ACCIDENT INVESTIGATION COMMISSION

FINAL REPORT

AIC 24 - 2002

Air Niugini Limited

P2-PXB

B737-800 aircraft

Hazardous material, mercury spill in aircraft cargo compartment

Jacksons International Airport, Port Moresby

Papua New Guinea

23 July 2024

About the AIC

The Accident Investigation Commission (AIC) is an independent statutory agency within Papua New Guinea (PNG). The AIC is governed by a Commission and is entirely separate from the judiciary, transport regulators, policy makers and service providers. The AIC's function is to improve safety and public confidence in the aviation mode of transport through excellence in: independent investigation of aviation accidents and other safety occurrences within the aviation system; safety data recording and analysis; and fostering safety awareness, knowledge and action.

The AIC is responsible for investigating accidents and other transport safety matters involving civil aviation in PNG, as well as participating in overseas investigations involving PNG registered aircraft. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The AIC performs its functions in accordance with the provisions of the *PNG Civil Aviation Act 2000,* and the *Commissions of Inquiry Act 1951,* and in accordance with *Annex 13* to the *Convention on International Civil Aviation.*

The objective of a safety investigation is to identify and reduce safety-related risk. AIC investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the AIC to apportion blame or determine liability. At the same time, an investigation report must include relevant factual material of sufficient weight to support the analysis and findings. At all times the AIC endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why it happened, in a fair and unbiased manner.

About the report

The AIC was informed at 12:04 local time (02:04 UTC) on 8 August 2024, through a phone call by CASA PNG of a serious incident involving a B737-800 aircraft, registered P2-PXB, operated by Air Niugini Limited, that occurred on 23 July 2024. The AIC immediately commenced an investigation.

The accident investigation *Final Report* has been produced by the AIC, P O Box, Boroko 111, NCD Papua New Guinea. It has been approved for public release by the Commission in accordance with *Para 6.5* of *ICAO Annex 13*. The report is published on the AIC website www.aic.gov.pg.

The report is based on the investigation carried out by the AIC under the Papua New Guinea *Civil Aviation Act 2000,* and *Annex 13* to the *Convention on International Civil Aviation*. It contains factual information, analysis of that information, findings and contributing (causal) factors, other factors, safety actions, and safety recommendations.

Maryanne J. Wal
Chief Commissioner
3 February 2025

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1 FACTUAL INFORMATION

1.1 Occurrence details

On 23 July 2024, at about 09:15 local time (23:15 UTC[1]), a B737-800 aircraft, registered P2-PXB, operated by Air Niugini Limited (ANL) was conducting a Regular Public Transport (RPT) flight from Jackson International Airport (Jacksons Airport), Port Moresby to Nadzab Tomodachi International Airport (Nadzab Airport), Morobe Province, Papua New Guinea, had a spillage of hazardous material, mercury in its aft cargo compartment, during passenger boarding and loading of cargo.

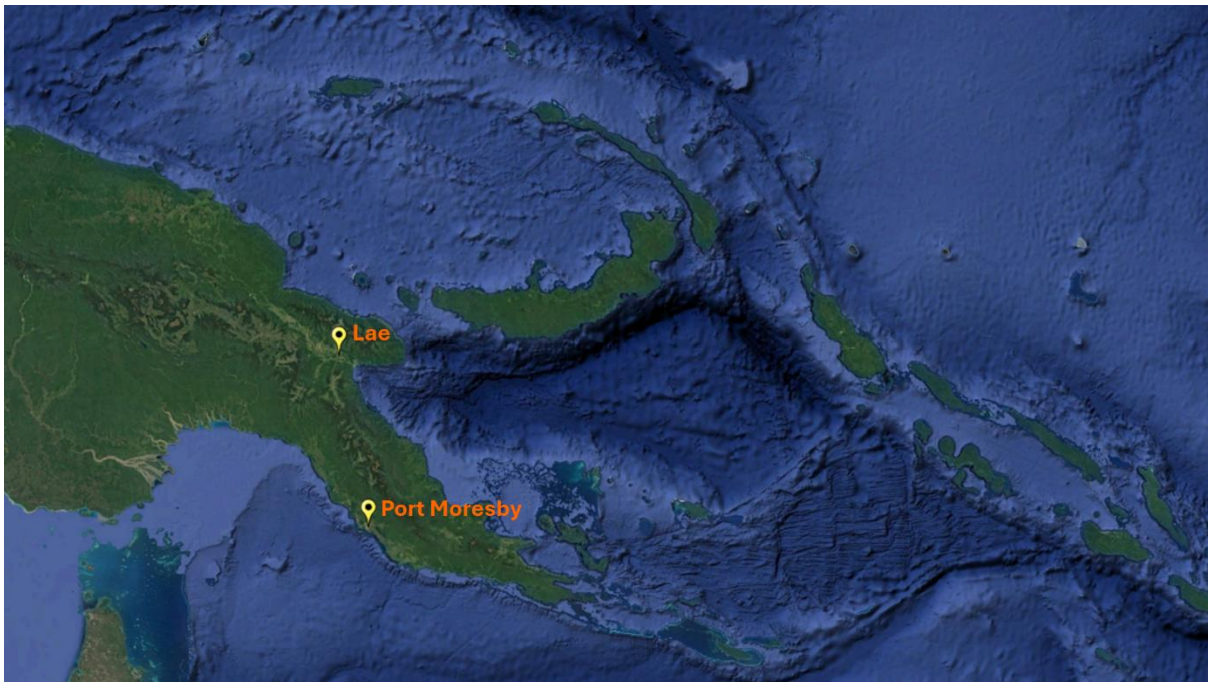


Figure 1: Overview of P2-PXB's planned departure/destination points

There were 67 persons on board the aircraft: 2 pilots, 4 cabin crew and 61 passengers.

According to the Pre-computed Flight Plan and the Cabin Crew Voyage Report, which were provided to AIC by the operator, the crew had operated a flight to Nadzab Airport at 06:45 and returned to Jacksons Airport on P2-PXB. Recorded data indicated that the aircraft touched down at Jacksons Airport at 08:41, taxied to the terminal and parked at Bay No.4. *Refer to Figure 2.*

The crew reported that they were on a routine turnaround for their next assigned flight back to Nadzab Airport, which according to the Flight Plan was estimated to depart Jacksons Airport at 09:30.

Records of the operator's *Cargo Airfreight Driver checklist (Time Log Sheet)* entries showed that at 07:28, earlier that morning, the driver who towed the trolley containing all cargo for the Lae flight, departed Cargo Terminal 2 (Domestic), and arrived at the Cargo Make-up Area at 07:35. The driver reported that he positioned the trolley at the Make-up Area and returned to Cargo Terminal 2. According to the driver, he had not observed any leakage or spillage from any of the cargo on the trolley.

[1] The 24-hour clock, in Coordinated Universal Time (UTC), is used in this report to describe the local time as specific events occurred. Local time in the area of the serious incident, Papua New Guinea Time (Pacific/Port Moresby) is UTC + 10 hours.

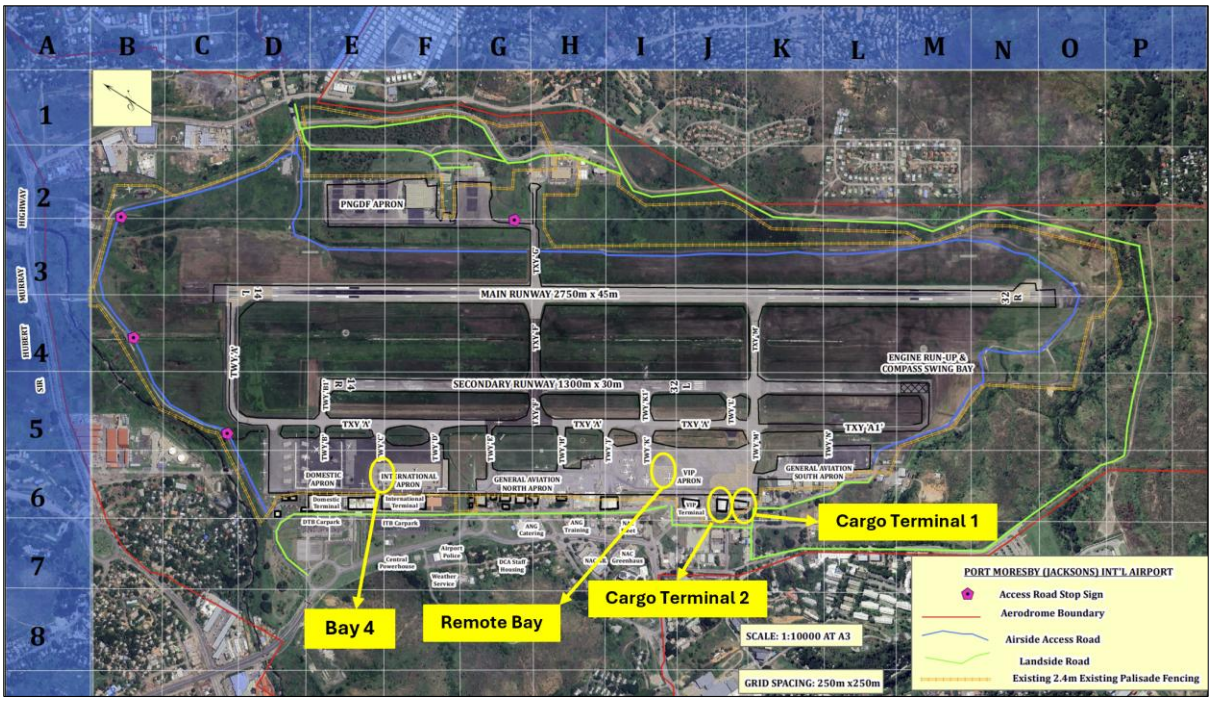


Figure 2: Port Moresby (Jacksons) International Airport Grid *(Source: National Airports Corporation)*

According to statements from the Ground/Cargo Handlers, the plan was to load all cargo and checked baggage into the aircraft's aft cargo compartment (Cargo Hold No.3). The cargo was intended to be loaded first followed by the checked baggage. Subsequently, they began loading the cargo in Cargo Hold No.3, at 09:00, about the same time when passengers reportedly started boarding.

The Supervisor was stationed at the base of the conveyor belt and was responsible for transferring cargo from the trolley onto the conveyor belt. Three porters were assigned to the Cargo Hold No.3: Porter 1 was positioned at the doorway, and Porter 2 and Porter 3 were inside Cargo Hold No.3. Porter 1 received cargo from the conveyor belt and passed them to Porter 2, who then passed them to Porter 3, to stack away in the cargo hold.

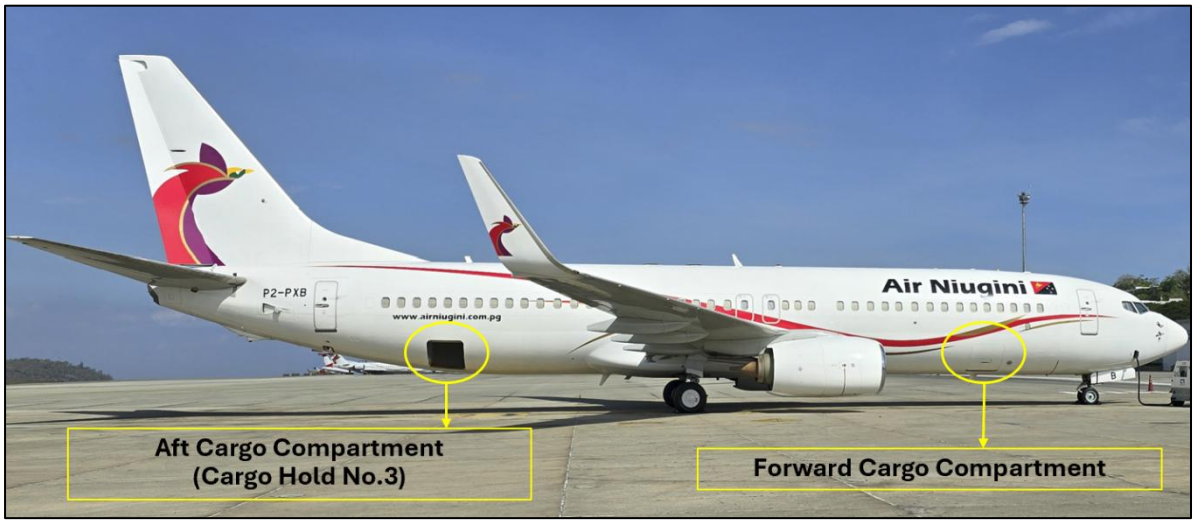


Figure 3: P2-PXB at the remote bay post occurrence indicating cargo compartment

During loading, Porter 3 noticed a spill on the floor, which he suspected to be Mercury[2] and immediately alerted his colleagues. As a result, loading was halted, and the Porters informed their supervisor about the spillage. The source of the spill was traced to a general cargo item, weighing 37 kilograms (kg) and declared as 'excavator parts' under consignment number 656-41871701. *See Section 1.6.3.1 for more information.* The supervisor contacted a team of Aircraft Engineers. After examining the spill, the engineers concluded that it was mercury.

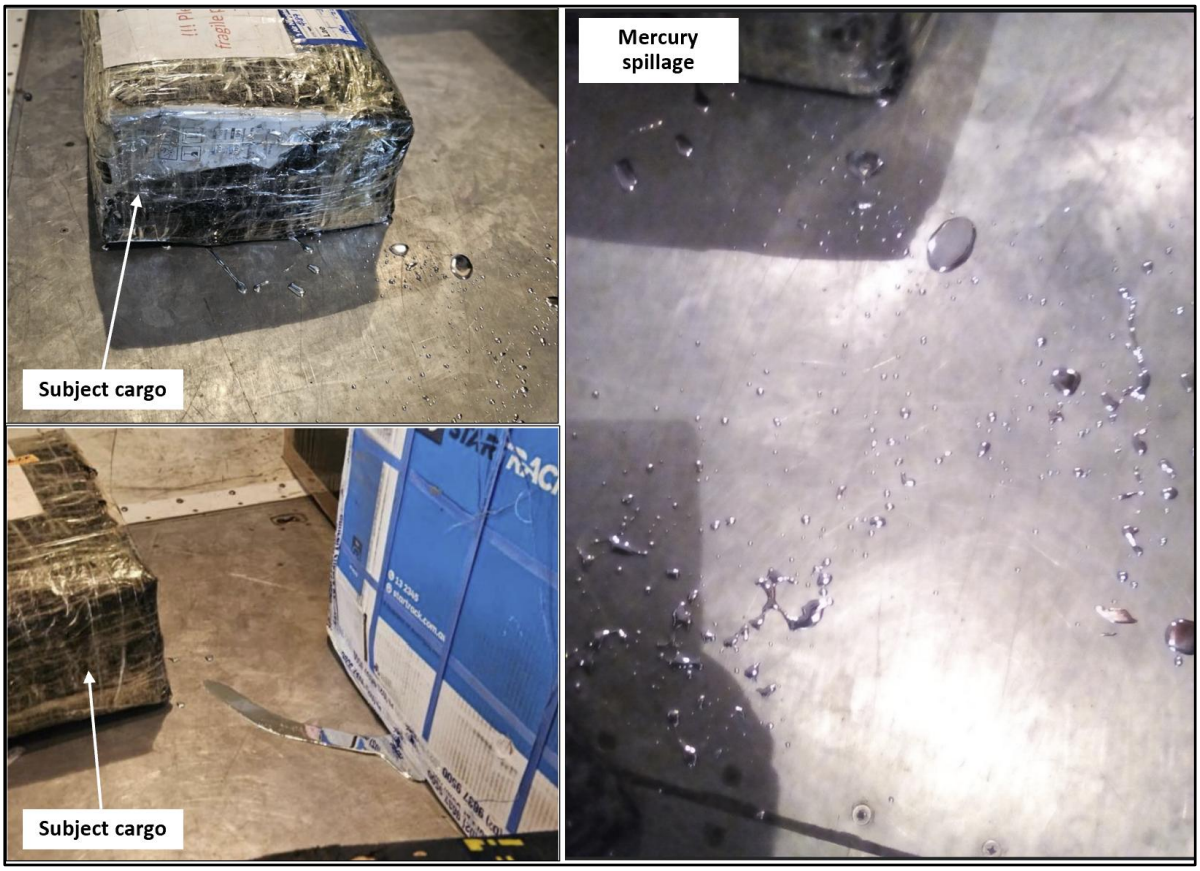


Figure 4: Photos of the cargo of interest and the mercury spillage (Source: Air Niugini Limited)

According to flight crew[3] statements all passengers had boarded the aircraft, and they were anticipating a Load Master to board the aircraft to complete loading formalities and dispatch the flight, for departure. During that time, a Porter entered the flight deck and informed the PIC about the spillage in Cargo Hold No.3, also providing pictures of the spill he had taken using his mobile phone. Soon afterward, an engineer proceeded to the flight deck and advised the flight crew about the spill, adding that the aircraft was grounded. The co-pilot recalled that the engineer informed them of the mercury spill at about 09:40.

The flight crew statements indicated that the PIC informed the cabin crew of the spillage incident and their intentions for all crew and passengers to disembark the aircraft. The PIC subsequently made a public announcement (PA) advising passengers that due to the unserviceability of the aircraft's aft cargo compartment, the flight could not proceed as planned. He instructed all passengers to disembark the aircraft and check with the ground staff at the departure lounge for more information on their flight to Lae. Subsequently, the passengers disembarked the aircraft, taking all their personal belongings with them.

2 A chemical element. Refer to Section 1.6.2.2 for more information on Mercury.

3 PIC and copilot.

Flight crew statements indicated that the PIC switched off both air condition packs, then advised the company Customer Services of the occurrence, via company radio. The engineers then took over the aircraft, retained the Aircraft Journey Technical Log (AJTL) and made an entry of the defect relating to the mercury spill.

After all passengers had disembarked the crew conducted respective checks in the flight deck and cabin. Upon completion of their respective checks, all crew disembarked the aircraft and proceeded to their respective crew rooms.

There were no reported injuries to the crew, cargo handlers and passengers.

1.2 Damage

According to the operator's internal *Safety Investigation Report* it was estimated that approximately 200 grams (g) of the Mercury substance had leaked from the package, spreading from the doorway of the aircraft's Cargo Hold No.3 and onto the compartment floor. *Refer to Section 1.6.3.3 for information on post occurrence maintenance information.*

There were no other reported damages.

1.3 The aircraft

1.3.1 Aft cargo compartment

According to the operator's *Boeing 737-800 Flight Crew Operations Manual RV 27 (30 March 2024)*, the lower cargo compartments, including the aft cargo compartment, are designed to meet Federal Aviation Administration (FAA) category Class C compartment requirements. This means that any fire within these compartments area are contained without compromising the safety of the aircraft or its occupants. The compartments are sealed and pressurised but do not have fresh air circulation and temperature control as do the upper passenger compartments.

A pressure equalization valve is in the aft bulkhead of each compartment. The valves let only enough air flow into or out of the cargo compartments to keep the pressure nearly the same as the cabin pressure.

Blowout panels in the lower cargo compartments provide pressure relief at a greater rate than the pressure equalization valve in case the aircraft pressurization is lost.

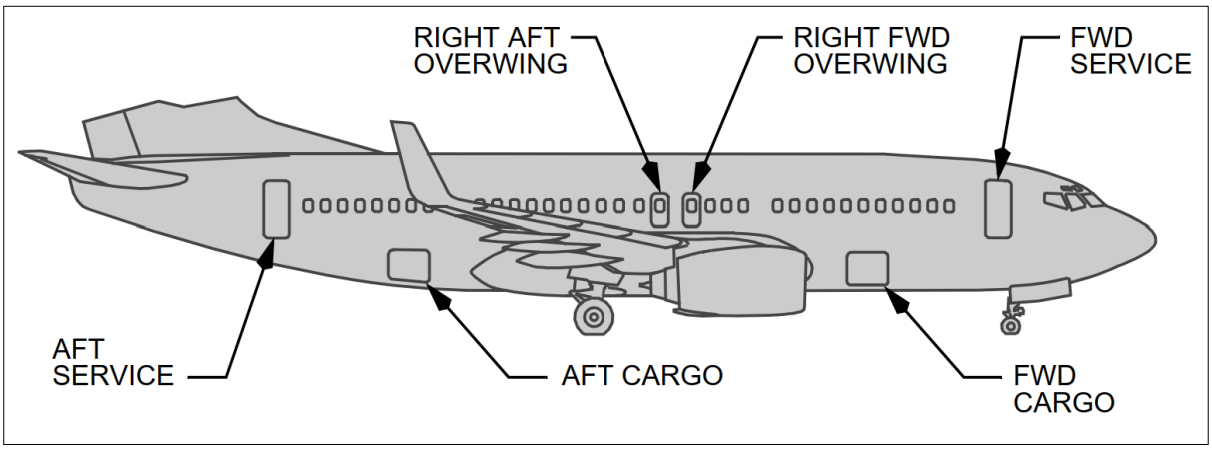


Figure 5: Schematic of P2-PXB indicating Aft Cargo Compartment (Cargo Hold No 3)

1.4 Personnel information

1.4.1 PIC

The PIC's personnel records showed the following qualifications:

- PNG Airline Transport Pilot License (ATPL) Aeroplane (A) issued on 14 January 2013
- Endorsement on Aeroplane:
  - Single-Engine Aeroplane (Land): <5700 kg Maximum Take-Off Weight (MTOW)
  - Multi-Engine Aeroplane (Land): BN2; PA31; C402; DHC7; F28; F70/100; B737 (300-900)
  - Aircraft Design Features: Constant Speed Variables Pitch Propellor; Retractable Undercarriage; Pressurisation System
- Current medical class one (1) with medical limitation recorded as spectacles.

The training records of the PIC showed that his B737 Safety and Emergency Procedures certificate and Dangerous Goods Awareness certificate were valid at the time of the occurrence.

According to *CAR Part 121.515 (c)*, for aircraft engaged in domestic commercial air transport operations crewed by more than one pilot, where the pilot has attained his 60th birthday, the holder of the air operator certificate must ensure the other pilot is below the age of 60 years. The PIC was 68 years old, and the copilot was 32 years old at the time of the occurrence. *Refer to Appendix 5.1.1 for further information about the PIC.*

1.4.2 Co-pilot

The co-pilot's personal records showed the following qualifications:

- PNG Commercial Pilot Licence issued on 19 December 2016
- Endorsement on Aeroplane:
  - Single-Engine Aeroplane (Land): <5700 kg MTOW
  - Multi-Engine Aeroplane (Land): BE76; DHC8; B737 (300-900)
  - Aircraft Design Features: Constant Speed Variables Pitch Propellor; Retractable Undercarriage; Pressurisation System.
- Current medical class one (1) with no recorded medical limitations

The training records of the co-pilot showed that his B737 Safety and Emergency Procedures certificate and Dangerous Goods Awareness certificate were valid at the time of the occurrence. *Refer to Appendix 5.1.1 for further information about the co-pilot.*

1.5 Organisational information

1.5.1 The Operator

Air Niugini Limited is a State-Owned Enterprise, with its headquarters in Air Niugini Haus, 7 Mile, Port Moresby, PNG. Its main operational base and maintenance base is located at Jacksons International Airport at 7 Mile, Port Moresby. Air Niugini operates both domestically and internationally.

1.5.1.1 Training

1.5.1.1.1 X-Ray Screeners Cargo Officer

Air Niugini Air Operator Security Programme (AOSP), Version 20, Section 3.18.5.1 states that to comply with regulatory requirements in the National Civil Aviation Security Training Program (CNCASTP) and the subsection of *PNG Civil Aviation Rule (CAR) Part 108*, all Personnel employed by Air Niugini who are involved with or responsible for implementing security measures and those authorised to access airside areas shall undergo initial and recurrent training that consists of theoretical and practical training.

Personnel implementing or responsible for security controls are to complete an initial training in which they are appropriately selected and sufficiently trained and deemed competent to perform their duties. A recurrent training shall take place within two (2) yeas to ensure knowledge is current with operational requirements and up to date training records maintained.

X-Ray screeners Cargo Officer prevent the carriage of unauthorized items and or goods that present a direct security threat on all Air Niugini aircrafts. The officer must have completed a certified security training course and aviation related training.

A Screening Officer must have prior exposure to security critical areas and be appropriately trained to a level of security awareness sufficient to understand the importance of maintaining standards of security control measures.

Section 3.18.12 Training Matrix in the operator's *AOSP, version 20* states that the X-Ray Screeners Cargo Officer is required to complete the following courses:

- Basic Security Officer Training
- Cargo X-Ray Screening Course
- Cargo Security Training
- Emergency Response
- Dangerous Goods Awareness (Initial/Recurrent)
- Aviation Security (Initial/Recurrent)

AOSP, Version 20, section 3.9.11 (2) states that Air Niugini Limited (ANL) will be responsible for security screening of cargo, courier and express mail and the mail accepted from unknown Shippers and will also ensure that this is not in any way inferior to the standards set by the appropriate Authority.

(3) Air Niugini Screeners shall perform the screening and be trained in accordance with standards contained in this Manual [AOSP, Ver 20]

AOSP, Version 20, section 3.9.11.17 'Authorisation for Screening Operatives' also states that only screeners that have completed the appropriate training stipulated in *section 3.9.11* and have received authorisation as per *section 3.3.11.12 (Refer to Section 1.5.2.2)* shall screen cargo, courier, express mail and mail.

The Cargo Screener's training records showed that she had completed the following trainings:

- Dangerous Goods Awareness (DGA) Course on 21 June 2022
- General Induction Awareness on 8 September 2022
- Safety Management System – Recurrent Training on 6 March 2023
- X-Ray Screeners Training on 28 March 2023
- Ground AVSEC Awareness on 14 July 2024

The training records for the Aviation Security (AVSEC) Cargo Screener indicates that she completed Initial X-ray Screening Course from 25 to 29 May 2015, followed by a refresher course from 29 to 30 June 2017, during which she successfully completed an X-ray Refresher Screening Observation. The records show that her most recent refresher course was completed on 28 March 2023, with a revalidated expiration date as 28 March 2025. However, there is no documentation to confirm that an X-ray Refresher Screening Observation took place during this latest refresher course.

The Officer's training records showed that she had completed a Ground Aviation Security Awareness Training, X-Ray Screeners Training (Recurrent) and was current. However, at the time of the occurrence, her Dangerous Goods Awareness (DGA) certificate had expired on 30 June 2024.

The investigation also found that the X-ray Screening Course was attended by the officer on 28 March 2023. However, according to the operator's *AOSP, Version 20*, the X-Ray Cargo screening course is required to be delivered in three (3) days.

1.5.1.1.2 Cargo Acceptance Officer

Cargo Procedures Manual (CPM), version 14.2, section 9.4 'Training Requirements' states that all personnel that perform operational duties in functions within the scope of cargo operations, including personnel of external service providers, shall complete recurrent training on a frequency in accordance with requirements of the regulatory authority but not less than once during every 36-month periods, except for recurrent training in Dangerous Goods.

Personnel that perform operational duties in functions within the scope of cargo operations shall complete the relevant category of Dangerous Goods recurrent training within 24 months of previous training.

…. Training shall include initial and recurrent training to ensure that personnel who undertake operational cargo functions are competent to perform their assigned responsibilities to comply with regulatory requirements as stipulated under *Civil Aviation Rules 92,108,119* and *121*.

CPM, Version 14.2, section 9.4.2 states that Freight Acceptance staff must be trained and demonstrate competence in:

- Dangerous Goods Acceptance
- Human Factors Principles
- Safety Management Systems
- Security Training
- The Air Niugini Cargo Procedures Manual, Dangerous Goods Manual and the IATA Dangerous Goods Regulations, the Corporate Policy and Procedures Manual.
- OH& S Principles and requirements
- The operation of vehicles and GSE (as per the approved standard operating procedures)
- Cargo and mail acceptance and handling

The Acceptance Officer's training records showed that he had completed the following trainings:

- Air Cargo Essentials – Initial Training on 3 June 2023
- Cargo Security – Initial Training on 26 July 2023
- Human Factors - Initial Training on 27 July 2023
- Safety Management System Awareness Initial Training on 29 September 2023 (Expiry date: 29 September 2025)
- Dangerous Good Regulations – Initial Training (Expiry date: 30 April 2026)

The training records of the Cargo Acceptance Officer showed that all required training were completed, and the Officer was appropriately trained at the time of the occurrence.

1.5.1.2 Staff Authorisation

According to *AOSP, Version 20, Section 3.9.11.21*, as part of preventative security measures, only personnel or staff who undertake the following activities will be duly authorised by the General Manager Ground Operations and Aviation Security after fulfilling all training requirements as per the training provided in Section 3.9.11 and have undergone background checks and assessed as competent.

1. Cargo and Security staff doing electronic or physical screening cargo, express mail, courier parcels, mails, transfer cargo or mail and special category cargo.
2. Cargo acceptance and security staff who are deemed as applying security controls to cargo, express mail, courier parcels, mails, transfer cargo or mail and special category cargo from an unknown shipper.

3. Cargo acceptance and security staff who physically check cargo, courier, express mails, transfer cargo or mail and special category cargo from an unknown customer.
4. Cargo and security staff who have access to designated access control areas where cargo courier, express mails, transfer cargo to mail and special category cargo from a known customer and mail are stored.
5. Cargo and security staff who will issue a security declaration for each consignment of cargo, express mail, courier parcel, mail transfer cargo or mail and special category cargo.
6. Cargo acceptance and security staff who be entering known details into the known customer register
7. Personnel other than Air Operator staff who deliver cargo to or accept cargo from the Operators Cargo facility.
8. Personnel other than Air Operator staff who drive delivery vehicles on behalf of the freight forwarder and/or Cargo Agent.

AOSP, Version 20, Section 3.9.11.23 states that Air Niugini Cargo and Security personnel who are deemed competent and appropriately trained (with security requirements of air cargo) and have undergone background checks will be granted authorisation by the department head in writing and will include:

1. Name of authorised staff
2. Designated single or multiple security control function
3. Expiry date of authorisation

The Authorisation certificate may only be valid for only two (2) years and may not be used by another personnel who is not authorised by the department head.

The investigation found that at the time of the incident, there was no record of an Authorisation granted by the department head for the Cargo Screening Officer and Cargo Acceptance Officer.

1.5.1.3 Cargo Acceptance Procedures

Dangerous Goods Manual (DGM), Version 13.2, Section 2.1 states that the point of acceptance is the most critical part of the safe transportation of dangerous goods. It is vital that any hazardous material is recognised here and that the regulations and procedures are strictly followed. All Acceptance counters must maintain full attention to detail.

Cargo Procedure Manual (CPM), Version 14.2, Section 2.1 states*;*

> *The acceptance of cargo involves critical aspects of customer services, revenue assessment, data capture and selection of schedules and in compliance with Air Niugini In-house procedures, Civil Aviation Industrial Standards and IATA applicable and IATA allocable laws and regulations.*

CPM, Version 14.2, Section 2.1.1 'Cargo Acceptance Procedure' states***;***

> *Cargo tendered for carriage by Air Niugini or another airline by a freight forwarded known Shipper, unknown shipper and/or regulated and unknown shippers shall be subject to the following requirements:*
>
> 1. *Shippers Instruction for Dispatch must be filled prior to capturing details on the Air Waybill. This will be used to gather the information of Shipper and the Consignee along with pieces and the estimated weight of the pieces and the nature of goods. Apart from that, it has first flight then any onward from the destination could be included.*
> 2. *Obtain a signature from whoever delivers the cargo against a positive identification*
> 3. *Check that the documents are in order*
> 4. *Cross the weights and number of pieces lodged*

5. *Cargo must be screened by means of a physical search of the contents or by an X-ray machine.*
6. *Where an international flight originates from a port without proper screening requirement, then cargo must be manually searched.*

CPM, Version 14.2, Section 2.1.2 'Unaccompanied Baggage/General Cargo' also states that the Freight Acceptance Questionnaire is used for both International and Domestic Shipments which shall be completed by the known shipper, regulated agents and unknown shipper in determining whether the provision of the Dangerous Goods Regulations are applicable to the despatch of consignment. *Refer to Appendix B, 5.1.2 of this report, for the Freight Acceptance Questionnaire form.*

DGM, Version 13.2, section 2.3.1 states*;*

> *Cargo declared under a general description may contain hazardous articles that are not apparent or known as hidden dangerous goods. Such articles may be found in baggage. With the aim of preventing undeclared dangerous goods from being loaded on an aircraft and passengers from taking on board those dangerous goods which are not permitted to have in baggage, cargo and passenger acceptance staff should seek confirmation from shippers and passengers about the contents of any items of cargo or baggage where there are suspicions that it may contain dangerous goods.*

The investigation found from evidence reviewed that necessary paperwork was completed by the shipper without the Acceptance Officer's presence. The Acceptance Officer was attending to other customers while the paperwork was being completed by the shipper. The Acceptance Officer also did not ask security questions to the shipper to confirm contents of the cargo.

The cargo of interest was weighed by the Acceptance Officer and loaded onto the roller for screening by a security Guard and not the Cargo Acceptance Officer.

1.5.1.4 Machinery Cargo

The operator's *DGM, Version 13.2, Section 2.5.9* states:

> *All machinery cargo new or used must be declared as Dangerous Goods. This refers to internal combustion machinery which is powered by flammable liquid.*

The operator's *DGM, Version 13.2, Section 6.3.3.12* states;

> *All machinery powered by fuel must be declared as Dangerous Goods despite been declared as Brand new. Ensure all fuel MUST be thoroughly drained and cleaned out and proper checks done physically.*
>
> *Dangerous Goods documents must be correctly filled and declared and checks done prior to uplift.*

The operator's procedures did not clearly define machinery. However, the operator's cargo acceptance questionnaire that was completed by the consignee/shipper referred to machinery as 'Machinery with internal combustion such as chainsaws, lawnmower or garden trimmings.'

From further research, machinery parts can be considered dangerous goods if they contain certain hazardous materials. For example, parts that include adhesives, paints, sealants, solvents, or other chemicals and gases are often classified as hazardous.

Excavator parts themselves are generally not classified as dangerous goods. However, certain components or materials within the machinery might be considered dangerous if they contain hazardous substances. For example, parts that include batteries, fuel, or hydraulic fluids could be classified under specific dangerous goods regulations due to their chemical properties.

Some excavator parts can contain hazardous substances. For example:

- Hydraulic Fluids: These can be toxic and harmful if leaked or improperly handled.
- Batteries: Excavators often use large batteries that contain lead or other hazardous materials.

- Asbestos: Older machinery might have components that contain asbestos, which is hazardous if disturbed.
- Fuel Systems: Diesel or other fuels used in excavators are flammable and can be dangerous

Many parts of an excavator are indeed part of internal combustion machinery. Excavators typically use diesel engines, which are a type of internal combustion engine. Key components of these engines include:

- Engine block: The main structure of the engine.
- Pistons: Move up and down within the cylinders.
- Crankshaft: Converts the pistons' linear motion into rotational motion.
- Fuel injectors: Deliver fuel into the combustion chamber.
- Turbochargers: Increase engine efficiency and power output.

The investigation found that the subject cargo was declared as an excavator part by the shipper and categorised by the Acceptance Officer as General Cargo. Asking relevant security questions during cargo acceptance would confirm if the cargo declared as excavator parts contained hazardous substances or not.

The investigation also found that the shipper/consignee did not provide a copy of the Material Safety Data Sheet (MSDS) and a signed certificate to prove that the General Cargo declared as Excavator part was non-hazardous as per the operators *Dangerous Goods Manual, Version 13.0, Section 2.2.1 Note* which states that the declaration on the Shippers Declaration for Dangerous Goods may omit the reference to placard, where appropriate. If the item is not dangerous, the shipper has to provide a Material Safety Data (MSDS) to prove that it is non-hazardous. If there is MSDS, then the shipper has to provide a signed certificate.

1.5.1.5 Cargo Screening Procedures

The operator's *DGM, Version 13.0, Section 8 (19), 'Security Screening'* states that while the purpose of security screening is to detect and prevent items having a security risk to the operations of aircraft from being transported as cargo or in baggage and mail, security screening safeguards aviation safety. The ICAO Technical Instruction (TI) require security screening staff to be trained to recognize and detect dangerous goods. However, it should be recognised that due to limitations in security screening technology, not all dangerous goods can be detected through such screening.

Hence, the detection of dangerous goods though security screening may only be conducted on a best effort basis. Notwithstanding this, many items of dangerous goods can still be detected by recognition of its shape and other physical properties. For example, gases contained in cylinders or aerosol cans, fire extinguishers, wet batteries, and even lithium batteries may be detected through security screening using x-ray machine. Whenever practicable, consider the screening equipment used to screen its cargo, baggage and mail and assess its effectiveness in detecting and preventing hidden or undeclared dangerous goods from being transported on its aircraft. Consequential procedures after undeclared goods have been detected, including reporting to relevant authorities, gathering of safety data and taking appropriate action against entities offering undeclared dangerous goods for transport can further manage safety in the transport of items in aircraft cargo compartments.

The *AOSP, Version 20, Section 3.9.11.3* states that Air Niugini utilises a Smiths X-Ray Machine, which is installed at the Cargo Warehouse in Port Moresby for the screening of cargo, courier, express mails and mail is approved by the appropriate authority.

The X-Ray system meets the performance standards to ensure maximum effectiveness in detecting explosive or incendiaries and meets imaging capabilities for screening cargo consignments when x-rayed. The following must be considered:

1. images of every part of the item being screened must be studied for at least 5 seconds

2. the X-Ray operator should check that the shading of the image on screen is consistent throughout. Lighter edges may indicate sheet explosive that does not completely line the top, bottom or sides of the consignment.

3. Operators must pay as much attention to the framework and any appendages as to the contents and any metallic or channelled parts of a consignment which would conceal a component of an explosive device should be examined for apparent bulges or protrusions.

When screened by X-Ray, each piece must be screened at least twice in succession with the image viewed by the same operator at the same location, from two different angles.

The investigation found from evidence reviewed that the Screener loaded the X-Ray machine, screened cargo and unloaded the cargo onto pallets. Evidence provided to the AIC also stated that the screener had exited the screening room immediately after the subject cargo had passed through the X-Ray machine. She had exited the screening room to assist the supervisor unload cargo onto pallets. The images of the subject cargo were not studied or paid attention to when it went through the X-Ray machine.

The investigation also found through evidence provided by the operator, that the cargo of interest was picked up from the x-ray machine roller by the supervisor and x-ray screeners cargo officer and dropped onto the pallet.

1.5.1.6 Cargo Screening Facilities

ICAO Annex 17, standard 4.6.5 states;

> *Each Contracting State shall ensure that operators do not accept cargo or mail for carriage on an aircraft engaged in commercial air transport operations unless the application of screening or other security controls is confirmed and accounted for by a regulated agent, a known consignor, or an entity that is approved by an appropriate authority. Cargo and mail which cannot be confirmed and accounted for by a regulated agent, a known consignor, or an entity that is approved by an appropriate authority shall be subjected to screening.*

The investigation found from onsite investigation at the operator's Cargo Terminal that the Cargo is accepted before it is screened.

1.5.2 International Air Transportation Association

The International Air Transport Association (IATA) is the trade association for the world's airlines, representing some 330 airlines over 80% of global air traffic. They support many areas of aviation activity and help formulate industry policy on critical aviation issues including the *IATA Dangerous Goods Regulator (DGR) Manual, Edition 65.*

1.6 Additional information

1.6.1 Notification & Investigations

PNG CAR Part 12.55 (a) states;

> *A holder of a certificate issued in accordance with the following Parts must notify as soon as practicable of any associated incident if the certificate holder is involved in the incident and the incident is a serious incident or an immediate hazard to the safety of aircraft operations……*

The email evidence provided to the AIC by the operator indicated that the operator had initially notified the Civil Aviation Safety Authority of Papua New (CASA PNG) about the occurrence via email, at 12:19 on 24 July 2024, a day after the occurrence day.

The AIC was initially notified of the occurrence by CASA PNG on 8 August 2024, at 12:04.

1.6.2 Dangerous Goods

According to *ICAO Annex 18, Chapter 1. Definitions*[4].

> ***Dangerous goods***. *Articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in the Technical Instructions, or which are classified according to those instructions.*

ICAO Annex 18, Chapter 7. Shipper's Responsibilities:

7.1 General requirements

> *Before a person offers any package or overpack of dangerous goods for transport by air, that person shall ensure that the dangerous goods are not forbidden for transport by air and are properly classified, packed, marked, labelled and accompanied by a properly executed dangerous goods transport document, as specified in this Annex and the Technical Instructions.*

According to IATA DGR Manual, dangerous goods can only be transported by air, if they are prepared by qualified personnel, unless if they are excepted. However, certain dangerous goods may be carried in baggage by passengers and crew, provided the specified requirements are met.

1.6.2.1 Mercury

Mercury is a chemical element with the symbol Hg and an atomic number 80. It has a Melting Point of 39 Degree Celsius (ºC), Boiling Point of 357 ºC and Density of 13.5 at 20ºC. It is the only element metal that is liquid at room temperature.

According to the *IATA DGR, Edition 65, Section 4.2 List of Dangerous Goods,* following are the identification details of Mercury[5]:

UN/ID number	: 2809
Proper Shipping Name/Description	: Mercury
Class or Division (Sub Hazard)	: 8 (6.1)
Hazard Labels(s)	: Corrosive & Toxic
Packing Group	: III
Packing Instructions (Passenger and cargo aircraft)	: 868[6]

The IATA DGR states that the carriage of mercury on a passenger and cargo aircraft is accepted, however, it has limitations as outlined in the DGR Manual. The net quantity per inner package in a glass or plastic must not exceed 2.5 kg, and the outer package must not exceed 35 kg.

The investigation found that the similar information was published by Air Niugini Limited, for public awareness. *Refer to Section 4.1 Safety Actions 4.*

4 The definition for Dangerous Goods in PNG CAR Part 1 is exactly the same as ICAO Annex 18 definition.

5 Refer to Appendix C, 5.3.1 for more information on the details.

6 Refer to Appendix C, 5.3.2 for more information on the packing instruction.

1.6.3 Post occurrence activities

1.6.3.1 Inspection of the subject cargo

The shipment was inspected by a Team from Air Niugini Limited Cargo, and the content was confirmed to be Mercury. Upon opening the package, the inspection team discovered that 7 plastic bottles of Mercury were concealed inside a portable printer and falsely labelled as excavator parts.

On 26 July 2024, the shipment re-scanned through the X-Ray screening machine, by the Cargo Team and AVSEC Team to establish if the mercury was picked up by the X-Ray Screening machine. The screened images showed that the mercury appeared dark, compared to the bottles of water which appeared orange in colour which indicated that the mercury was picked up by the X-ray screening machine.

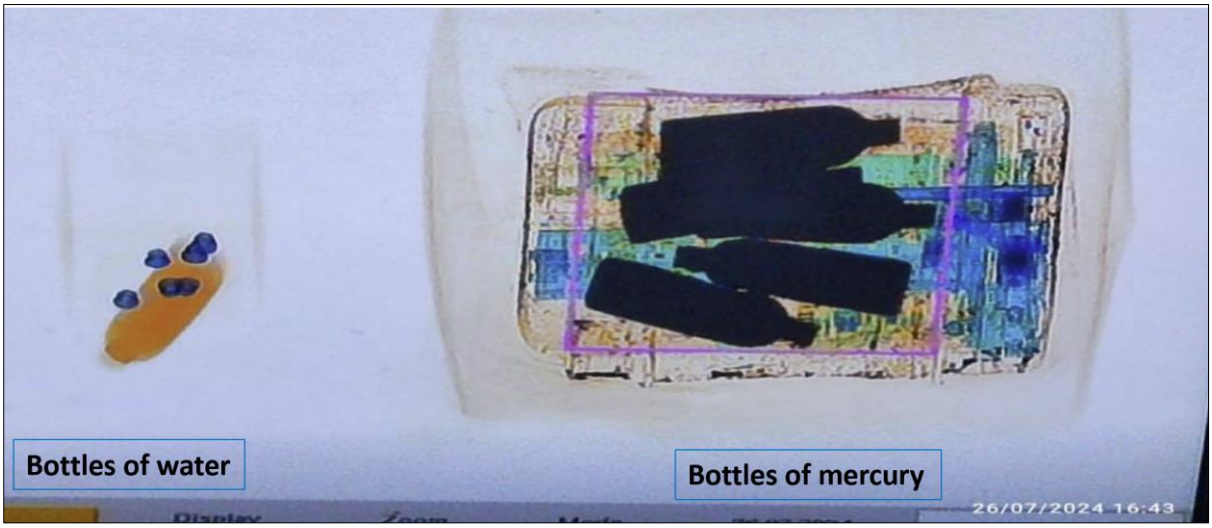


Figure 6: Images of re-scanned shipment in comparison to scanned bottles of water (Source: Air Niugini Ltd)

On 16 August 2024, the AIC investigation team inspected the subject cargo in the Cargo Storage Room and found that all contents of the shipment including the portable printer were packed in a clear plastic bag. The team discovered seven 330-milliliters (ml) bottles: six containing mercury, and one completely empty. The remaining contents of the package included a portable printer, several empty packets of various items and pieces of foam and cardboard, which appeared to have been used for padding and cushioning the bottles of Mercury. There were traces of mercury all over the rest of the cargo contents. The mercury was believed to have leaked out from the bottle that was found to be empty. This was also confirmed by the cargo personnel who had unpacked the cargo to check the contents, repacked it and re-screened it following the occurrence, on the day of the occurrence.

Seven bottles: five full of mercury and the empty bottle were identified as Air Niugini Particles water bottles and the other full bottle was identified as a Pure water bottle.

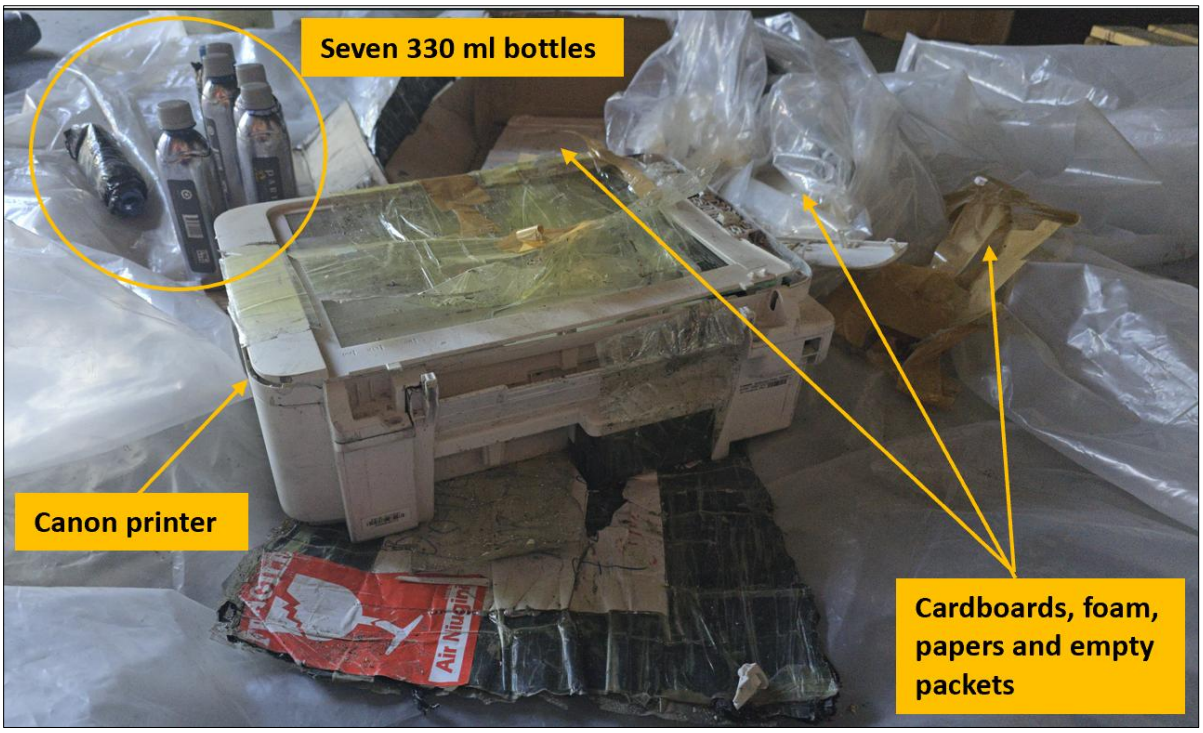


Figure 7: Contents of subject cargo

The investigation team weighed the six bottles containing Mercury, each of which was found to weigh 5 kg.

Figure 8: Bottles used to transport Mercury

The investigation weighed empty bottles of Particle Water bottle and Pure Water, and found their respective empty weights to be 23.55 g and 21.36 g.

With that, the actual content of mercury for each of the six bottles was found to be:

Bottle No.	Type of bottle	Weight with mercury	Empty weight of bottle	Weight of mercury
1	Pure Water	5 kg	21.36 g	4.98 kg
2	Particles Water	5 kg	23.55 g	4.97 kg
3	Particles Water	5 kg	23.55 g	4.97 kg
4	Particles Water	5 kg	23.55 g	4.97 kg
5	Particles Water	5 kg	23.55 g	4.97 kg
6	Particles Water	5 kg	23.55 g	4.97 kg
7	Particles Water	Undetermined due empty from the spill	23.55 g	Undetermined due empty from the spill

Table 1: Information on seven bottles in the cargo of interest

The empty bottle was examined, initially without the lid and it was found to be intact. After searching through the rest of the contents of the cargo package, the lid was located and appeared to be cracked or broken. *Refer to Figure 9.*

Figure 9: Empty bottles with broken lid from which the Spill occurred

1.6.3.2 Interview with the consignee of the Cargo

The Air Niugini Limited (ANL) security and Cargo Air freight personnel stated during interview with the AIC, that the consignee / customer was contacted on 24 July 2024, a day after the occurrence date. The customer made himself available at ANL Cargo Terminal 2 as requested by the operator, where he was interviewed by ANL Aviation and Cargo Personnel.

The AIC reviewed the operator's *Safety Investigation Report*, which was provided to the AIC by the operator, and established that the shipper had knowingly mis-declared the Dangerous Goods as General Goods, in fear of airline staff refusing to accept the mercury. The report further states that the shipper admitted to falsely consigning mercury on two separate occasions. The cargo records showed that;

- On 28 March 2024, at 16:24. The cargo was falsely declared as 'Auto Parts Medical Good', weighing 27 kg; and
- On 06 May 2024, at 12:30. The cargo was falsely declared as 'Auto Parts', weighing 29 kg.

The shipper reported that on both occasions the cargo was consigned by his counterpart, the mercury was not detected, and the cargo were uplifted to Lae, as intended.

Following the interview, the Aviation Security Personnel completed their security formalities and handed the shipper over to the Airport Police.

1.6.3.3 Post occurrence maintenance

The operator reported that the aircraft remained at Bay 4 from 23 to 27 July 2024. On 28 July 2024, the aircraft was towed to a remote Bay.

The following tests and inspections were carried out post incident:

Date	Maintenance/Tests/Inspection	Remark
23 July 2024	Air Niugini and Safe Air Management System (SAMS) maintenance team in Port Moresby cleaned up and inspected the mercury spill, dated 23/07/2024 over a two-week period.	SAMS team provide *Part 145* engineering support on behalf of Icelandair who have leased the B737-800 to Air Niugini Limited. Icelandair Technical Services and Maintenance Control provide support to Air Niugini *Part 119* Maintenance Control and SAMS team. The SAMS team collected swab samples at 5 specific locations. CASA directed Air Niugini Ltd that radiographic testing (x-ray) be performed on P2-PXB.
5 September 2024	P2-PXB performed a ferry flight from Port Moresby to Manila to undergo Radiographic Testing.	
6 to 21 September 2024	MACHSCAN TECHNICAL SERVICES INC (MTSI) perform radiographic testing (x-ray) on P2-PXB in Manila, Philippines.	**Results** 1st radiographic testing (x-ray)-Zero visible indication of any Mercury (Hg) corrosion or embrittlement defects on the x-ray films directly related to the Hg Spill Zone. 2nd Phase x-ray was performed at these 5 specific locations by MTSI. These 2nd Phase x-ray stated that there was still reduced presence of

		Hg after the clean-up. Further cleaning was performed. 3rd Phase x-ray was performed between STA 767 and STA 807, S23L to S23R.The developed film results showed approximately 73% of scanned areas were free of Mercury (Hg). Final cleaning was performed, x-ray was performed and the final results indicated zero traces of Mercury (Hg).
23rd September 2024	Radiographic testing (X-ray) on lower aft fuselage that was carried out by MTSI team entered into the Air Niugini Aeroplane Journey and Technical Log No. 01897.	Aircraft released to Service

Table 2: Inspections/Tests Post-Incident

1.6.4 Human Factors

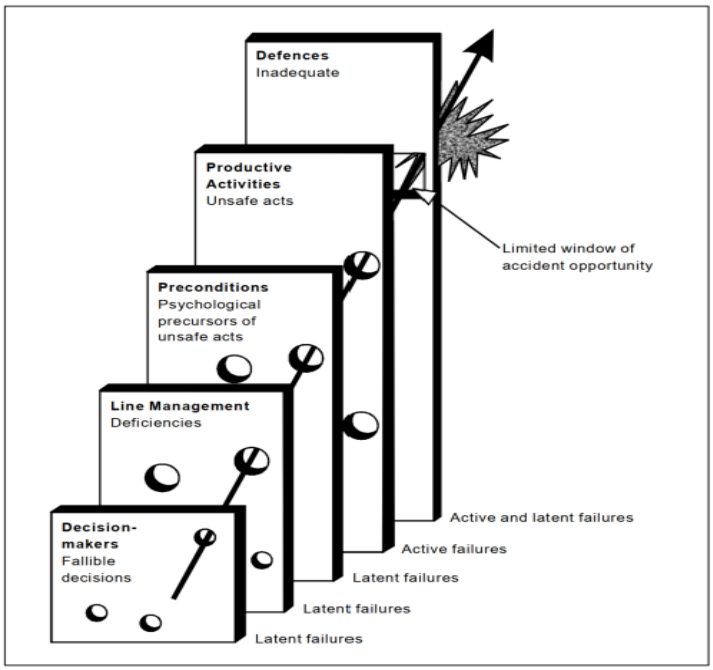


Figure 10: Reasons Model of accident causation (*Source: ICAO Doc 9756, Part 3*)

A framework proposed by James Reason (1990) explains how humans contribute to the breakdown of complex, interactive, and well-guarded systems such as the aviation industry. In such a system, accidents rarely originate from active failures or unsafe acts of front-line operators alone. According to Reason, accidents result from the interaction of a series of flaws, or latent failures, already present in the system (Refer to Figure 10).

The two types of failures, active and latent depend upon the immediacy of their consequences. An active failure is an error or violation which has an immediate adverse effect. Active errors are usually made by the front-line operator. A pilot raising the landing gear lever instead of the flap lever exemplifies this failure type. A latent failure is a result of a decision, or an action made well before an accident, the negative consequences of which may lie dormant for a long time. These failures usually originate at the decision-maker, regulator, or line management level, that is, people far removed in time and space from the event. A decision to merge two companies without providing training to standardize operating procedures illustrates the latent failure. These failures can also be introduced at any level of the system by the human condition — such as policies that lead to poor motivation or fatigue.

Latent failures, which originate from questionable decisions or incorrect actions, although not harmful if they occur in isolation, can interact to create a "window of opportunity" for a pilot, an air traffic controller, or mechanic to commit an active failure which breaches all the defenses of the system and results in an accident. The front-line operators are the inheritors of a system's defects. They are the ones dealing with a situation in which technical problems, adverse conditions, or their own actions will reveal the latent failures present in a system. In a well-guarded system, latent and active failures will interact, but they will not often breach the defenses. When the defenses work, the result is a minor event or at most an incident; when they do not, it is an accident.

a) Upper management decisions. Amongst these latent failures are decisions made by upper management, an aviation company's corporate managers or regulatory officials. When allocating resources, management has to balance, among other things, safety against cost. These objectives can conflict and may result in flawed decisions which will be reflected throughout the system.

b) Line management deficiencies. Managerial decisions, including those that are flawed, have to be implemented by line management through their standard operating procedures, training programmes, flight and crew scheduling, etc. If deficiencies also exist at this level, they will increase the accident potential of those managerial decisions; for example, dispatch who has inadequate appreciation for operational conditions may jeopardize safety by trying to follow a policy which is not appropriate for the situation.

c) Existing preconditions. If certain characteristics or preconditions, such as an unproductive environment, poorly motivated or unhealthy workforce, machines in a poor working state, and poorly established procedures are present in the system, they will influence the front-line operation's actions and become a source of unsafe acts.

d) Latent failures. Flawed decisions at the managerial levels, line management deficiencies, and existing preconditions at the worker level represent the system's latent failures.

e) Unsafe acts. Unsafe acts take many forms and, because of error, can never be totally eliminated.

f) Defenses. In a complex and well-guarded system, these latent failures may lie dormant for a long time without having significant impact on safety because very effective defenses, such as checks, procedures or GPWS, allow for a great number of these flaws to be simultaneously present in the system without serious consequences.

g) Window of opportunity. An accident trajectory occurs when unsafe acts interact with latent failures present in the system and breach all the system defenses, thus creating a "Window of opportunity" for an accident to occur.

h) Summary. Many unsafe acts are committed without consequence because existing conditions did not favour an interaction of all the deficiencies present in the system. Investigators, therefore, should not only examine unsafe acts made by front-line operators, but should work their way from unsafe acts and inadequate or removed defenses, through the accident trajectory, all the way back to upper management levels. Addressing the higher levels' deficiencies, in addition to the ones closely related to the unsafe acts, allows the investigator to formulate preventive measures which will affect a larger set of occurrences.

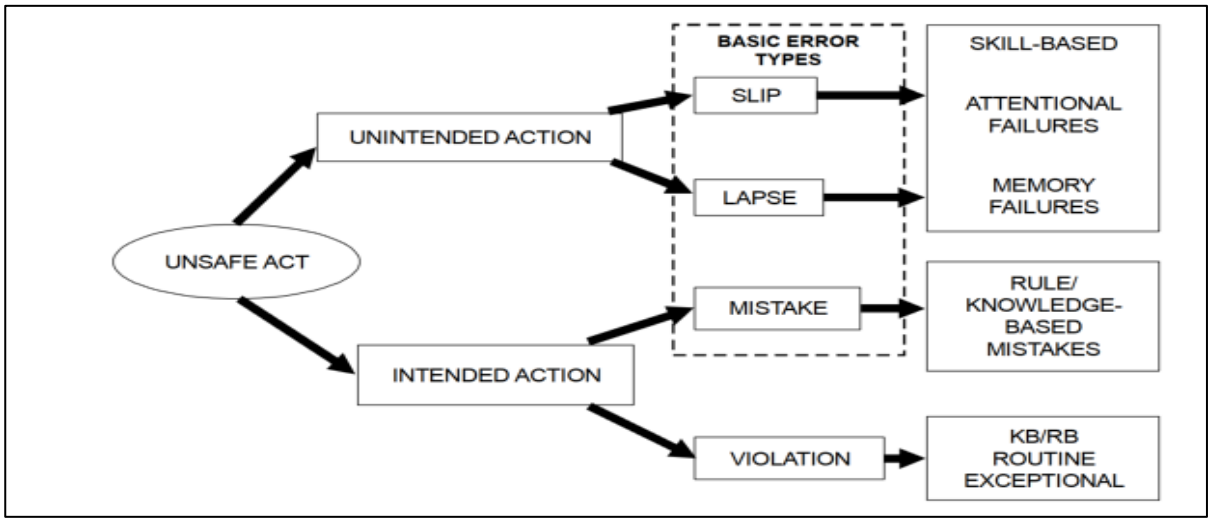


Figure 11: Generic Error Modelling (GEM) System (adapted from Reason,1990)

The Generic Error Modelling System (GEMS) framework facilitates the linkage of an error/violation to an individual's level of performance at the time the failure occurred; how errors and violations can have their roots in common behavioural failure patterns (i.e. failure modes) and are not necessarily the result of irrational behaviour.

There are two distinct categories of error, those actions that deviate from intention or are unintended (i.e. actions that do not proceed as planned) and those that are intended (i.e. actions that proceed as planned, but they fail to achieve the desired consequences). Errors can be further broken down into types, and the type depends largely on examining the concept of intended action. It is important to note that the criteria of "intentionality" refers to the action itself and not the intention to err.

a) Unintended actions. "Was the action that was carried out, the action that was planned?" If the answer to that question is no, then an unintentional action occurred. An unintentional action resulting in an error arises from a failure in the execution of the action in that there was a difference between what action was supposed to have occurred and what action actually did. An error in execution is either a slip or a lapse.

Slips usually arise as the result of not paying sufficient attention to the execution of the action. For example, an operator reaches for a switch, without looking, and places the control in the "OFF" position from the "STANDBY" position, when the intent was to place the switch control in the "ON" position.

A lapse is an unintentional action where there is a memory failure. For example, a person following a series of instructions may forget one of the steps involved in a task.

Whether the error is a slip or a lapse, the planned action is the correct action for the situation; however, the operator fails to execute the action properly.

b) Intended actions. “Was the action that was carried out, the action that was planned?” If the answer to that question is yes, then it is an intended action. An intentional action resulting in an error or violation involves a failure in planning in that the intended action was inappropriate. An error in planning is either a mistake or a violation. With this error type, the action proceeds exactly as planned but fails to achieve the desired consequences; in other words, the error is in the planning — it is the incorrect action for the situation. Mistakes are often failures of thought and of the decision-making process. They are usually more subtle than slips and lapses and considerable time can pass between the execution of the erroneous action and its detection. Mistakes, where there is no desire to do the wrong thing, can be distinguished from a violation where a deliberate decision to act against a rule or plan has been made. The term violation denotes a calculated adjustment or modification of a rule or plan which differentiates it from the basic error types as defined by the slip, lapse and mistake.

Latent Failures

1. Inadequate Screening Officers on shift.

According to the operator's Aviation Security Operations Roster for Cargo Frontliners for 13 to 26 July 2024, there are three (3) shifts. The shift that had handled the subject cargo was shift three (3). The investigation found that there was only one (1) Screening Officer for Shift 3. Shift one (1) and two (2) had two Screening officers (See Table 3).

SHIFT 1	SHIFT 2	SHIFT 3
Team Leader	Team Leader	Team Leader
Screener	Screener	Screener
Screener	Screener	Security Officer
Security Officer	Security Officer	Security Officer
Security Officer	Security Officer	
	Security Officer	

Table 3: Aviation Security Operations Roster for Cargo Frontliners

2. Inadequate Rest Day Off (RDO) and Break times

According to the roster provided by the operator for 13th to 26th July 2024 (See Table 3), Rest Day Off for Shift One (1) was six (6) days and shift two (2) showed four (4) rest days off, while shift 3 showed two (2) Rest Day off.

The investigation also found that for Shift 3, there is only one screener who does the screening at the Cargo warehouse and at both International and Domestic terminals. Before screening, the machine is started up and checks and tests done. The Cargo is then loaded into the x-ray screener, screened and unloaded onto pallets.

Break times are between ten (10) to fifteen (15) minutes. The roster also showed that the total shift hours is8 hours; one hour is for break and 7 hours duty time, however, staff do not take the one-hour breaks. Only short breaks are taken during their shift.

The Roster showed that Shift 3 had a 3 AM morning shift and 12 PM afternoon shift. The 12 PM shift starts and ends at 9 PM. The 3 AM shift starts and ends at 12:00 PM. Interviews with personnel found that the shift that had handled the subject cargo was Shift 3 for the 12 PM start and 9 PM finish. According to personnel interviewed, they clocked in at 10AM, signed on for duties at 11.30 AM and started at 12 PM.

By 8 PM, the shift ended, x-ray machine was tested before shutting down and by 8.30 PM, the officers then walked up from Domestic terminal to the base via the airside to sign off and get ready for the 9 PM drop off. Total hours from clock in at 10 AM to drop off at 9 PM was 11 hours.

3. Lack of appropriate training for the Screening Officer

The investigation found that the Screener had attended the x-ray screening course on 23 March 2023 and was current at the time of the incident. The expiry date of the X-ray Screening course was 28 March 2025. The X-ray screening course is a 3-day course; however, it was conducted in 1 Day.

The Cargo Screener was due for the Dangerous Goods Awareness training on 30 June 2024.

4. The Cargo Acceptance Area and Screening area setup does not meet ICAO Annex 17 requirements.

ICAO Annex 17 requires operators to apply security controls or screen cargo or mail before accepting for carriage on an aircraft engaged in commercial air transport operations.

Active Failures

1. The Shipper did not declare Dangerous Good (Mercury). Cargo was consigned as an Excavator part/General Cargo. The Mercury was packed in plastic water bottles and concealed in a printer. (*Intended Action-Violation/Sabotage*).

According to the operator's *Dangerous Goods Manual, Section 2.2.1 (1) (2) (3) 'Shippers Specific Responsibility'*, before any package or over-pack of dangerous goods is offered for air transport, the shipper must comply with the following specific responsibilities:

1. *A shipper must provide such information to his employees that will enable them to carry out their responsibilities with regard to the transport of dangerous goods by air.*
2. *The shipper must ensure that the articles or substance are not prohibited for transport by air.*
3. *The articles or substances must be properly identified, classified, marked, labelled documented and be in the condition for transport in accordance with the regulations.*

The shipper completed the Freight Acceptance Questionnaire and signed the Airwaybill, but he did not declare any Dangerous Good.

The Freight Acceptance Questionnaire the shipper signed indicated that the provisions of the DG were not applicable to the despatch of the consignment.

2. Cargo Acceptance Officer did not ensure Security Questions were asked to the Shipper to determine if the cargo declared as General Cargo (Excavator Part) contained hazardous substances). Shipper completed Paperwork on his own. (*Intended Action-Mistake/Rule Based*).
3. Cargo Screening Officer did not effectively monitor cargo of interest through the x-ray machine. (*Intended Action-Mistake/Rule Based*).

The Cargo Screener advised that she may have missed screening the cargo of interest due to only one person loading, screening and unloading of cargo. When cargo was placed onto the roller by the Cargo Officer and into the screening area, the Screener then pushed the cargo pieces through the X-ray screening machine. The Screener further stated that on the day, after signing on, she did some screening at International terminal then at Domestic Terminal. She placed five (5) to six (6) cargo pieces into the machine for screening then stopped the machine and reversed the image to identify any suspicious cargo. Then she moved on to help the Shift Supervisor unload cargo by lifting them and placing them onto a pallet. In the process she may have missed screening the subject cargo because she was loading cargo through the machine, screening and unloading. Since she was the only screener, she had to carry out all three tasks; loading, screening and unloading. The Supervisor assisted unload cargo onto the pallet to clear the conveyor belt for more cargo. All heavy cargo was unloaded by the Screener and Supervisor and placed on the pallet.

She further stated that with the large number of bottles that contained mercury, she would have easily identified it as suspicious cargo if monitored on the screen, but for this shipment, she had missed it.

Evidence provided by the operator indicated that after loading the cargo of interest into the X-ray machine, she looked at the X-ray screening monitors before she exited the screening room immediately after the cargo of interest passed through the x-ray machine. She had exited the screening room to assist the Shift Supervisor unload cargo onto pallets. The images of the cargo of interest was not studied or paid attention to when it went through the X-ray machine.

2 ANALYSIS

The operator's Dangerous Goods Manual mandates that all machinery cargo, whether new or used, must be declared as Dangerous Goods, including internal combustion machinery powered by flammable liquids. The shipper had mis declared the cargo as Excavator Parts. While the cargo was labelled as "excavator parts", which could also be considered 'machinery parts', the Cargo Acceptance Officer did not request further details from the cargo owner or inspect the contents before accepting the cargo. The investigation found that the Acceptance Officer's inaction to inspect the cargo of interest resulted in hazardous substance (mercury) being accepted for shipment.

The Cargo of interest was processed through the x-ray screening machine as required. However, the Screening Officer did not effectively monitor the screen when the cargo passed through. The investigation found that the Screening officer was multi-tasking, loading cargo into x-ray, screening and assisting with unloading onto pallet and was distracted. This may have resulted in inattention to the cargo being screened. Personal Latent Unsafe condition factors and Organisational Latent Unsafe condition factors interacted to create a '*window of opportunity'* for active failures to be committed which breached all the defences of the system. Existing preconditions influenced actions and became a source of the unsafe acts. The unsafe acts were a result of intended and unintended actions. The unsafe acts of the shipper, cargo screener and Acceptance Officer interacted with the latent failures present in the system and breached the defences, thus creating a '*window of opportunity'* for the incident to occur.

The training records also showed that the Cargo Screening Officer's Dangerous Goods Awareness certificate had expired on 30 June 2024. The investigation found that the X-ray Screening Course (Theory) was attended by the officer on 28 March 2023. However, according to the operator's Air Operator Security Program, Version 20, the X-Ray Cargo screening course is required to be delivered in three (3) days covering theory and practical assessment of the staffs understanding of the lessons learnt during the theory part of the course. The investigation determined that the lack of Dangerous Goods Awareness recurrent training and lack of practical training for the X-ray screening course may have contributed to the Cargo Screening Officer's underperformance in carrying out her duties.

Mercury, like many substances, expands when heated. If mercury is packed in plastic water bottles, several factors could cause it to expand:

Mercury expands significantly when exposed to heat. If the bottle is left in a warm environment, the mercury inside will expand as it heats up. The investigation found that the mercury was packed in plastic bottles and plastic is not a good conductor of heat, which means it can trap heat inside the bottle, causing the mercury to expand more than it would in a container made of a more conductive material like glass or metal. As mercury expands, it increases the pressure inside the bottle. Since plastic bottles are flexible, they might bulge or even burst if the pressure becomes too high. It is also important to handle mercury with care due to its toxic properties and to store it in appropriate containers designed to withstand temperature changes and pressure. It is the view of the AIC that since the mercury was placed in inappropriate containers (water bottles) which were not designed to withstand temperature changes and pressure, this may have resulted in the bottles of mercury expanding, causing the lid to break.

Incorrect handling of the subject cargo during loading and unloading for transportation may have caused the lid to break.

3 CONCLUSIONS

3.1 Findings

a) The cargo containing mercury was falsely declared as excavator parts.

b) The cargo was accepted as general cargo, although excavator parts may be classified as 'Machinery Parts' which according to the operator's DGM are required to be declared as dangerous goods.

c) The cargo acceptance officer's lack of awareness of cargo contents and possible reliance on the security cargo screening system, prevented him from requesting additional information from the owner of the cargo, or inspecting the cargo to verify the contents.

d) Ineffective or inadequate screening of the cargo by the screening officer prevented her from verifying the presence of the concealed hazardous substance.

e) Short staffing of X-ray cargo screening contributed to resulted in multi-tasking and lack of situational awareness of the Screener who screened the cargo in question.

f) Inadequate training relating to dangerous goods awareness, likely contributed to the underperformance of the screening officer.

g) The incorrect labelling of the cargo was misleading for the Cargo Handlers and Porters.

3.2 Contributing factors

a) Incorrect packaging of the mercury contents.

b) Inadequate cargo acceptance procedures.

c) Short staff and inadequate training for cargo screeners likely contributed to underperformance of the Screener.

d) Incorrect labelling of the cargo that was misleading to the Cargo Handlers Porters.

4 SAFETY ACTIONS & RECOMMENDATIONS

4.1 Safety actions

Air Niugini Limited, through its Internal Safety Report, informed the Accident Investigation Commission (AIC) of the following Safety Actions completed and proposed following the occurrence:

Procedural

Proposed Action:

Security to reassess, allocation of workforce for cargo screening. There should be at least one person to screen and another person to verify. This also help to rule out any malpractices.

Action taken:

No evidence.

Training

Proposed Action: *Security team to review the effectiveness of the X-ray screener training and practical image interpretation to be completed at the earliest.*

Actions Taken: *A Basic X-ray Screeners Initial Training was conducted from 03-07 August 2024 for the screeners.*

Organisational

Proposed Action:

Air Niugini management to consider screening of all packages before acceptance and a methodology to prevent any kind of tampering post screening and pre acceptance shall be implemented.

Action Taken:

A Counter Acceptance Awareness Meeting was conducted on 06 August 2024. The meeting minutes indicated that discussions were focused on the Acceptance Process Review and Physical Checks of cargo. During the meeting, manpower was discussed.

Organisational

Proposed Action:

Air Niugini to create awareness among shippers by displaying statutory warning along with details of the offences and punishments.

Action Taken:

Air Niugini Limited issued a Public Notice titled 'CONDITIONS OF CARRIAGE ON MERCURY, A DANGEROUS GOOD. The notice contained information on Mercury, it's limitation, packing instructions and penalties for failing to comply with this requirement.

Procedural

Proposed Action:

Air Niugini cargo drivers and loaders should be educated about inspecting the packages / goods before they load it onto trolleys / aircraft and report any leakage.

Action Taken:

An Internal Memorandum Ref: 08/2024 was issued to Cargo Loaders / Drivers with reminding them to ensure thorough inspection of freights are conducted during loading / unloading preparations and must immediately report if they find signs of tampering or evidence of leakage from the packages. Furthermore, if a package is found to have content leaking, the package must be immediately isolated and reported.

Procedural

Proposed Action:

Air Niugini to amend to include Mercury or other corrosive chemicals or substances in the freight acceptance questionnaire.

Action Taken:

The Freight Acceptance Questionnaire was revised to include Mercury.

4.2 Recommendations

As a result of the investigation into the serious incident involving the B737-800 aircraft registered P2-PXB, which sustained spillage of the hazardous substance, mercury, in its aft cargo compartment at Jacksons Airport, Port Moresby, Papua New Guinea, on 23 July 2024, the Papua New Guinea Accident Investigation Commission (PNG AIC) issued the following recommendations to address concerns identified in this report.

4.2.1 Recommendation number AIC 24-R15/24-2002 to Air Niugini Limited

The PNG Accident Investigation Commission (PNG AIC) recommends that Air Niugini Limited (ANL) should ensure that there is adequate number of x-ray Cargo Screening Officers to allow effective screening of cargo in accordance with the requirements of its *Air Operator Security Program*.

Action requested

The AIC requests that Air Niugini Limited note recommendation *AIC 24-R15/24-2002* and provide a response to the AIC within 90 days of the issue date, nor later than 27 February 2025 and explain (including evidence) how Air Niugini Limited has addressed the safety deficiency identified in the safety recommendation.

4.2.2 Recommendation number AIC 24-R16/24-2002 to Air Niugini Limited

The PNG Accident Investigation Commission recommends that Air Niugini Limited should ensure all its X-ray Cargo Screening Officers are appropriately qualified and adequately trained to effectively perform their duties, in accordance with the requirements its *Air Operators Security Program.*

Action requested

The AIC requests that Air Niugini Limited note recommendation *AIC 24-R16/24-2002* and provide a response to the AIC within 90 days of the issue date, nor later than 27 February 2025, and explain (including evidence) how Air Niugini Limited has addressed the safety deficiency identified in the safety recommendation.

5 APPENDICES

5.1 Appendix A

5.1.1 Table containing additional information of the report

General Details			
Date and time		23 July 2024, about 09:00 (23:00 UTC)	
Occurrence category		Serious Incident	
Primary occurrence type		Mercury Spillage in cargo compartment	
Location		Jacksons International Airport	
Type of Operation, Passenger information and damage details			
Type of Operation		Passenger and cargo	
Persons on board:		Crew: 2 Flight Crew & 4 Cabin Crew	Passengers:61
Injuries:		Crew: Nil	Passengers: Nil
Damage		Nil	
Other damage		Nil	
Fire		There was no evidence of pre-or post-impact fire.	
Crew details			
PIC		Co-pilot	
Gender	Male	Gender	Male
Age	68	Age	32
Nationality	Australian	Nationality	Papua New Guinean
Licence type	ATPL-A	Licence type	CPL (A)
Total hours	447.72	Total hours	875.23
Total hours in Command	194.62	Total hours in Command	Not applicable
Total hours on type	447.72	Total hours on type	336.87
Aircraft Details			
Aircraft Manufacturer		Boeing Aircraft Company	
Aircraft Model		Boeing 737-81M	
Serial Number		40067	
Year of manufacture		2014	
Total airframe hours since new		29,029.30	
Total cycles since new		12,394	
Certificate of Registration (CoR) issued		Issued: 05 April 2024	Expires: Non-Terminating
Certificate of Airworthiness		Issued: 09 May 2024	Expires: Non-Terminating
Engine data			
Engine manufacturer		CFM	
Engine Model		CFM56-7B26E	
Serial number		Engine 1 (Left): 660490	Engine 2 (Right): 660479
Aerodrome information			
Name of Aerodrome		Jacksons International Airport	
Locator indicator		AYPY-Port Moresby	
Airport operator		National Airports Corporation (NAC)	
Latitude:		09 26.509 S	
Longitude		147 13.144 E	
Elevation		129 ft (39 m)	

5.2 Appendix B

5.2.1 Air Niugini Limited Freight Acceptance Questionnaire

11.23 Freight Acceptance Questionnaire

Air Niugini FREIGHT

FREIGHT ACCEPTANCE QUESTIONNAIRE

The following details are required to assist in determining whether the provisions of the Dangerous Goods Regulations are applicable to the despatch of your consignment.

ARE ANY OF THE FOLLOWING ITEMS INCLUDED IN THE CONSIGNMENT BEING PRESENTED?

(Please tick √ Yes or No)

No.		Yes	No
1	Fireworks, ammunition, sporting ammunition, firearms, any weapons, explosives or other dangerous devices, articles or substances (as listed throughout), that may be used to commit an act of unlawful interference being carried through the consignment.		
2	Cylinders of compressed air, oxygen, liquid petroleum gas (LPG) or any type of aerosol can (e.g. deodorant, shaving cream, hair spray, paint, etc.)		
3	Camping stoves, cigarette / pipe lighters or cigarette lighter refills		
4	Nail polish, colognes, perfumes, paint, fuel or paint thinners		
5	Matches		
6	Dry ice, specimens or samples		
7	Detergents, bleaches, drain or oven cleaners		
8	Fibreglass repair kits, adhesives and puncture repair kits		
9	Medicines containing alcohol		
10	Any type of chemical, pesticides, herbicides, etc.		
11	Camping equipment		
12	Diving equipment		
13	Machinery with internal combustion engines such as chainsaws, lawnmowers or garden trimmers		

PLEASE NOTE: Under Part 119 of the Papua New Guinea Civil Aviation Rules and under the Laws that govern the transport of baggage and cargo worldwide, heavy penalties including imprisonment apply to shippers who do not declare dangerous goods in any item consigned to an airline.

IF YOU ARE UNSURE WHETHER AN ITEM YOU ARE CONSIGNING COULD BE CONSIDERED DANGEROUS GOODS PLEASE ASK OUR STAFF FOR ASSISTANCE.

Shipper's Name:

Shipper's Signature:

(Office use only)

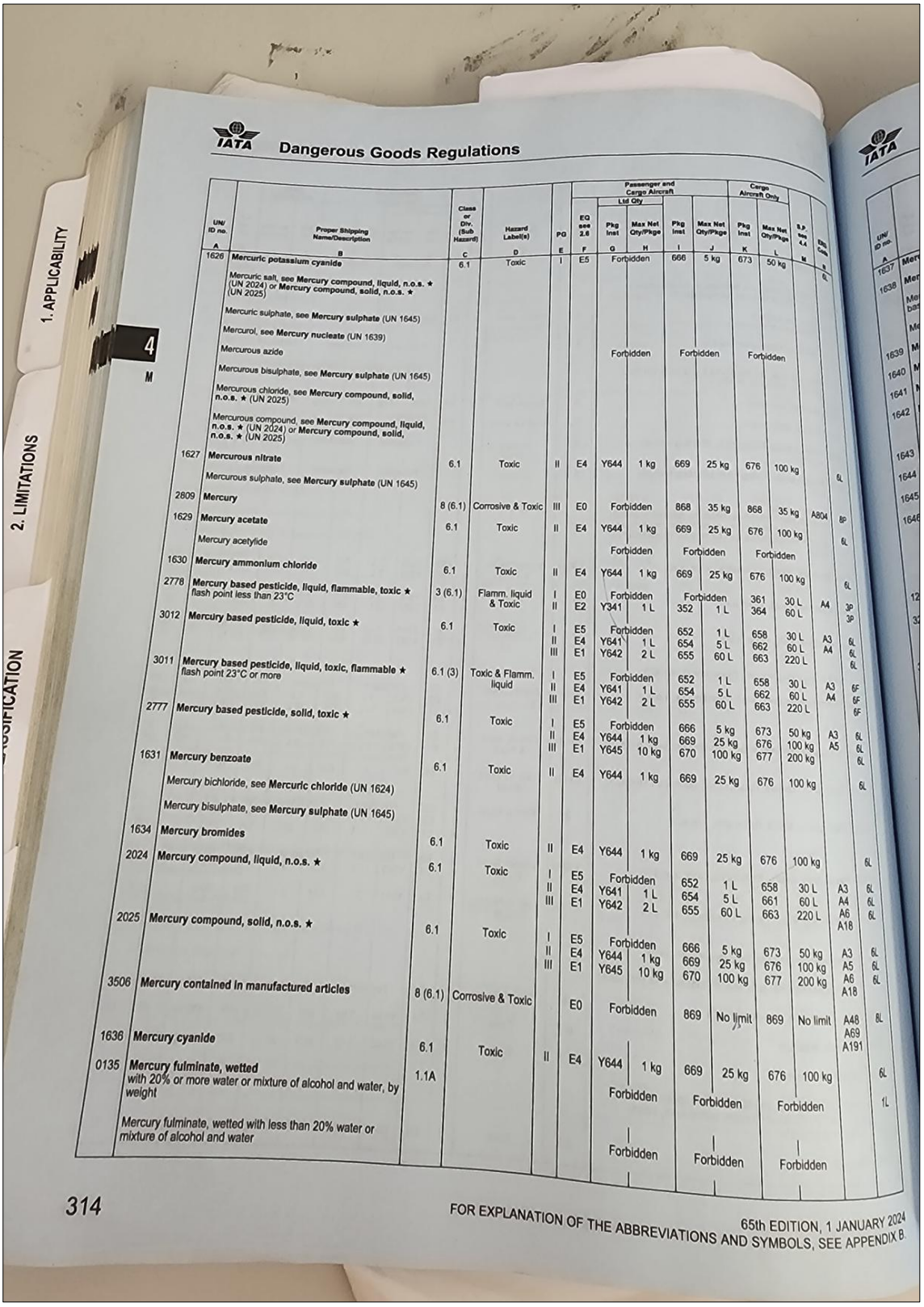
Air Waybill Number:

Additional Information:

ANG Code: SF0050

5.3 Appendix C

5.3.1 Mercury Information



IATA Dangerous Goods Regulations

UN/ ID no.	Proper Shipping Name/Description	Class or Div. (Sub Hazard)	Hazard Label(s)	PG	EQ see 2.6	Passenger and Cargo Aircraft Ltd Qty Pkg Inst	Passenger and Cargo Aircraft Ltd Qty Max Net Qty/Pkge	Passenger and Cargo Aircraft Pkg Inst	Passenger and Cargo Aircraft Max Net Qty/Pkge	Cargo Aircraft Only Pkg Inst	Cargo Aircraft Only Max Net Qty/Pkge	S.P. see 4.4	ERG Code
A	B	C	D	E	F	G	H	I	J	K	L	M	N
1626	**Mercuric potassium cyanide**	6.1	Toxic	I	E5	Forbidden		666	5 kg	673	50 kg		6L
	Mercuric salt, see **Mercury compound, liquid, n.o.s.** ★ (UN 2024) or **Mercury compound, solid, n.o.s.** ★ (UN 2025)												
	Mercuric sulphate, see **Mercury sulphate** (UN 1645)												
	Mercurol, see **Mercury nucleate** (UN 1639)												
	Mercurous azide					Forbidden		Forbidden		Forbidden			
	Mercurous bisulphate, see **Mercury sulphate** (UN 1645)												
	Mercurous chloride, see **Mercury compound, solid, n.o.s.** ★ (UN 2025)												
	Mercurous compound, see **Mercury compound, liquid, n.o.s.** ★ (UN 2024) or **Mercury compound, solid, n.o.s.** ★ (UN 2025)												
1627	**Mercurous nitrate**	6.1	Toxic	II	E4	Y644	1 kg	669	25 kg	676	100 kg		6L
	Mercurous sulphate, see **Mercury sulphate** (UN 1645)												
2809	**Mercury**	8 (6.1)	Corrosive & Toxic	III	E0	Forbidden		868	35 kg	868	35 kg	A804	8P
1629	**Mercury acetate**	6.1	Toxic	II	E4	Y644	1 kg	669	25 kg	676	100 kg		6L
	Mercury acetylide					Forbidden		Forbidden		Forbidden			
1630	**Mercury ammonium chloride**	6.1	Toxic	II	E4	Y644	1 kg	669	25 kg	676	100 kg		6L
2778	**Mercury based pesticide, liquid, flammable, toxic** ★ flash point less than 23°C	3 (6.1)	Flamm. liquid & Toxic	I	E0	Forbidden		Forbidden		361	30 L	A4	3P
				II	E2	Y341	1 L	352	1 L	364	60 L		3P
3012	**Mercury based pesticide, liquid, toxic** ★	6.1	Toxic	I	E5	Forbidden		652	1 L	658	30 L	A3	6L
				II	E4	Y641	1 L	654	5 L	662	60 L	A4	6L
				III	E1	Y642	2 L	655	60 L	663	220 L		6L
3011	**Mercury based pesticide, liquid, toxic, flammable** ★ flash point 23°C or more	6.1 (3)	Toxic & Flamm. liquid	I	E5	Forbidden		652	1 L	658	30 L	A3	6F
				II	E4	Y641	1 L	654	5 L	662	60 L	A4	6F
				III	E1	Y642	2 L	655	60 L	663	220 L		6F
2777	**Mercury based pesticide, solid, toxic** ★	6.1	Toxic	I	E5	Forbidden		666	5 kg	673	50 kg	A3	6L
				II	E4	Y644	1 kg	669	25 kg	676	100 kg	A5	6L
				III	E1	Y645	10 kg	670	100 kg	677	200 kg		6L
1631	**Mercury benzoate**	6.1	Toxic	II	E4	Y644	1 kg	669	25 kg	676	100 kg		6L
	Mercury bichloride, see **Mercuric chloride** (UN 1624)												
	Mercury bisulphate, see **Mercury sulphate** (UN 1645)												
1634	**Mercury bromides**	6.1	Toxic	II	E4	Y644	1 kg	669	25 kg	676	100 kg		6L
2024	**Mercury compound, liquid, n.o.s.** ★	6.1	Toxic	I	E5	Forbidden		652	1 L	658	30 L	A3	6L
				II	E4	Y641	1 L	654	5 L	661	60 L	A4	6L
				III	E1	Y642	2 L	655	60 L	663	220 L	A6	6L
2025	**Mercury compound, solid, n.o.s.** ★	6.1	Toxic	I	E5	Forbidden		666	5 kg	673	50 kg	A18	
				II	E4	Y644	1 kg	669	25 kg	676	100 kg	A3	6L
				III	E1	Y645	10 kg	670	100 kg	677	200 kg	A5	6L
3506	**Mercury contained in manufactured articles**	8 (6.1)	Corrosive & Toxic		E0	Forbidden		869	No limit	869	No limit	A6	6L
1636	**Mercury cyanide**	6.1	Toxic	II	E4	Y644	1 kg	669	25 kg	676	100 kg	A18	
0135	**Mercury fulminate, wetted** with 20% or more water or mixture of alcohol and water, by weight	1.1A				Forbidden		Forbidden		Forbidden		A48 A69 A191	8L
	Mercury fulminate, wetted with less than 20% water or mixture of alcohol and water					Forbidden		Forbidden		Forbidden			6L 1L

1. APPLICABILITY
2. LIMITATIONS
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FOR EXPLANATION OF THE ABBREVIATIONS AND SYMBOLS, SEE APPENDIX B.

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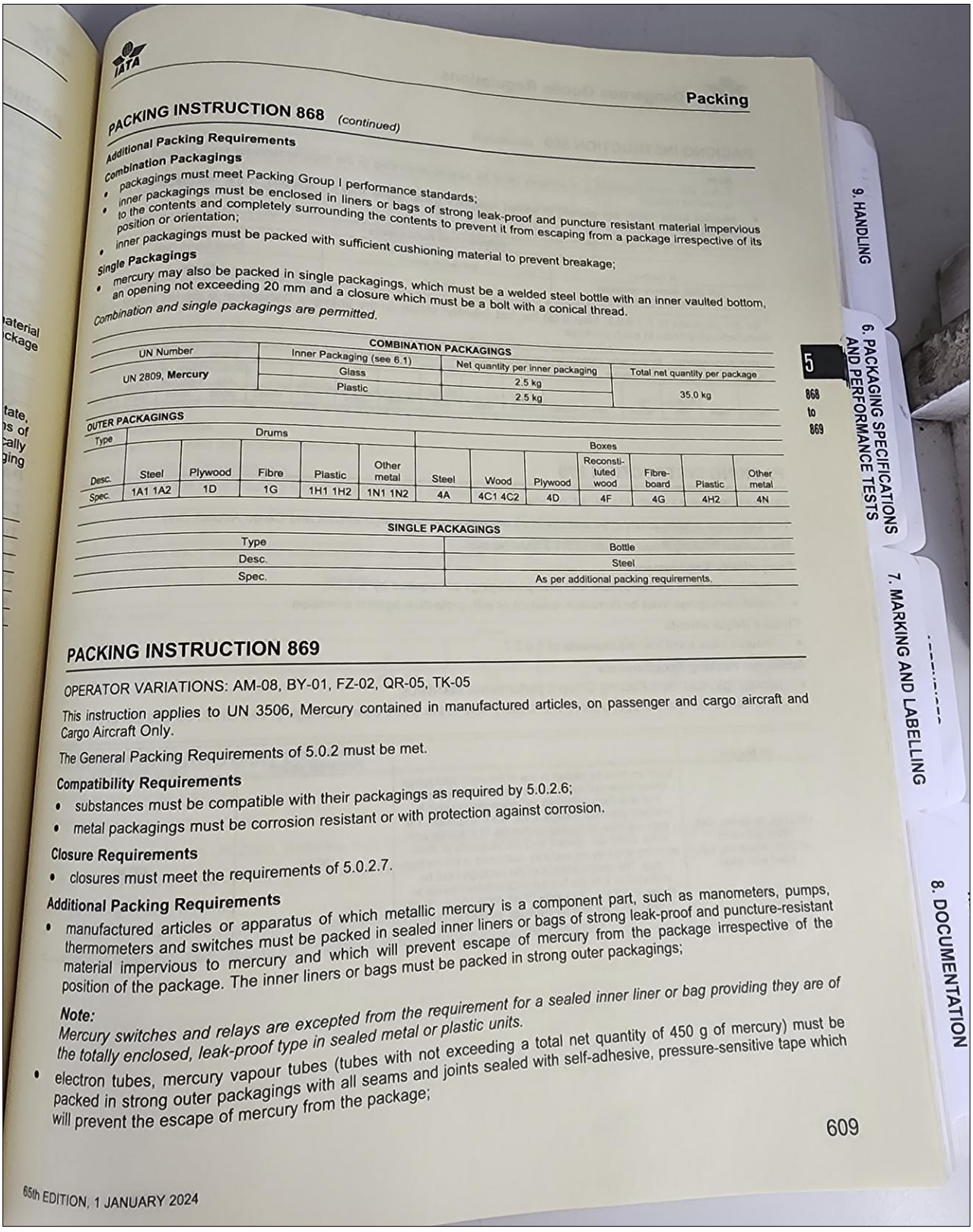
5.3.2 Packing Instruction 868



IATA

Packing

PACKING INSTRUCTION 868 *(continued)*

Additional Packing Requirements

Combination Packagings

- packagings must meet Packing Group I performance standards;
- inner packagings must be enclosed in liners or bags of strong leak-proof and puncture resistant material impervious to the contents and completely surrounding the contents to prevent it from escaping from a package irrespective of its position or orientation;
- inner packagings must be packed with sufficient cushioning material to prevent breakage;

Single Packagings

- mercury may also be packed in single packagings, which must be a welded steel bottle with an inner vaulted bottom, an opening not exceeding 20 mm and a closure which must be a bolt with a conical thread.

Combination and single packagings are permitted.

COMBINATION PACKAGINGS			
UN Number	Inner Packaging (see 6.1)	Net quantity per inner packaging	Total net quantity per package
UN 2809, **Mercury**	Glass	2.5 kg	35.0 kg
	Plastic	2.5 kg	

OUTER PACKAGINGS												
Type	Drums					Boxes						
Desc.	Steel	Plywood	Fibre	Plastic	Other metal	Steel	Wood	Plywood	Reconsti-tuted wood	Fibre-board	Plastic	Other metal
Spec.	1A1 1A2	1D	1G	1H1 1H2	1N1 1N2	4A	4C1 4C2	4D	4F	4G	4H2	4N

SINGLE PACKAGINGS	
Type	Bottle
Desc.	Steel
Spec.	As per additional packing requirements.

PACKING INSTRUCTION 869

OPERATOR VARIATIONS: AM-08, BY-01, FZ-02, QR-05, TK-05

This instruction applies to UN 3506, Mercury contained in manufactured articles, on passenger and cargo aircraft and Cargo Aircraft Only.

The General Packing Requirements of 5.0.2 must be met.

Compatibility Requirements

- substances must be compatible with their packagings as required by 5.0.2.6;
- metal packagings must be corrosion resistant or with protection against corrosion.

Closure Requirements

- closures must meet the requirements of 5.0.2.7.

Additional Packing Requirements

- manufactured articles or apparatus of which metallic mercury is a component part, such as manometers, pumps, thermometers and switches must be packed in sealed inner liners or bags of strong leak-proof and puncture-resistant material impervious to mercury and which will prevent escape of mercury from the package irrespective of the position of the package. The inner liners or bags must be packed in strong outer packagings;

  Note:
  Mercury switches and relays are excepted from the requirement for a sealed inner liner or bag providing they are of the totally enclosed, leak-proof type in sealed metal or plastic units.

- electron tubes, mercury vapour tubes (tubes with not exceeding a total net quantity of 450 g of mercury) must be packed in strong outer packagings with all seams and joints sealed with self-adhesive, pressure-sensitive tape which will prevent the escape of mercury from the package;

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5 868 to 869

9. HANDLING
6. PACKAGING SPECIFICATIONS AND PERFORMANCE TESTS
7. MARKING AND LABELLING
8. DOCUMENTATION