disintegration due to fatigue failure.
- The lack of cadmium re-plating to the tie bolts initiated corrosion fatigue.

3.2 Factors

- The tire failure of the left landing gear was initiated by the failure of 4 of 16 bolts installed that experienced fatigue crack.
- The operator failed to perform maintenance program to the wheel hub tie bolts especially to the cadmium re-plating.

4 SAFETY ACTIONS

At the time of issuing this Draft Report, the National Transportation Safety Committee had not been informed of any safety actions resulting from this serious incident.

5 SAFETY RECOMMENDATIONS

As result of this investigation into this serious incident, the National Transportation Safety Committee (NTSC) made the following recommendation.

5.1 Recommendation to PT. Merpati Nusantara Airlines

The National Transportation Safety Committee recommends that the PT. Merpati Nusantara Airline should perform cadmium re-plating to the tie bolts after ten times wheel hub assembling as stated in the CMM.

5.2 Recommendation to PT. Merpati Nusantara Airlines

The National Transportation Safety Committee recommends, Refer to Honeywell Aircraft Landing System (ALS) CMM chapter 32-40-09, the PT. Merpati Nusantara Airline should:

- For single bolt failures, each tie bolt adjacent to the broken bolt should be removed and scrapped.
- For multiple bolt failures, all tie bolts in the wheel should be scrapped

5.3 Recommendation to PT. Merpati Nusantara Airlines

The National Transportation Safety Committee recommends, Refer to Honeywell Aircraft Landing System (ALS) CMM page 518, Attachment Hardware Inspection, the PT. Merpati Nusantara Airline should:

- Operator should adopt a life-limit replacement plan for the wheel hub machine bolts to the life limit at 8,000 landings.
- Cadmium plating should be restored on the machine bolt after 10 nut installations.

5.4 Recommendation to the Directorate General of Civil Aviation (DGCA)

The National Transportation Safety Committee recommends that the Directorate General Civil Aviation to oversight the operators in the above mentioned issues.

6 APPENDIX

Appendix A: Identifying tire failure

1. Techniques in identifying tire failure

To determine the origin of the piece of tire, the date of installation and the depth of the groove were compared. The records showed that average main-wheel tire wear requiring replacement was 30 to 40 days.

The maintenance records showed that during a period of 1 week the tire groove had reduced an average of 2 millimetres. Tire number two had been installed for 30 days; average tire change schedule. The remaining groove for the tyre number two predicted to be less than 2 millimetres in depth. The piece of tire that was found in Makassar had 4.5 millimetres depth of groove. This investigation determined that the piece of tire was part of tire number one.

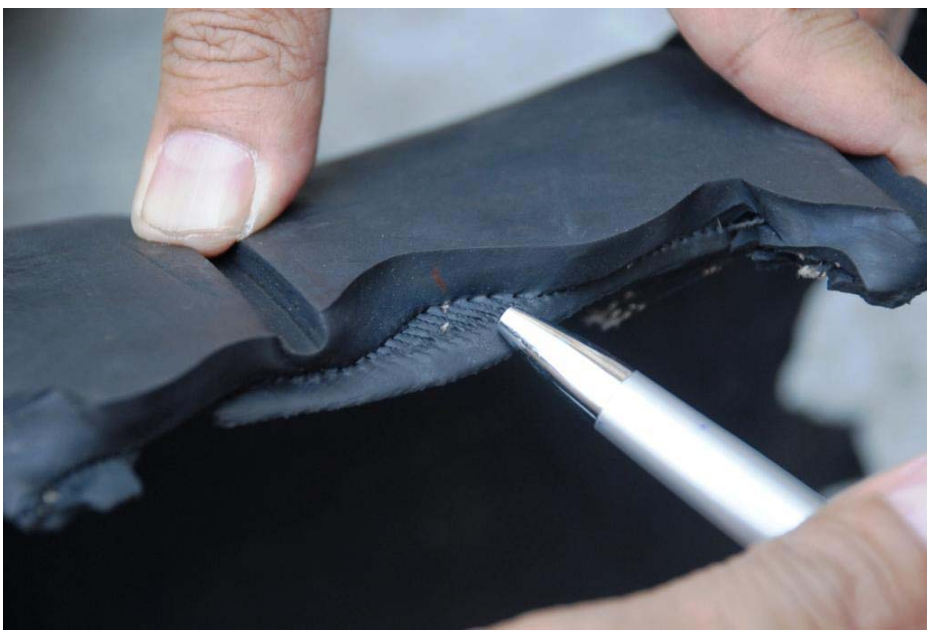


Figure 9: The shape of the cut and the nylon holes are not types of damage by FOD.

The shape of cut on the piece of tire has an angle and curved. The nylon pulled out from its position. This was evidence that the tire failure was not caused by foreign object damage (FOD).

Blue marks as result of the chemical reaction of magnesium to heat would be an indication of tire under inflation for a period of time. That evidence was not found on this piece of tire, indicating that the tire did not fail as result of under inflation. There was also no evidence of tire delamination.

2. Loss of tire pressure

A further examination on hub of wheel number one found that four bolts of 16 bolts (Figure 2) were missing. The mating surface of the wheel hub becoming loosened led the tire pressure to rapidly deflate. The failure of the number one tire was immediately followed by number two tire burst due to overload.

The wheel, with its deflated tire, was rotating at high speed during the take-off roll causing the tire to peel off and break into pieces. Some tire thread pieces impacted to the aircraft's wing and fuselage. It is likely the sound that the pilot heard.

Failure of number one and number two tires caused severe aircraft dragging to the left. The PIC initiated an aborted take off.

During the aborted take off, the wheel number three and four became over heated and the tire fuses were melted.

Appendix B: Excerpt Honeywell Component Maintenance Manual

Honeywell

Honeywell International Inc.
Aircraft Landing Systems (CAGE 55284)
3520 Westmoor Street
South Bend, Indiana 46628-1373
https://pubs.cas.honeywell.com

737-200/300/400/500

MAIN WHEEL ASSEMBLY

PART NUMBERS 2606671-1, 2606671-2 AND 2606671-3

COMPONENT MAINTENANCE MANUAL
with ILLUSTRATED PARTS LIST

NOTICE: This is a reprint. All basic and revised pages have been combined into one document replacing Publication No. 12-558 and revisions thereto.

D. Attachment Hardware Inspection.

4.0	Attachment Hardware	Inspection Intervals: Tire Change	Inspection Intervals: Overhaul
NOTE:	ALS recommends operators to adopt a life-limit replacement plan for the machine bolts (60) in an effort to reduce inspection time and potentially reduce in-service failure rates. ALS initially recommends that the life limit be set at 8,000 landings. Adjustments to the life limit may be made, depending on the individual operator's acceptable in-service failure rate. If a life-limit replacement plan is adopted, NDT inspections of machine bolts are optional. Refer to the ALS SPM (ATA 32-49-01) for more detailed information regarding implementation of a life-limit replacement plan. NOTE: Cadmium plating should be restored on the machine bolt after 10 nut installations to maintain joint lubricity, critical to achieving proper joint preload during installation. Instructions for replating the machine bolts are found in the Repair section. As an alternative, if the self-locking nuts (50B) are replaced after 10 uses, the machine bolts do not need to be replated. Refer to the ALS SPM (ATA 32-49-01) for additional information regarding ALS recommendation for maintaining cadmium plating in the joint through a self-locking nut replacement plan.		
4.1	Visual - Inspect machine bolt (60) date codes if a life-limit replacement plan is used. Retire machine bolts exceeding the established life limit.	X	X
4.2	Visual - Examine shop records to determine number of accumulated self-locking nut (50B) installations on the machine bolts (60). If 10 reuses or tire changes have been previously accomplished, replace the machine bolt or restore the cadmium plating per the Repair section. If the self-locking nuts are replaced or replated after 10 reuses, this step may be omitted.	X	X
4.3	Visual - Inspect machine bolt (60) for corrosion and mechanical damage per the ALS SPM (ATA 32-49-01). Replace machine bolt as required. Missing cadmium plating on the shank or head of the machine bolt is not cause for rejection unless corrosion pitting is observed.	X	X
4.4	NDT - Perform magnetic particle inspection on machine bolts (60) per the ALS SPM (ATA 32-49-01). Retire machine bolts with crack indications. This inspection may be omitted if a life-limit replacement plan is used.	X	X
NOTE:	ALS recommends operators replace the self-locking nuts (50B) after 10 uses to ensure cadmium plating is present in the thread interface. Refer to the ALS SPM (ATA 32-49-01) for additional information on this subject. Instructions for replating the self-locking nuts are found in the Repair section.		
4.5	Visual - If a 10-reuse replacement policy is used for the self-locking nut (50B), examine shop records to determine number of accumulated self-locking nut installations on the machine bolts (60). If 10 reuses or tire changes have been previously accomplished, replace the self-locking nut.	X	X

4.0	Attachment Hardware	Inspection Intervals	
		Tire Change	Overhaul
4.6	Visual - Inspect self-locking nut (50B) for corrosion and mechanical damage per the ALS SPM (ATA 32-49-01). Replace self-locking nut as required.	X	X
4.7	Measurement - Inspect locking feature of self locking nut (50B) for minimum reusable torque as shown in Figure 801 and the ALS SPM (ATA 32-49-01). Discard nuts not meeting this requirement. This step may be omitted if a 10-reuse replacement plan is used.	X	X
4.8	Measurement - At operator option based on service experience with nut loosening, check locking feature of self-locking nuts (95, 140) for minimum reusable torque per Figure 801. Discard nuts not meeting the minimum requirement.		O
4.9	Visual - Inspect all miscellaneous attachment hardware not mentioned above for corrosion and damage.	X	X

E. Thermal Fuse Plugs, Valve Assembly, Safety Relief Valve, and Plugs Inspection.

5.0	Thermal Fuse Plugs (180, 182 as Applicable), Valve Assembly (5), Safety Relief Valve (75A), and Plugs (183, 184 as Applicable)	Inspection Intervals	
		Tire Change	Overhaul
5.1	Visual - Inspect threads for damage.		X
5.2	Visual - Inspect preformed packing groove or land on each component. Ensure no sharp edges or burrs are present that might cut a preformed packing upon installation.		X
5.3	Visual - Inspect thermal fuse plugs (180, 182) for a melted or partially melted condition. If melted, refer to Paragraph 4. for additional instructions.	X	X
5.4	Measurement - Check safety relief valve (75A) for air leakage by installing in a suitable fixture and pressurizing to 300 psi (21 bars). No leakage is allowed. Replace defective safety relief valves.		X

IPL Fig. & Item No.	Item	Lubrication*	Torque Value Pound-Inches (Newton-Meters)	
			Minimum Reusable	Wrench Torque (Target/Nominal Torque Value is Underlined)
1-5	Valve Assembly	None	N/A	175 ± 25 (19.8 ± 2.8)
1-50B	Self-Locking Nuts (With tire installed)	AMS 2518 or MIL-T-5544	19 (2.1)	Preliminary: 875 (98.9) Final: 1750 ± 50 (197.7 ± 5.6)
1-50B	Self-Locking Nuts (With tire installed)	MIL-T-83483 or MIL-PRF-83483	19 (2.1)	Preliminary: 800 (90.4) Final: 1600 ± 50 (180.8 ± 5.6)
1-75A	Safety Relief Valve	MIL-L-23398 or MIL-L-46147	N/A	175 ± 25 (19.8 ± 2.8)
1-135	Machine Screws	None	N/A	70 ± 10 (7.9 ± 1.1)
1-95, 140	Nut	None	2 (0.2)	45 ± 5 (5.1 ± 0.6)
1-182	Thermal Fuse Plug	None	N/A	80 ± 5 (9.0 ± 0.6)
1-183	Machine Thread Plug	MIL-L-23398 or MIL-L-46147	N/A	175 ± 25 (19.8 ± 2.8)

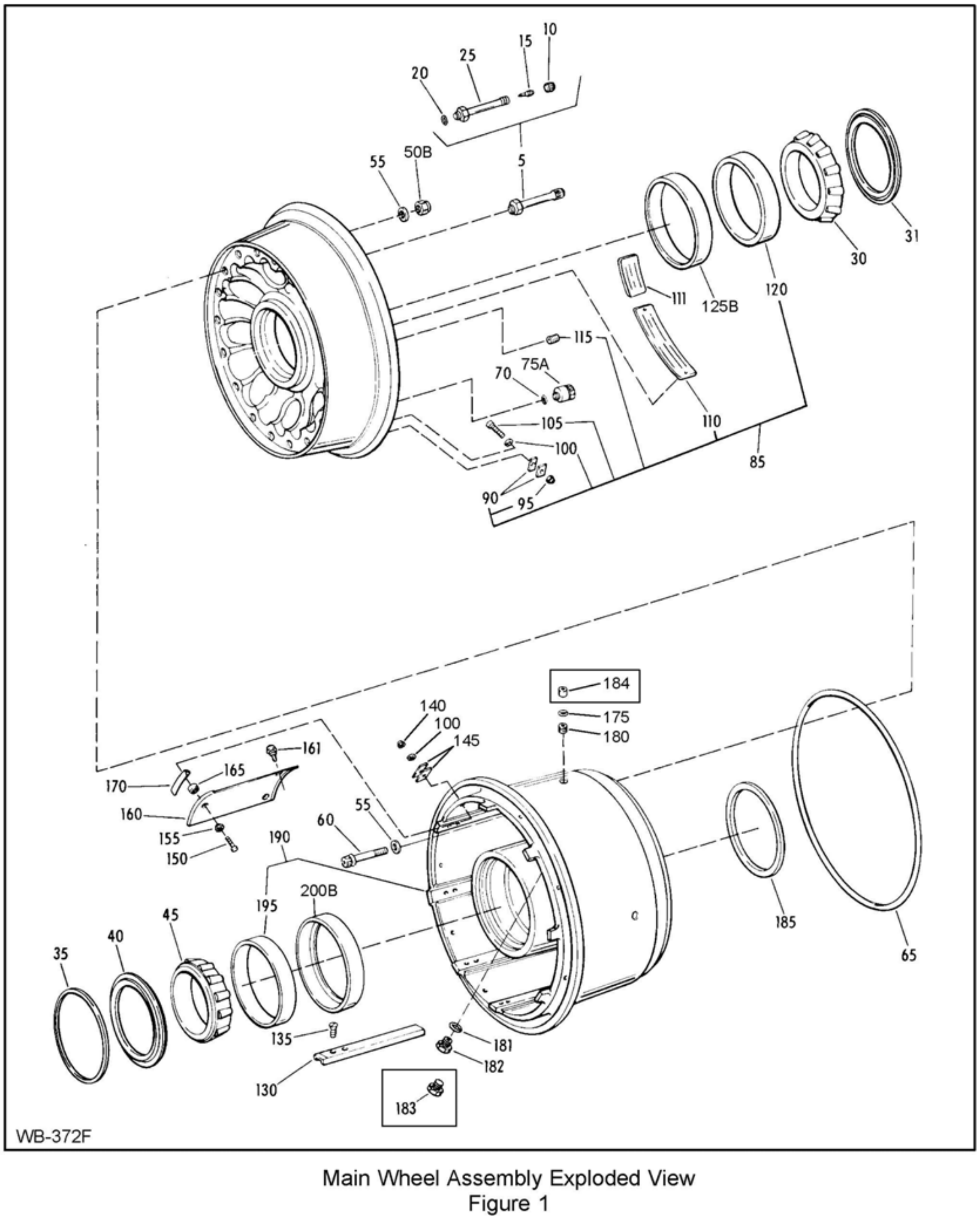
CAUTION: IF ANY BOLT OR NUT IS INADVERTENTLY TIGHTENED TO A VALUE THAT IS 10% OR MORE ABOVE THE SPECIFIED FINAL TORQUE VALUE, THEN THAT BOLT AND NUT SHOULD BE SCRAPPED. ALSO, INSPECT MATERIAL UNDER THE NUT AND BOLT FOR YIELDING.

NOTE: Torque wrenches must be accurate and capable of reproducing specified values per Federal Specification GGG-W-686. Aircraft Landing Systems (ALS) recommends torquing to the target/nominal value.

NOTE: Packing lubrication that contacts the threads of the inflation valve, safety relief valve, and thermal fuse screws need not be removed before installation.

* When lubrication is specified, lubricate threads and bearing surfaces at each installation with the specified compound. Use full strength. Do not dilute. Lubricants may be purchased from lubrication vendors per the referenced MIL or AMS specifications identified above.

Table of Torque Values
Figure 801



Main Wheel Assembly Exploded View
Figure 1

	FIG. ITEM	PART NUMBER	AIRLINE PART NO.	NOMENCLATURE	EFF. CODE	UNITS PER ASSY.
	1-20B	732		. . PACKING, Preformed .... (V27783) (V55284, 2602195)		1
	–20C	2602195		. . PACKING, Preformed		1
	25	TR761-02		. . STEM, Valve .... (V79934) (V55284, 2606690)		1
	–25A	VS827-1		. . STEM, Valve .... (V17875) (V55284, 2606690)		1
	–25B	6027-1		. . STEM, Valve .... (V27783) (V55284, 2606690)		1
	–25C	2606690		. . STEM, Valve		1
R	–26	151387		. . PACKING, Preformed .... (For service repair) (See Figure 646)		AR
	30	27690*		. BEARING, Tapered roller .... (V60038) (V55284, 103S187, superseded by P/N 2606294, use until exhausted) (Outboard) (V55284, 2606294, supersedes P/N 103S187)		1
	31	2610036		. SEAL, Grease (Optional) .... (Added by SB 2606671-32-028)		1
	35	2606169-11		. RING, Retaining		1
	40	2606693		. SEAL, Grease		1
	–41	2608896		. . WASHER, Grease seal nib repair		AR
	45	596*		. BEARING, Tapered roller .... (V60038) (V55284, 103S205, superseded by P/N 2606298, use until exhausted) (V55284, 2606298, supersedes P/N 103S205)		1
	–50	LH3840T-9		DELETED		
	–50A	65270-918		DELETED		
	50B	2604374		. NUT, Self-locking		16
	55	2602542		. WASHER, Recessed		32
	60	2602540		. BOLT, Machine		16
	65	2607266		. PACKING, Preformed		1

* This P/N bearing, when ordered from ALS, meets Timken Performance Code 20629 (629 Code). To obtain 629 Code bearings from Timken distributors, the 629 Code must be specified, otherwise standard product may be shipped.

FIG. ITEM	PART NUMBER	AIRLINE PART NO.	NOMENCLATURE	EFF. CODE	UNITS PER ASSY.
1-70	TR-RG6		. PACKING, Preformed .... (V79934) (V55284, 2602195)		1
–75	A3323-9		DELETED		
75A	2605243		. VALVE, Safety relief		1
–80	D1002-2		DELETED		
85	2606692		. WHEEL HALF ASSEMBLY, ... Outboard (Superseded by P/N 2608058, use until exhausted) (Permanently marked as P/N 2606688 or 2607087)	A,C	1
–85A	2608058		. WHEEL HALF ASSEMBLY, ... Outboard (Supersedes P/N 2606692) (Superseded by P/N 2607949-1, use until exhausted) (Permanently marked as P/N 2607949)		1
–85B	2607949-1		. WHEEL HALF ASSEMBLY, ... Outboard (Supersedes P/Ns 2608058 and 2606692) (Permanently marked as P/N 2607949)		1
90	146287		. . WEIGHT, Balance .... (0.12 oz) (3.40 g)		AR
–90A	153230		. . WEIGHT, Balance .... (0.21 oz) (5.95 g)		AR
–90B	153237		. . WEIGHT, Balance .... (0.41 oz) (11.62 g)		AR
–90C	2606616		. . WEIGHT, Balance .... (0.15 oz) (4.25 g)		AR
–90D	2606715		. . WEIGHT, Balance .... (0.29 oz) (8.22 g)		AR
95	22FH1032		. . NUT, No. 10-32 (V56878) .... (V55284, 146204) (Superseded by P/N NAS679A3, use until exhausted)		AR
–95A	1801-02		. . NUT, No. 10-32 (V56878) .... (V55284, 146204) (Superseded by P/N NAS679A3, use until exhausted)		AR
R –95B	NAS679A3		. . NUT, Self-locking .... (Supersedes P/N 146204)		AR