

DATA SUMMARY

LOCATION

Date and time	Friday, 5 September 2003; 10:00 h local
Site	Renedo de Esgueva (Valladolid)

AIRCRAFT

Registration	N3574M
Type and model	Aerostar (Raven) RX-7, s/n RX7-3203

Engines

Type and model	N/A
Number	N/A

CREW

Pilot in command

Age	32 years
Licence	Balloon Pilot
Total flight hours	83 hours
Flight hours on the type	67 hours

INJURIES

	Fatal	Serious	Minor
Crew		1	
Passengers			
Third persons			

DAMAGES

Aircraft	Important
Third parties	Minor in a cottage and a tree

FLIGHT DATA

Operation	General aviation – Airshow – Race
Phase of flight	Cruise

1. FACTUAL INFORMATION

1.1. Event description

The aircraft was competing in the Spanish XXV National Championship of Aerostation out of competition, under the requirements of the Official Regulation of Aerostation of the «Spanish Royal Flying Association» («Real Federación Aeronáutica Española»). On September 5, 2003, they were participating in a stage in which the pilots had to take off from a freely elected area and then they tried to reach to certain coordinates provided by the race management.

In the previous day's stage, between 10 and 15 hot air balloons had landed in a field close to Valladolid, under winds so strong they made the basket of balloon registered N3574M to drag along the ground, as it was normal in landings under those conditions. The burner of the balloon reportedly received a heavy hit because of that.

The pilot of that balloon arrived on 5 September to the same landing area they had used the previous day. At those moments, other 10 or 15 balloons were taking off for the stage. According to her statement, the pilot assembled the balloon, carried out the routine preflight checks, and took off, with her being the only occupant of the aircraft.

The balloon climbed with a normal behaviour of the burner. After some 10 min of flight, the pilot noticed that the pilot light seemed to be malfunctioning, because it was bigger than normal. Then a flame appeared outside and around the burner, because one of the propane hoses was loose. The pilot shut off both fuel lines and just after this action one of the hoses detached from its joint to the burner. She grabbed the loose hose, put it outside the basket and used the on board fire extinguisher to fight the fire. The flames burned areas of her face, neck, right forearm and hands.

The balloon started to descend and she could not drive it to a free obstacle zone, and finally crashed into a tree and a cottage in a particular property approximately 3 km away from the field used for take off.

The emergency services were warned and they moved the pilot to hospital, where she remained longer than 48 h because of the second-degree burns she had sustained.

1.2. Pilot information

The pilot had the title of Hot Air Balloon Pilot n.º 325, issued by the DGAC of Spain (Civil Aviation Authority of Spain) on 20-12-2001, and her licence was valid from 19-6-2003 to 23-6-2005. On her logbook there were recorded a total of 83 h of flight, of which 67 were flown on the air balloon N3574M.

1.3. Information on the aircraft

1.3.1. General description

The hot air balloon Aerostar RX-7, s/n RX7-3203, had a maximum gross weight limit of 1480 lb, and carried on board three bottles of propane made of aluminum, each with 10 gallons of capacity. It was included on the FAA Type Certificate Data Sheet A15CE (Revision 40). Until 1986 the holder of the type certificate was Raven Industries.

The air balloon was equipped with a burner of propane gas model and serial number «Raven 51464-B RP2R-442», according to the identification placard attached to it. The aircraft flight manual (AFM) showed that a burner «51464 Rally Dual Inlet» could be installed.

The «dual inlet» burner had two inlets of liquid propane. Those inlets were fed by hoses from the propane bottles on board that were used as fuel of the balloon. The hoses were fitted to the burner inlets through nuts that were threaded and then wrench tightened with a tool carried on board during the balloon assembly before every flight.

The «pilot light» is fed by liquid propane from the main fuel line. The propane is then converted to a gaseous state in a brass regulator just below the pilot light head (see Figure 1). The second fuel line carries liquid propane as a redundant fuel source or back up, in the event that the main fuel system malfunctions and needs to be shut down. In this event, the burner can be operated through the use of the metering valve.

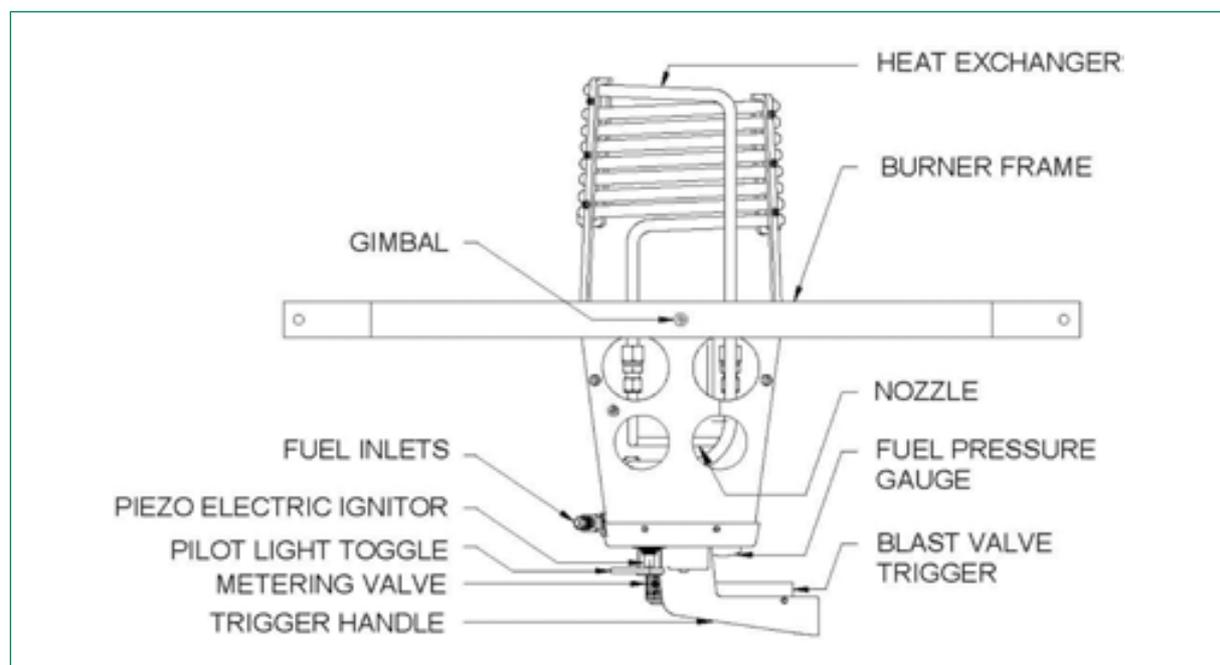


Figure 1. Drawing of a burner similar to the one on board the accident balloon. The fuel hoses fittings are wrench tightened to the bottom of the burner

1.3.2. *Instructions of the Flight Manual*

The Flight Manual of the aircraft «Aerostar (Raven) Model RX-7 Hot Air Balloon», revision P (9-July-2002), mentioned on page (4.1e) that launches and landings with surface winds of 7 MPH and 15 MPH, respectively, had been demonstrated, although those values were not a limitation, and also detailed the following preflight tasks and inspections (2.22):

«Assembly:

- Attach the envelope load fittings and burner frame. (...)
- Remove dust plugs/caps from fuel lines and burner fuel inlet fittings. (...)
- Attach liquid and vapor fuel lines to fuel inlets on burner(s) and wrench tighten. (...)

On paragraph 2.25 of the preflight inspection it was stated:

- «— Attach the envelope load fittings and burner frame. (...)
- Tanks and fittings: no visible leaks, damage, corrosion.
- Tanks straps: secure.
- Fuel lines: no holes, cracks, abrasions, loose fittings.
- (...)

The emergency procedures of the manual contained two procedures related to the circumstances of the accident:

«3.26 Fuel line/Fitting Leaking Propane

If propane is determined to be leaking from lines or fittings and no fire has resulted:

1. Shut off all open flame sources (pilot light(s), metering/blast valves).
2. Shut off fuel to respective line/valve
3. Tighten leaking fittings as necessary

When propane is no longer detectable:

4. Relight burner to maintain flight
(...)

3.27 Onboard fire

Any type of fire must be considered as a life threatening situation while airborne and plans should be made immediately to land while the fire is being fought:

1. Secure all fuel at tanks if possible

NOTE

Small fires which may occur at loose fittings may in some cases be snuffed out by placing leather flight glove over flame momentarily.

2. Use hand held fire extinguisher to fight fire

If fire is uncontrollable:

3. Effect rate-of-descent for immediate landing by venting or opening deflation panel.

(...)

Finally, the Flight Manual (1.5, Protection Equipment) mentioned that *«Helmets are required for all occupants on board and must be worn during emergency procedures...»*. Additionally, they said that *«Leather gloves and fire retardant clothing are optional but recommended»*. As stated on paragraph 3.27.1 of the manual, *«Small fires which may occur at loose fittings may in some cases be snuffed out by placing leather flight glove over flame momentarily»*.

1.3.3. Maintenance instructions

The «Continued Airworthiness Instructions» of Aerostar, Revision D of 15-Septembre-2003, that were provided by the manufacturer after the accident, stated on paragraph 2.0 «Preventive Maintenance» that before every flight the pilot had to carefully inspect the burner for general integrity and operation, noting particularly loose or missing nuts and bolts.

Additionally, it was required to change the fuel lines at an interval not exceeding 120 months.

1.3.4. Airworthiness of ballon N-3574M

The balloon was still registered in USA at the date of the accident, although it had already been sold to an owner in Andorra.

The balloon had to pass inspections every 12 calendar months or every 100 flight hours, whichever expires first, and in those inspections several tasks were to be carried out on the burner in a suitable center, always following the mentioned «Continued Airworthiness Instructions» of Aerostar.

The last revision reported on the balloon FAA logbook was carried out on 3 February 2000 in a maintenance center in USA, before the aircraft was sold to the current owner in Andorra. The following data were obtained:

1. Balloon

- | | |
|---------------------------|--------------|
| 1.1. Manufacturer: | AEROSTAR |
| 1.2. Model: | RALLY RX-7 |
| 1.3. Serial number: | RX7-3203 |
| 1.4. Year of manufacture: | 1989 (April) |
| 1.5. Registration: | N-3574M |

2. FAA Airworthiness Certificate

- | | |
|----------------------|---|
| 2.1. Type: | Standart Airworthiness Certificate |
| 2.2. Date issued: | 4-28-89 |
| 2.3. Date of expiry: | Not defined. Valid depending on the maintenance carried out |

3. Maintenance records (as logged in the balloon logbook)

- | | |
|--|---|
| 3.1. Total flight time: | 318.50 h |
| 3.2. Date of last 100 h inspection: | 2 March 2000, with 244.80 flight hours |
| 3.3. Flight hours since the last 100 h inspection: | 73.70 h. Time since the last logged inspection: 3 years and a half, approximately |

The pilot stated that the burner was being inspected with the required frequency, but no official records were being noted in the logbook.

The CIAIAC informed both the Spanish Airworthiness Authorities and the Airworthiness Authorities of Andorra about the reported maintenance status of the balloon.

As mentioned above, the balloon had 3 bottles of propane made of aluminum with 10 gallons of capacity each. The manufacturer of the balloon had issued Service Bulletin 137 on 1 July 2003 that requested the all the aluminum bottles of 10 gallon were immediately removed from service, because they had a potential to rupture when exposed to high heat in the event an onboard fire occurred.

According to the information provided by the manufacturer in the service bulletin, «*no stainless steel fuel cylinders, to Aerostar's knowledge, have exhibited this characteristic since their introduction into ballooning in the early 1960's*».

1.4. Meteorological information

General

On 5 September, 2003, at 0600 UTC, there were relative low pressures, with an almost stationary anticyclone or high pressure area of 1030 hPa over Azores Islands.

METAR of Aerodrome of Villanubla on 5 September 2003-12-05

0730 UTC: wind 120°, 4 kt; visibility 500 m, fog, vertical visibility 100 ft; temperature 13 °C

0800 UTC: wind 100°, 3 kt; visibility 400 m, fog, vertical visibility 100 ft; temperature 13 °C

0900 UTC: wind 100°, 1 kt; visibility 5000 m, haze, very cloudy at 300 ft; temperature 15 °C

Data at height over Madrid

Flight level	Wind (kt)	Temperature (°C)
020	256°/5 kt	24
050	257°/5 kt	15
100	235°/10 kt	3
150	254°/18 kt	-4

Weather in the place of the accident

Although actual weather data were not available, because there was no meteorological station close to the place of the accident, it is most likely that the wind was very light and the temperature around 13 °C.

Early in the morning there was fog in several areas of the province of Valladolid that disappeared later on. In the city of Valladolid, approximately 10 km away from the place of the accident, there was haze first thing in the morning, and disappeared at around 9:00 UTC. Because of that, and taking into account the data of the aerodrome of Villanubla, it is probable that in the place and at the time of the accident there was also fog with bad visibility.

The ambient temperature and wind speed were suitable for the flight. It is considered that the weather was not a factor that influenced the causes or the consequences of

this accident, except for the fact that the meteorological conditions could have made uncomfortable the wearing of gloves during the flight.

The landing of the previous day (during which the burner suffered a hit) was carried out with an estimated wind of 12 kt (23 km/h).

1.5. Inspection of the balloon wreckage

The wreckage was inspected in the facilities of an organization with capability for that task.

The entire balloon, with envelope, basket and burner, was sent to that organization in a trailer sealed by the police. The day of the inspection, the seals were opened and the basket was visually inspected. It showed clear signs of have burned with the flame pointing from outside to inside. The fire affected the wicker material until it was extinguished with powder.

Inside the basked there was the burner, with a placard reading «RAVEN 51464-B, RP2R-442», together with three bottles of propane gas, manufactured by WORTHINGTON, model DOT 4E240 and serial numbers 4435J, 47295J and 47300J.

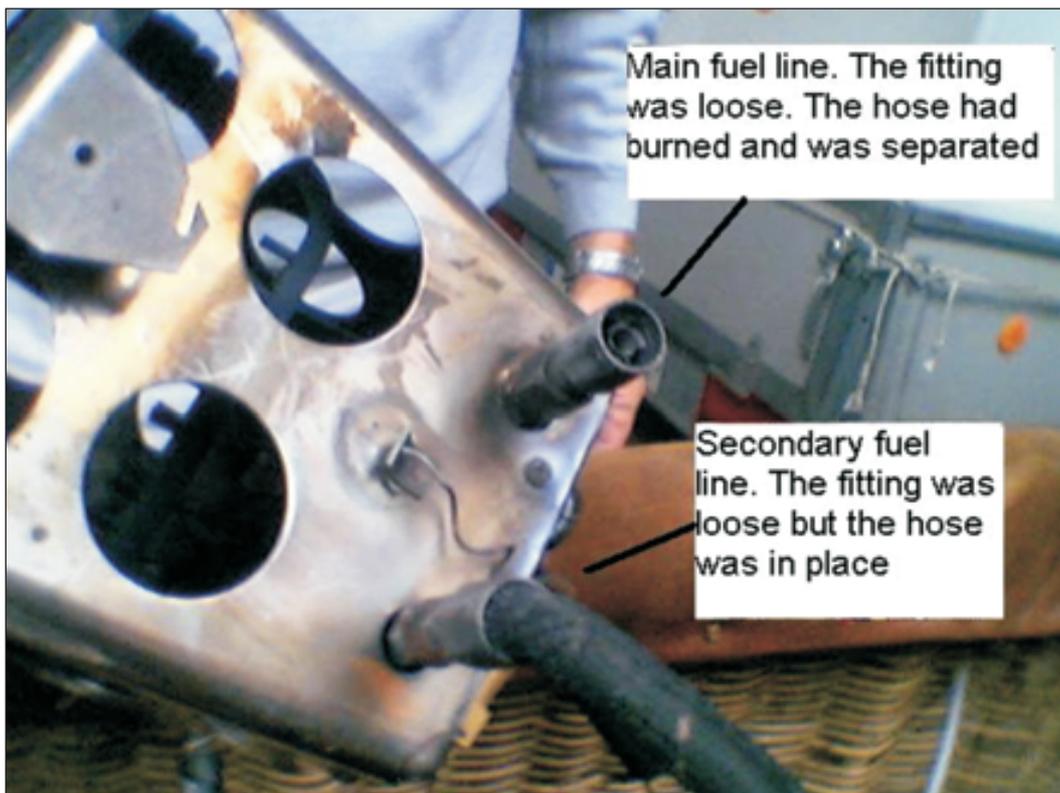


Figure 2. View of the burner after the accident

The burner and its frame were taken with the intention of assembling it again in the basket, simulating a preflight task. The right hand hose (the main line, that feeds propane to be converted to a gaseous state) was burnt and detached from its fitting, while the fitting itself was still threaded to the burner inlet. The other hose was attached to its fitting and it was threaded to the inlet (see Figure 2).

It was tried to loosen the fittings and it was noticed that the first one (the main line) could easily be loosened by hand. The other fitting (corresponding to the secondary line) was also loose. The wrench was not found among the balloon wreckage. The pilot stated later on that she had the wrench on her pocket at the time of the accident.

Two new hoses were installed in the burner, which was then fitted to a burner test bench, and it was observed that all the components and controls of the burner were functioning correctly.

It was concluded that the fire was initiated in the hose whose fitting was loose the most (the main fuel line). The pilot grabbed the burning hose and took it outside the basket, which would explain why it appeared burnt from outside.

2. ANALYSIS

The information gathered shows that there were two circumstances surrounding the accident:

- The fittings of the propane hoses could not have been wrench tightened during the assembly of the burner and preflight inspection.
- The pilot was not wearing gloves that could protect her hands in the event of a fire. According to her statement, she felt uncomfortable with the gloves in flight that day.

In this model of balloon, as a difference with respect to other European models, the hoses must be assembled and disassembled on every flight, attaching them to the burner with fittings that must be tightened using a wrench carried out on board to assure an adequate torque. According to her statement, the wrench was in the pocket of the pilot at the moment of the accident.

After the accident, it was noticed that both fittings were loose, specially the one of the main fuel line, and they could be removed by hand. This would not have been possible if the fittings would have been wrench tightened.

It is probable that the preflight tasks were carried out in a hurry, under the pressure of the competition. In that environment, it is possible that the task of applying torque with the wrench was omitted, and after some flight time a fire was initiated in the main inlet

due to a leak of fuel through the thread of the fitting. The hose could then have detached from the fitting, due to the high heat and to the own pressure of the fuel.

Once the fire started, the pilot applied the emergency procedure in the best way she could, due the negative circumstances she faced when, after grabbing the hose with the bare hands, she suffered burnings. Despite of that, she could use the fire extinguisher and the subsequent descent and impact into the ground was not too violent.

The need to assemble the burner and to tight the fittings every time the balloon is prepared for a flight seems to be a very delicate item of the preflight inspection, because it is not a simple check but requires a positive and adequate action from the pilot. The omission or incompleteness of this action could have serious consequences as it happened in this accident. The Flight Manual does not show the torque needed in the fittings (it only says " "wrench tighten") and, in this case, the burner was actually functioning in an apparently normal way (i.e. it allowed the launch and initial climb of the balloon) for certain time.

The design of the system does not have any protection against this kind of omissions during the assembly of the burner, and only a careful adherence to the preflight inspections may avoid the reoccurrence of similar events.

The fact that the person on board was not wearing fire protection clothing (especially gloves) was another factor that produced the personal injuries mentioned. From the information gathered, it is concluded that gloves are normally carried out on board, and they are often used during preflight assembly, but not during actual flight, especially when ambient temperature is high.

Finally, according to the manufacturer, the presence of aluminum bottles on board represented an additional hazard that could have caused damages even more serious during the accident. The Service Bulletin 137 of Aerostar requested such bottles to be immediately removed from service, due to the potential of explosion in the event of fire on board. No related Airworthiness Directive to make that bulletin legally mandatory has been found.

3. CONCLUSION

The accident was probably caused because the fitting of the main propane line was not adequately tightened, which produced an on board fire due to the leak of fuel.

4. SAFETY RECOMMENDATIONS

None.