

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 051/CENIPA/2016

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PP-MBN
MODEL:	AS-350B
DATE:	21MAR2016



NOTICE

According to the Law no 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination and execution of the activities of investigation and prevention of aeronautical accidents.

The elaboration of this Final Report was conducted taking into account the contributing factors and hypotheses raised. The report is, therefore, a technical document which reflects the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

The document does not focus on quantifying the degree of contribution of the different factors, including the individual, psychosocial or organizational variables that conditioned the human performance and interacted to create a scenario favorable to the accident.

The exclusive objective of this work is to recommend the study and the adoption of provisions of preventative nature, and the decision as to whether they should be applied belongs to the President, Director, Chief or the one corresponding to the highest level in the hierarchy of the organization to which they are being forwarded.

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree no 21713, dated 27 August 1946.

Thus, it is worth highlighting the importance of protecting the persons who provide information regarding an aeronautical accident. The utilization of this report for punitive purposes maculates the principle of “non-self-incrimination” derived from the “right to remain silent” sheltered by the Federal Constitution.

Consequently, the use of this report for any purpose other than that of preventing future accidents, may induce to erroneous interpretations and conclusions.

N.B.: This English version of the report has been written and published by the CENIPA with the intention of making it easier to be read by English speaking people. Taking into account the nuances of a foreign language, no matter how accurate this translation may be, readers are advised that the original Portuguese version is the work of reference.

SYNOPSIS

This is the Final Report of the 21MAR2016 accident with the AS-350B aircraft, registration PP-MBN. The accident was classified as “Fuel Exhaustion”.

During a passenger transport flight, in the municipality of Jaguaripe - BA, the aircraft presented an engine flame-out, due to fuel exhaustion, colliding against the ground in a dense vegetation area, characteristic of the Atlantic Forest.

The aircraft had substantial damage.

The pilot perished 25 days after the accident.

An Accredited Representative of the BEA - *Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile* – France (State where the aircraft was manufactured), was designated for participation in the investigation.



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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	(Brazil's) National Civil Aviation Agency
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CHT	Technical Qualification Certificate
CM	Registration Certificate
CMA	Aeronautical Medical Certificate
CTP	Main Gearbox
GRAER-BA	Bahia Military Police Air Group
IAC	Civil Aviation Instruction
IFR	Instrument Flight Rules
NR	Main Rotor Rotation
PCH	Commercial Pilot License - Helicopter
PPH	Private Pilot License - Helicopter
RBAC	Brazilian Civil Aviation Regulation
RBHA	Brazilian Regulation of Aeronautical Homologation
SAMU	Emergency Mobile Care Service
SNCL	ICAO location designator – Lorenzo Aerodrome, Morro de SP - BA
SIVB	ICAO location designator – Valença Aerodrome - BA
SERIPA II	Second Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accident Investigation and Prevention System
TPP	Private Air Service
UTC	Universal Coordinated Time
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	Model: AS-350B	Operator: Transp. Fox e Com. de Mad. Eireli-Me e Outros
	Registration: PP-MBN	
	Manufacturer: Eurocopter France	
Occurrence	Date/time: 21MAR2016 -1245 UTC	Type(s): "Fuel Exhaustion"
	Location: Out of the Aerodrome	
	Lat. 13°06'50"S Long. 038°57'50"W	Subtype(s): Nil.
	Municipality – State: Jaguaripe - BA	

1.1 History of the flight.

The aircraft took off from a space reserved for an open market, in the municipality of Nazaré - BA, to the Lorenzo Aerodrome, in the municipality of Morro de São Paulo (SNCL) - BA, at about 09:35, in order to transport personnel, with one pilot and three passengers on board.

Before proceeding to the destination, the aircraft made a local flight over the city of Nazaré.

In route, the aircraft lost altitude and collided against the ground in an area of dense vegetation, characteristic of the Atlantic Forest, in the municipality of Jaguaripe – BA.

The aircraft had substantial damage.

The pilot suffered serious injuries and died 25 days after the accident. Two passengers suffered minor injuries and one passenger left the accident unharmed.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	1	-	-
Serious	-	-	-
Minor	-	2	-
None	-	1	-

1.3 Damage to the aircraft.

The aircraft suffered substantial damage in the commander / passengers' cabin, in the landing gear, rotors, tail cone and in the horizontal and vertical stabilizers.

The engine, the main gearbox (CTP) and the rear axle of the transmission had minor damages.

1.4 Other damage.

Nil.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	
	Pilot
Total	151:20
Total in the last 30 days	Unknown
Total in the last 24 hours	Unknown
In this type of aircraft	32:46
In this type in the last 30 days	Unknown
In this type in the last 24 hours	Unknown

N.B.: The Data on flown hours were obtained through the SACI / ANAC system. Information on flight hours could not be obtained from third parties.

1.5.2 Personnel training.

The pilot took the Private Pilot course - Helicopter (PPH) at the *Edra Aeronáutica Escola de Aviação*, Ipeúna - SP, in 2013.

1.5.3 Category of licenses and validity of certificates.

The pilot had the Commercial Pilot License - Helicopter (PCH) and had valid Aircraft Technical Qualification for the AS-350B type.

1.5.4 Qualification and flight experience.

The pilot was qualified and had about 150 total flight hours.

1.5.5 Validity of medical certificate.

The pilot had valid Aeronautical Medical Certificate (CMA).

1.6 Aircraft information.

The aircraft, serial number 2499, was manufactured by Eurocopter France in 1991 and was registered in the Private Air Service (TPP).

The aircraft had valid Airworthiness Certificate (CA).

The Investigation Committee did not have access to the airframe, engine and rotors logbooks.

The last inspection of the aircraft, the "airframe eventual of 02 and 03 hours type", was performed on 27JAN2016, according to information provided by HBR - *Helibase Serviços Comércio e Manutenção Aeronáutica Ltda.*, Osasco, SP. The Information on hours flown after the inspection is unknown.

The last revision of the aircraft, the IAM / 5000H / 72M type, was made on 18DEC2015, according to information provided by HBR - *Helibase Serviços Comércio e Manutenção Aeronáutica Ltda.* The information regarding the hours flown after the inspection is unknown.

1.7 Meteorological information.

Nil.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The occurrence took place outside the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

At the site of the accident, evidence showed that the helicopter dragged itself about 15 meters above the vegetation (Figure 1) until full stop, landing with the right side facing the ground and nose pointing south.

The impact was concentrated on the right side of the aircraft (Figure 2).



Figure 1 - View of aircraft trajectory.



Figure 2 - Positioning of the aircraft after full stop.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Nil.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Nil.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

The pilot and passengers were removed from the wreckage of the aircraft with the help of common people and, after receiving the first aid from the Fire Department and SAMU, they were taken to the hospitals in Salvador through helicopters of the Bahia Military Police Air Group (GRAER-BA).

The pilot had multi-traumatism and died 25 days after the accident due to the worsening of the injuries. Two passengers suffered minor injuries and one passenger left unharmed.

1.16 Tests and research.

To carry out the investigation at the site of the accident, the SERIPA II investigators had the participation of a representative from HELIBRAS.

The main rotor blades (Figure 3) showed no significant impact on the leading edge. The observed damages were not characteristic of impact with power (torque and NR).



Figure 3 - Main rotor blades without impact on the leading edge.

The components of the main rotor head (Figure 4) showed little damage. The general state of the main rotor head indicated that the impact of the blades occurred with low rotational energy.



Figure 4 - main rotor head.

The main rotor pitch control rods (Figure 5) were connected and there was no damage due to wire or ground impact.



Figure 5 - Main rotor blade pitch control rod.

The connection between the engine and the CTP was not damaged (Figure 6). The state of the components of this coupling suggested that, at the time of the accident, the impact of the main rotor blades on the ground occurred when the engine of the aircraft was with low power.

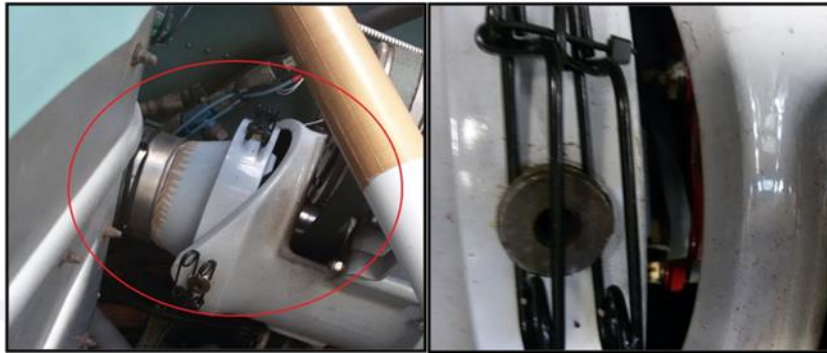


Figure 6 - Connection between the engine and the CTP.

The coupling of the connecting shaft between the engine and the drive shaft of the tail rotor was normal (Figure 7). The absence of damage in the component indicated that the contact of the tail rotor blades with some obstacle occurred when the engine was with low power.



Figure 7 - Coupling of the connecting shaft with the drive shaft of the tail rotor.

The tail rotor drive shaft (Figure 8) showed normal conditions with no signs of damage or reaction stress due to the impact of the tail rotor blades with the ground.



Figure 8 - Tail rotor drive shaft.

The tail rotor blades did not show signs of significant impact (Figure 9). The observed damages were not characteristic of impact with the engine developing power.



Figure 9 - Tail rotor blades.

At the crash site, there was no characteristic smell and no signs of fuel leakage. The aircraft had the left side up and the reservoir nozzle was preserved (Figure 10).



Figure 10 - Preserved Reservoir nozzle.

The fuel system, including the tank, remained intact after the accident.

The fuel pump outlet hose has been removed (Figure 11). There was no fuel in the hose.



Figure 11 - Fuel hose.

It was also observed that there was no fuel in the fuel filter housing (Figure 12).



Figure 12 - View of the housing of the fuel filter element.

In the tank of the aircraft, there were approximately 1.75 liters of fuel (Figure 13).

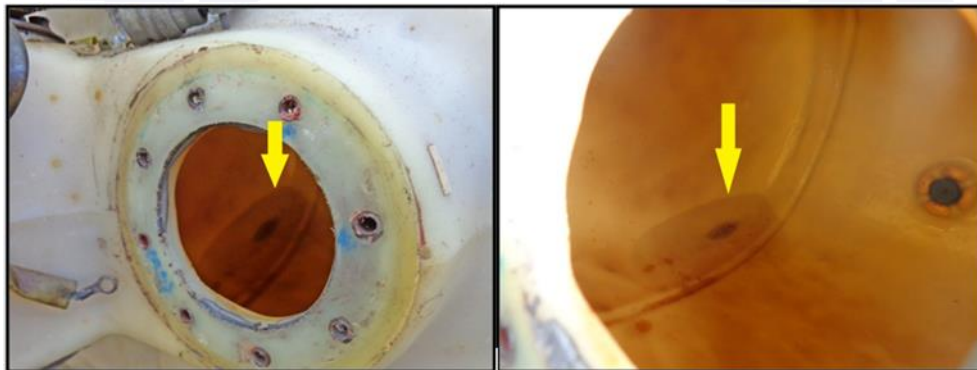


Figure 13 - Views of the remaining fuel in the tank.

1.17 Organizational and management information.

The aircraft was registered as Private Air Services (TPP) and operated under the rules of RBHA 91. According to ANAC records, the aircraft was owned/was operated by *Transp. Fox e Com. de Mad. Eireli-Me e Outros*, located in the city of Piên - PR.

The pilot involved in the accident was the owner of the company, being responsible for dealing with matters inherent to the maintenance and operation of the helicopter.

1.18 Operational information.

The aircraft was within the weight and balance parameters specified by the manufacturer.

According to information gathered through the Civil Aviation System, since the 10JAN2016, the aircraft already operated in the region among the cities of Salvador, Simões Filho, Morro de São Paulo, Nazaré and Valença (Figure 14).



Figure 14 - Region in which the aircraft had operated in the last days.

According to information gathered, in recent days, the aircraft had stayed overnight at the Valença Aerodrome (SNVB).

On 18MAR2016, the aircraft was refueled with 180 liters of fuel, at 17:49 pm (local), in the city of Valença - BA.

On 20MAR2016, the aircraft was refueled with 100 liters of fuel, at 14:07 (local time), in the city of Valença - BA.

The total capacity of the aircraft's fuel tank was 540 liters.

The low fuel level warning system triggered the "COMB" light when the amount of fuel reached approximately 60 liters in the tank.

The Service Instructions of the Complementary Flight Manual, in Section 8.2, page 1, of model AS-350B aircraft, established that the volume of fuel not usable was 1.25 liter.

According to information provided by another pilot who operated the aircraft on 18MAR2016, on that date, the pilot involved in the accident assumed the operation of the helicopter with the Fuel Quantity Indicator showing 40% (216 liters) of fuel in the tank and the fuel indication system was operating properly.

There was no record of failure of the fuel quantity indication system in the aircraft logbook.

It was not possible to identify whether, at the time of the accident, the fuel quantity indication system was defective.

For flight planning purposes, the aircraft's cruising speed was considered to be 120 kt.

1.19 Additional information.

The pilot had been away from his family for some time and, according to information gathered, in recent months, he had operated the aircraft in different regions of the country.

A few days before the accident, still in March, the pilot had informed a relative about his possible trip to Pernambuco, where he would sign a contract. At the time, he commented that he was in financial difficulties, including staying in hotels / inns in the region of Morro de São Paulo.

On the day of the accident, after taking off from the city of Nazaré - BA, and before proceeding to Lorenzo's Aerodrome in Morro de São Paulo - BA, the aircraft made a local flight over the city of Nazaré, having crashed against a power grid wire (Figures 16 and 17). This wire crossed the area where the open market in that city took place, and which

coincided with the place used for takeoff. Despite this fact, after the collision, the aircraft continued the flight.



Figure 16 - Wire reached by the aircraft (already repaired).



Figure 17 - Sketch of takeoff / collision site with the wire.

Between the area where the collision with the wire happened and the location of the accident, the aircraft covered a distance of 5,15 NM.

The last records listed in the aircraft logbook, found in the accident site, were from 26DEC2015.

The aircraft's supply nozzle did not show evidence of violation that suggested the withdrawal of fuel from the tank by third parties in the period between the accident and the initial action.

Regarding the flight performance under VFR conditions with helicopters, RBHA 91 established in item "b" of item 91.151 (Fuel Requirements for VFR flights) that:

"No person may start a VFR flight in a helicopter unless, considering wind and weather conditions, there is sufficient fuel to fly to the first landing site and, assuming normal cruise consumption, to fly for at least 20 minutes."

Regarding the completion of the Logbook of the aircraft, IAC 3151 establishes in its item 9.3 (Fill in the logbook by the crew) that:

"The Logbook shall be filled in, in such a way that all data relating to a flight step are completed and signed by the commander of the aircraft prior to the departure of the aircraft crew and after the end of the flight."

Regarding the requirements for the realization of daytime VFR flights, RBHA 91 established in subsection 12 from item "b" of item 91.205 that, in order to fly VFR during the day, the fuel quantity indicators, indicating the amount of fuel in each tank, were required.

On the fuel management, determining the functional measurement, it was included in the aircraft's Complementary Flight Manual (Chapter 8.2, paragraph 5, page 3):

- Place the helicopter on a level surface.
- Check, on the fuel gauge, the quantity of fuel remaining in the tanks.
- Observe the following safety precautions:
- Fill the tanks, monitoring the quantity of fuel delivered on the bowser flow meter.
- Position and lock the filler plug, using the key.
- Check that the difference in the aircraft fuel gauge readings, corresponds to the quantity of fuel delivered and determine the corresponding weight.

The Service Letter 1215-28-94, issued by EUROCOPTER on 20JUL1994, endorsed the procedures described above, established through the aircraft's Complementary Flight Manual.

The Service Letter 1215-28-94 was applicable to aircraft AS-350 versions B, D, B1, L1, B2 and BA.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

The accident happened after the aircraft took off from the city of Nazaré - BA, to the Lorenzo Aerodrome (SNCL), located on the third beach of Morro de São Paulo - BA.

Before proceeding to the destination, the aircraft carried out a local flight over the city of Nazaré, and collided with a power grid wire that crossed the area used for the open market of that city.

Despite this fact, after the collision, the aircraft continued the flight.

En route, the aircraft lost altitude, colliding with the ground in an area of dense vegetation.

Between the area where the collision with the wire occurred and the location of the accident, the aircraft covered a distance of 5.15NM.

The following evidence showed that the impact of the helicopter on the ground occurred when the engine developed low power:

- the blades of the rotors (main and tail) had no characteristics of impact damage with power;
- the general state of the main rotor head indicated that the impact of the blades occurred with low rotational energy;
- the main rotor pitch control rods were connected;

- the coupling assemblies between the engine and the CTP showed no signs of damage characteristic of the engine reaction force at the moment of the impact of the blades; and

- the tail rotor drive shaft was in normal condition with no signs of damage or reaction stress due to the impact of the tail rotor blades with the ground.

The following evidences showed that the loss of power of the engine in flight occurred because of fuel exhaustion:

- there was no characteristic smell of fuel or evidence of a leak in or near the wreckage of the aircraft;

The amount of fuel found in the tank was not enough for the fuel system to keep the engine running.

The good general condition of the main rotor's pitch control rods reinforces the idea that the collision with the power grid wire did not cause damage that could compromise the operation of the aircraft to the point of contributing to the accident.

It was not possible to establish the adequate traceability of the last flights carried out by the aircraft. Although the reports of common people realize that the aircraft made daily flights in the region, the last records in the Logbook found at the site of the accident were from 26DEC2015, characterizing the non-compliance with the provisions of IAC 3151 - Logbook.

The fact that the aircraft made several flights between uncontrolled Aerodromes in the days prior to the accident also made it difficult to trace its movements.

When conducting flights at uncontrolled Aerodromes, the pilot / operator was aware that it would be difficult to ascertain the technical conditions of the crew and the helicopter by the civil aviation supervisory body. On that occasion, it could be verified the lack of updated records in the Logbook of the aircraft, in particular, regarding the flights performed and the fuel volumes used in the refueling.

It was not possible to identify whether, at the time of the accident, the fuel quantity indication system was faulty. This aspect refers to the possibility that the pilot decided to take off with insufficient amount of fuel to perform the flight, contrary to RBHA 91.

On the other hand, the lack of record of the hours flown and the amount of fuel supplied in the Logbook may have contributed to the loss of the pilot's situational awareness, leading him to conclude that there was enough fuel for the aircraft to make the intended flight .

The compliance with the Complementary Flight Manual (Chapter 8.2, Paragraph 5, Page 3), defining the verification of the functional fuel metering system each time the aircraft is refueled, would restore the pilot's situational awareness.

The operation of the aircraft with low fuel level may have been motivated by the financial difficulties experienced by the pilot.

The dynamics of the observed events refers to the absence of the managerial supervision of the operational activities involving that aircraft, since its pilot and operator consisted of the same person. This aspect was added to the lack of adherence to the operational rules / norms, conduct characterized by noncompliance with IAC 3151 and RBHA 91.

In this scenario, the helicopter started operating in an environment with little or no risk management, where barriers, such as the procedures established in the corresponding Complementary Flight Manual, were gradually transposed, leading to the accident.

3. CONCLUSIONS.

3.1 Facts.

- a) the pilot had valid Aeronautical Medical Certificate (CMA);
- b) the pilot had valid Aircraft Technical Qualification of AS-350B;
- c) the pilot was qualified and had approximately 150 total flight hours;
- d) the aircraft had valid Airworthiness Certificate (CA);
- e) the aircraft was within the weight and balance parameters;
- f) the Investigation Committee did not have access to the aircraft airframe, engine and rotor logbooks;
- g) the last records listed in the aircraft logbook were from 26DEC2015;
- h) the aircraft collided with a power grid wire when flying over the city of Nazaré - BA;
- i) the collision with the power grid wire did not cause damage that might compromise the operation of the aircraft;
- j) between the area of the collision with the wire and the location of the accident, the aircraft covered a distance of 5.15NM;
- k) the impact of the aircraft against the ground occurred with the engine developing low power;
- l) the engine's loss of power was due to lack of fuel;
- m) the aircraft had substantial damage;
- n) two passengers suffered minor injuries and another one left unharmed; and
- o) the pilot suffered serious injuries, dying 25 days after the accident.

3.2 Contributing factors.

- **Motivation – undetermined.**

The operation of the aircraft with low fuel level may have been motivated by the financial difficulties experienced by the pilot, favoring the inadequate control of the amount of fuel and the consequent failure of flight planning.

- **Flight indiscipline – a contributor.**

The lack of the updated record in the Logbook, in particular, referring to the volume of fuel supplied in the aircraft, characterized the non-compliance with regulation / operational rule (IAC 3151).

It was not possible to ascertain whether, prior to the flight, the pilot had precise knowledge of the volume of fuel in the aircraft. This fact would ratify the non-compliance with the operational regulations / standards (RBHA 91 and Complementary Flight Manual).

- **Piloting judgement – a contributor.**

By failing to use suitable instruments for the control of fuel supplied / consumed by the aircraft, the pilot failed to adequately assess the risks involved in flying under such circumstances.

- **Flight planning – a contributor.**

The fact that the takeoff occurred without the aircraft having enough fuel to reach its intended destination indicates that the flight planning failed.

- **Decision-making process – a contributor.**

The decision to proceed with the flight either after the collision with the power grid wire without the proper control of the fuel supplied / consumed by the aircraft demonstrated a sequence of inadequate assessments that exposed the aircraft and the pilot to unsafe operating conditions.

- **Managerial oversight – a contributor.**

The lack of follow-up of the aircraft's operations by someone who could identify the failures occurred in the planning and execution phases of the flights on time, contributed to the accident.

4. SAFETY RECOMMENDATION.

A measure of preventative/corrective nature issued by a SIPAER Investigation Authority or by a SIPAER-Link within respective area of jurisdiction, aimed at eliminating or mitigating the risk brought about by either a latent condition or an active failure. It results from the investigation of an aeronautical occurrence or from a preventative action, and shall never be used for purposes of blame presumption or apportion of civil, criminal, or administrative liability.

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of the air activity operational safety, and shall be treated as established in the NSCA 3-13 “Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State”.

Recommendations issued at the publication of this report:

To the Brazil's National Civil Aviation Agency (ANAC):

A-051/CENIPA/2016 - 01

Issued on 27/07/2018

Disseminate the lessons learned in this investigation by seeking to alert operators and pilots of the AS-350 Esquilo to the risks arising from the non-compliance with the procedures in the Complementary Flight Manual (Chapter 8.2, paragraph 5, page 3), especially with regard to management of supplied and consumed fuel, and the non-compliance with items 151 and 205 of RBHA 91.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

Nil.

On July 27th, 2018.