REPUBLIC OF RWANDA

Ministry of Infrastructure

Aviation Accident and Incident Investigation Directorate General

Final Investigation Report on the incident to the Airbus A330-300 with registration 9XR-WP, operated by RwandAir, involving unsecured Dangerous Goods in flight on 17th February 2023.

The sole objective of investigations carried out by the AAID is the prevention of accidents and incidents. It shall not be the purpose of such an investigation to apportion blame or liability.

Ref AAID [2023-01]

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List of abbreviations used in this report

Acronym	Full name
AAID	Aviation Accident and Incident Investigation Directorate
BRU	Three letter code for Brussels International Airport
CBTA	Competency Based Training Assessment
IATA	International Air Transport Association
ICAO	International Civil Aviation Authority
KGL	Three letter code for Kigali International Airport
NOTOC	Notification to Captain
SARPs	Standards and Recommended Practices
SPIs	Safety Performance Indicators
RCARs	Rwanda Civil Aviation Regulations
UN	United Nations
UTC	Universal Time Coordinated
WB 700	RwandAir Kigali to Brussels Flight Number

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Synopsis

On 17th February 2023, RwandAir, Airbus A330-300 Registered 9XR-WP conducted the scheduled flight from Kigali to Brussels carrying 102 Passengers and cargo that included Dangerous Goods. The dangerous Goods carried were UN2795 - Batteries wet filled with alkali, UN 1072- Oxygen compressed and UN 1044- Fire extinguisher.

The flight was uneventful and arrived at Brussels on 18th February 2023 where a loader identified that dangerous goods were not secured. During loading at Kigali International Airport, dangerous goods were properly labelled, packaged, loaded, segregated and separated as required but were not secured in the aircraft in line with the required standards.

In the course of investigation, AAID identified the findings, contributing factors and established that the root cause of the incident as the lack of practical knowledge in relation to the securing of dangerous goods in the cargo holds of the aircraft.

During investigation, AAID formulated five (5) Safety Recommendations addressed to RwandAir and Rwanda Civil Aviation Authority in order to prevent the recurrence of similar incident.

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 General

On 17th February 2023, an A330-300, registered 9XR-WP, conducted Flight WB 700. The flight departed from Kigali International Airport (KGL), Rwanda at 22:26[1] and arrived at Brussels, Belgium on 18th February at 07:07 in the morning.

The flight had 102 Passengers on board and General cargo in its cargo compartment that included dangerous goods (Batteries wet filled with alkali, Oxygen compressed and fire extinguishers).

The dangerous goods UN 2795 –Batteries wet filled with alkali, UN 1072- Oxygen compressed and UN 1044- Fire extinguishers were labelled, packaged, loaded, segregated and separated as required but were not secured in the aircraft in line with Rwanda Civil Aviation Regulations part 18, ICAO Doc 9284 Technical instructions, IATA Dangerous Goods Regulations and RwandAir Dangerous Goods Program Manual[2].

Fire extinguishers UN 1044 loaded was of 20kg net weight and the Oxygen compressed cylinders mentioned above, UN 1072, were empty.

1.1.2 Loading and Securing Dangerous Goods of Flight WB700 in Cargo Holds

The dangerous goods were declared, packaged and labelled in accordance with the required standards. However, during loading the Dangerous Goods were segregated, separated but left as loose cargo which were not secured in the aircraft cargo holds to prevent any movement while in flight. The dangerous goods were put in H53 compartment of the cargo holds.

[1] All time are in UTC
[2] RwandAir Policies and Procedures manual governing carriage of dangerous goods



Figure 1: Unsecured dangerous goods in WB700 cargo holds.

1.1.3 Ground Stop at BRU

The KGL-BRU Flight WB 700 was uneventful and arrived at 07:06 on 18th Feb. 2023 at Brussels. While off-loading, staff at Brussels found that the dangerous goods on board were not secured in accordance with international standards.

1.1.4 Information obtained from Ramp Staff during interview

During the conduct of the investigation, Loaders, Ramp Manager and Ramp Supervisor were interviewed and stated that, on that particular flight WB 700, dangerous goods were handled the same way they have been doing it, and it is the way they were trained. The NOTOC was prepared and handed over to the Captain as required.

1.2 Injuries to persons[3]

The incident did not result in any injuries to persons.

[3] This report follows the paragraph numbering according to Appendix 1 of ICAO Annex 13. Paragraphs numbers that are not listed, are not applicable to this investigation.

1.3 Damage to aircraft

Through the notification WB/CEO/02/23/046 provided by RwandAir, after landing at Brussels, inspection was conducted and no damage to aircraft was found.

1.6 Aircraft information

Manufacturer	Airbus
Type	A330-300
Manufacturer's Serial Number	1759
Registration	9XR-WP
Engines	MODEL: TRENT 772B-60 - LH Engine serial number; 42756 - RH Engine serial number; 42757
Date of manufacture	30th November 2016
Certificate of airworthiness	Date of issue: 29 November 2022 Date of expiry: 30 November 2023

1.7 Meteorological Information

Meteorological conditions were not a factor in this incident.

1.17 Organisational and Management Information

1.17.1. Notification of occurrence

The occurrence happened on 17th February 2023 however, the flight crew Air Safety record showed it was logged in on 22nd February 2023. RwandAir provided notification of this occurrence to AAID on 28th February 2023.

1.17.2. Training Requirements Related to Handling Dangerous Goods

RwandAir ramp staff who loaded the aircraft had valid certificates. However, training program and training plans for dangerous goods do not contain trainings on securing of dangerous goods.

RwandAir's Dangerous Goods Program Manual stipulates in section 2.26 (m) Employee Training Programs that *"technical personnel will receive training as prescribed by the Technical Instructions and the Authority"*. RCAR Part 18.085 (d) requires operators to train technical personnel responsible for handling dangerous goods tasks and keep their training records updated prior to their performance of duties related to transport of dangerous goods by air.

The relevant basis for handling dangerous goods is defined in the RwandAir Dangerous Goods Program Manual which requires trainings to be conducted in accordance with RCAR Part 18, ICAO DOC 9284 and IATA DGR. However, RwandAir training program and plan, did not address these standards that require the operator to train how to secure dangerous goods in the aircraft cargo holds in such way that will not make any movement in flight.

1.17.3. Rwanda Civil Aviation Regulations

Rwanda Civil Aviation Regulation Part 18 was developed in line with ICAO Annex 18 SARPs. However, it has not been "updated" in accordance with current ICAO technical instructions as required by standard 10.1[4] of ICAO Annex 18. The requirement for updating the dangerous goods training program is found in ICAO DOC 10147 "Guidance on Competency-based Approach to Dangerous Goods Training and Assessment."

[4] ICAO Annex 18 - Standard 10.1: "Initial and recurrent dangerous goods training programmes shall be established and maintained in accordance with the Technical Instructions."

2. ANALYSIS

2.1. Introduction

Dangerous goods are required to be secured by Rwanda civil aviation regulations part 18[5], ICAO Doc 9284[6] Technical instructions, IATA Dangerous Goods Regulations, and RwandAir Dangerous Goods Program manual in the cargo holds of the aircraft.

2.2. Risk Associated with Dangerous Goods UN 2795

The standards in place require securing of dangerous goods including Batteries Wet, filled with Alkali which are harmful to human and animal health while transported by aircraft. UN 2795 (Batteries wet, filled with Alkali) is corrosive to the aircraft as it carries a Class 8 Corrosive label. The risk associated with the transportation of Batteries Wet, filled with Alkali, is minimized to acceptable level by securing them in order to prevent any movement in the aircraft during flight.



Figure 2: Class 8 Corrosive Dangerous Goods

[5] RCAR Part 18- Transport of Dangerous Goods by Air Regulations- Ministerial Order N°01/CAB.M/019 OF 06/02/2019

[6] ICAO DOC 9284 - Technical Instructions for the Safe Transport of Dangerous Goods by Air

2.3. Transportation of Oxygen compressed Cylinders and Fire Extinguishers

Oxygen compressed cylinders are considered as low risk based on the unlikelihood of causing an incident or accident. However, the standard for transportation of oxygen compressed cylinders should be complied with to prevent any potential for causing an incident.

The fire extinguishers are also considered hazardous substances with low risk when shipped in accordance with the regulatory standards. The maximum allowable weight of fire extinguisher of UN1044 type to be carried on passenger flight is maximum of 75kg[7]. The fire extinguishers carried in WB700 was 20kg net quantity.



Figure 3:UN1044 Class 2 Dangerous Goods, Non-flammable Fire extinguisher



Figure 4: UN 1072 Class 2 Dangerous Goods, Non-flammable Compressed Oxygen

2.4. Technical Guidance Materials related to The Handling of Dangerous Goods

RwandAir has approved Dangerous Goods Program Manual that is supposed to guide technical personnel how to properly handle dangerous goods in line with IATA regulations, RCAR Part 18 Regulations and ICAO Dangerous Goods Technical Instructions (DOC 9284) requirements. However, it does not provide

[7] Table 4.2.F, page 252, IATA DGR Regulations

guidance on how dangerous goods are required to be secured in the aircraft cargo holds to prevent it from any movement.

The initial and recurrent training program and plan have been developed and implemented but the practical trainings on how dangerous goods are secured are not incorporated.

According to IATA Dangerous Goods regulations, *"… The operator must protect the packages of dangerous goods from being damaged including by the movement of baggage, mail, stores or other cargo. Particular attention must be paid to the handling of packages during their preparation for transport, the type of aircraft on which they are to be carried and the method required to load that aircraft_so that accidental damage is not caused through dragging or mishandling of the packages. The operator must secure dangerous goods in the aircraft in a manner that will prevent any movement….."*[8]

In addition, RCARs 18.210 requires the operator to secure dangerous goods in the aircraft in such way that will not make any movement in flight. RwandAir Dangerous Goods Program Manual, Section 2.58 highlights securing of Dangerous Goods but the procedures do not clearly guide how dangerous goods are supposed to be secured.

2.5. Competency-Based Approach to Dangerous Goods Training and Assessment

The implementation of a competency-based approach to training and assessment has been recognised as the main reliable means to achieve a safe and efficient air transport system through depending on a competent workforce. The ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO Doc 9284, "Technical Instructions*") "require the employers to ensure personnel are competent to perform any function for which they are responsible prior to performing it."*

A competent workforce reduces the costs caused by poor performance or miscommunication of job expectations. The consequences of employing an

[8] IATA Dangerous Goods Regulations Section 9.3.5 Paragraph 1&2, 57th Edition, 1 January 2016

incompetent dangerous goods workforce can be especially damaging, as this could result in costs and even more critically result in safety risks to aircraft and its occupants. A competency-based approach to training and assessment is an effective way to ensure that the application of loading and securing dangerous goods required standards in relation to segregation, separation, orientation, securing and protecting from damage is met.

In line with ICAO competency-based approach to training and assessment, the operator is responsible for ensuring the effectiveness of the training programme. At the end of a period of training, feedback on performance on the job from trainees, instructors, assessors and employers should be gathered to determine the effectiveness of the training and assessment in supporting the progression of learning towards competence in the workplace.

The evaluation of the training should be based on valid and reliable evidence such as course results, trainee feedback, instructor feedback, audit reports, and occurrence reports. The evaluation may lead to changes or improvements being made to the competency-based training and assessment design.

2.6. Compliance to the Rwanda Civil Aviation Regulations Part 18

RwandAir Ramp staff who loaded the dangerous goods in cargo holds of the aircraft stated, that after separating and segregating them, they believed that it was enough for their safe transport by air as they have been doing it.

In the course of investigation, AAID determined that RwandAir Ramp staff did not know how there were supposed to secure the dangerous goods after loading them in the cargo holds of the aircraft. This resulted from improper training received, that did not clearly define how the dangerous goods are supposed to be secured in the aircraft.

2.7. Concept of Practical Drift

Scott A. Snook's theory of practical drift is used to understand how performance of any system “drifts away” from its original design. Tasks, procedures, and equipment are often initially designed and planned in a theoretical environment, under ideal conditions, with an implicit assumption that nearly everything can be predicted and controlled, and where everything functions as expected. This is usually based on three fundamental assumptions that the technology needed to achieve the system production goals is available; personnel are trained, competent and motivated to properly operate the technology as intended; and policy and procedures will dictate system and human behaviour.

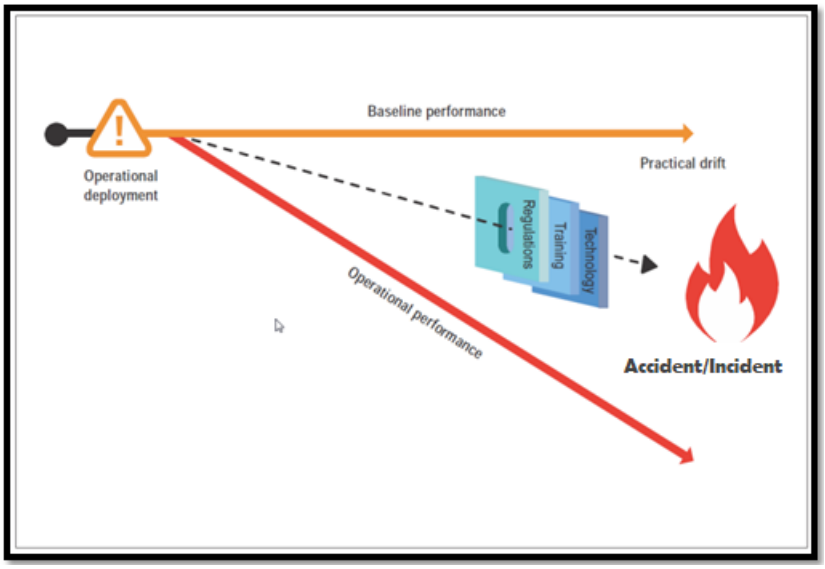


Figure 5: Concept of Practical Drift

Once operationally deployed, the system should ideally perform as designed, following baseline performance (orange line) most of the time.

In reality, the operational performance often differs from the assumed baseline performance as a consequence of real-life operations in a complex, ever-changing and usually demanding environment (red line). Since the drift is a consequence of daily practice, it is referred to as a “practical drift”. The term “drift” is used in this context as the gradual departure from an intended course due to external influences.

Snook contests that practical drift is inevitable in any system, no matter how careful and well thought out its design. Some of the reasons for the practical drift include:

a) technology that does not operate as predicted;
b) procedures that cannot be executed as planned under certain operational conditions;
c) changes to the system, including the additional components;
d) interactions with other systems;
e) safety culture
f) adequacy (or inadequacy) of resources (e.g. support equipment);
g) Learning from successes and failures to improve operations, and so forth.

The Concept further illustrates that in reality people will generally make the system work on a daily basis despite the system's shortcomings, applying local adaptations (or workarounds) and personal strategies. These workarounds may bypass the protection of existing safety risk controls and defences.

Safety assurance activities such as audits, observations and monitoring of SPIs can help to expose activities that are "practically drifting". Analysing the safety information to find out why the drift is happening helps to mitigate the safety risks. It would, however, be ideal to capture the drift at its inception, thus quickly returning to baseline performance and it is done through monitoring of operations. Daily operations should tell a story through data. The trick is capturing the right data at the right time and the closer to the beginning of the operational deployment that practical drift is identified, the easier it is for the operator to intervene.

3. CONCLUSIONS

3.1 Findings

3.1.1 RwandAir staff who handled the dangerous goods had valid certificates.

3.1.2 RwandAir training program and plan do not cover trainings related to the securing of dangerous goods in the aircraft.

3.1.3 The RwandAir technical staff who handle the dangerous goods stated that dangerous goods are secured by separating and segregating them in the aircraft cargo hold.

3.1.4 RwandAir dangerous goods instructors have valid certificates.

3.1.5 RwandAir training program and plan do not contain training on each aircraft type.

3.1.6 The occurrence was reported by RwandAir to AAID nine (9) days after the occurrence.

3.1.7 RCARs Part 18 is not updated in line with ICAO Technical Standards contained DOC 10147.

3.1.8. Loading Staff at Brussels, found Dangerous Goods not secured.

3.1.9. There were no aircraft damage associated with this incident

3.1.10. Dangerous Goods packages were found not damaged at Brussels Airport.

3.1.11. A NOTOC was prepared and handed over the Captain

3.1.12. Dangerous Goods were in range of the allowable weight as per standards.

3.2 Causal Factor

3.2.1 Lack of practical knowledge in relation to the securing of dangerous goods in the cargo holds of the aircraft is considered as the probable cause of the incident.

3.3 Contributing Factors

3.3.1 The AAID determines that failure to incorporate the trainings on how the dangerous goods are secured as prescribed in ICAO Technical Instructions and IATA regulations contributed to the cause of the incident**.**

3.3.2 RwandAir ramp personnel responsible for handling dangerous goods do not get proper trainings on how dangerous goods are secured and also lack of practical trainings on each aircraft type which led to inappropriate handling of the dangerous goods in the aircraft cargo holds.

4. SAFETY RECOMMENDATIONS

To: RwandAir

4.1. To ensure the Training Program and Plan on dangerous goods are developed in line with ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air and IATA Dangerous goods regulations in place.

4.2. To ensure dangerous goods practical trainings are conducted after theory to equip the staff with technical skills on how dangerous goods are secured to prevent any movement in the aircraft.

4.3. To ensure mandatory reportable occurrences are notified within timeframe as required by RCARs Part 19 and Part 30.

To: Rwanda Civil Aviation Authority

4.4. To ensure that ICAO directives of Competency Based Training Assessment (CBTA) are adapted in RCARs as required.

4.5. To enhance safety oversight activities in relation to the handling of dangerous goods that are transported by air.

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