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Aircraft Type and Registration: Thunder and Colt Model 77A Hot Air Balloon, G-HOSI

No & Type of Engines: Colt double burner with single liquid fire jet

Year of Manufacture: 1990

Date & Time (UTC): 13 July 1991 at 0715 hrs

Location: San Giustino, near Florence, Italy

Type of Flight: Private

Persons on Board: Crew - 1 Passengers - 2

Injuries: Crew - 1 serious Passengers - 1 serious

Nature of Damage: Balloon destroyed

Commander's Licence: Private Pilot's Licence (Balloons)

Commander's Age: 51 years

Commander's Flying Experience: 90 hours (all on type)

Information Source: Accident Report by Italian Authorities, AAIB examination of wreckage and other inquiries by the British Balloon and Airship Club and AAIB.

G-HOSI was one of a number of balloons which had taken off from a local airstrip at about 0630 hrs local time. The wind conditions were light, estimated at about 3 kt, and the flight lasted about 45 minutes during which time the balloon reached a maximum altitude of 2,000 ft. Descending, the pilot selected a field of stubble for landing. The field turned out to have a steep gradient which was across the direction of approach, downwards from right to left, but the wind condition at touchdown was calm and the balloon and basket remained erect. The pilot waited a few seconds and then pulled on the 'parachute' vent line and asked one of the passengers, his daughter, to get out of the basket to take the crown line and pull the envelope away from the basket as it collapsed. He reached up to turn off the pilot lights. As he did so he realised that the balloon was collapsing down on top of the basket and he was suddenly engulfed in flames. The pilot's daughter's view of what was happening was obscured by the material of the collapsing balloon and the second passenger in the basket is reported as describing herself being under the cloth of the flaming balloon. The pilot, facing the tanks, had the impression that the fire originated on his left hand side just above the top of the basket and he was aware of a roaring noise co-incident with the eruption of flame around the basket. He felt that there was no time to shut off valves and he jumped out of the basket but, realising that the second passenger

was still in the basket he turned and pulled her out and away from the fire. The pilot and the injured passenger suffered burns to the arms and torso.

Eye-witnesses on the ground and in other balloons report seeing the balloon on the ground with the envelope collapsing; one witness described seeing 'reverse fluting' in the envelope shape as it collapsed. One external witness also saw the basket being engulfed in flames and all described a long vertical pillar of flame which persisted for some time (variously three to five minutes, 10 minutes or 20 minutes). The flame was about one quarter or one third of the height of the balloon, was red and yellow in colour and, initially, there was a lot of smoke generated by the surrounding fire. Eventually, according to one witness, the flame inclined to the horizontal becoming briefly more intense before it subsided and extinguished. After the fire, it was apparent, from the position of the remaining lines and the crown ring, that the envelope had descended almost vertically onto the basket. Both envelope and basket had been consumed together with an area of grass and stubble and only the burners, hoses, valves and tanks were left, albeit in a fire damaged condition.

An investigation was carried out locally for the Italian Ministry of Transport and the results of this were made available to AAIB. When the Wreckage had been released it was returned to the UK and examined by AAIB and the Manufacturer.

A schematic drawing in the attached Figure shows the burner and propane supply system fitted in G-HOSI. The steel pressure bottles had occupied the left upper and right upper positions in the basket. They had suffered a high external temperature but had not ruptured. On site it had been noted that the flexible hoses, although burned, appeared intact and connected and no other disconnections could be seen. The pressure reducing valves on both tanks had been destroyed and the aluminium knob on the vapour valve of the right upper tank had partially melted and resolidified. The valve handle positions were recorded on site and, on return to the UK, all the valves were dismantled and examined for evidence of their position during the fire and for any evidence of a defect or a failure. The results of these examinations are listed below.

	Left		Right	
	Position on site	Internal evidence	Position on site	Internal evidence
Liquid Supply Valve	Open	None	Open	Open
Blast Valve	Open	Open	Open	Open
Liquid Fire Valve	Not determined	Closed		
Crossover Valve	Not determined	Closed		
Vapour Line Valve	Not determined	None	Open	Open
Pilot Valve	Closed	None	Closed	Near to closed

An official of the British Balloon and Airship Club also attended the site and noted the blast valves as being 'OFF' but there had been some disturbance of the wreckage and all available photographs show the handles to be in the 'ON' position as recorded by the local investigator.

When the valves and lines were examined a number of anomalies were found. In the right hand blast valve (Worcester type) it was found that two of the four main assembly bolts were broken and there was some staining on the valve block mating face which would indicate that propane had leaked from the upstream side of the valve. However, when the bolts were examined by a metallurgist it was determined that they had failed while hot and had been affected by cadmium penetration, an embrittling process commonly seen in such components when fire damaged. The aluminium block of the right hand liquid valve (Worcester type with Rego self-sealing connector) also exhibited some unusual irregular grooving on its upstream mating face but this, again, under close examination proved to be a local melting effect evidently sustained during the fire. The threads of the two unions attaching the left and right liquid lines to their respective Rego connectors were markedly different in appearance; the right hand thread was soiled and the left was bright. It was thought that this could indicate that the right union had not been tight and that either propane had leaked, causing the staining, or that combustion products had entered from the outside. It also appeared that the outer of two O-rings in the connector was missing but closer examination showed that there was a residue of carbonised material in the seal groove which when analysed indicated the presence of a fluorinated polymer. An experiment was carried out with serviceable connector and a charged cylinder. With both seals in place the outside collar was unwound one and a half turns from tight to a position where the internal self-sealing valve had not closed. The connector O-rings were still effective and there was no leak. It was noticed that the right cylinder fittings showed more severe fire damage than the left and it may be that the staining of the union threads merely reflected this. It was concluded that there was no positive evidence of a mechanical problem within the balloon's propane system.

The fact that the burner pilot valves were closed coincides with the pilot's recollection of his intended final action though his subsequent impression was that he had not in fact managed to close the valves. The blast valve internal damage, together with their recorded positions on site, shows that these valves were open during the fire. The evidence also indicates that the tank liquid valves were open and this, together with the blast valve evidence, accords with witness descriptions of a vertical 'pillar of flame'. Though some witnesses described the tall flame as being like the liquid fire flame the evidence is that the liquid fire valve was shut and it could be that what was being seen was flames from the normal burners which were suffering a depleted oxygen supply because of the conflagration which surrounded them. A flame burning in an oxygen poor environment would also be visible over a greater height than usual. The pilot recalled no intention to open the blast valves either to re-inflate the balloon and re-seal the parachute valve or to vent the lines and cool the coils. The initial eruption of flame below the level of the burners could have been caused by a propane leak, a source for which has not been identified, or by unignited propane being ejected into the envelope and then descending,

assisted by the collapsing envelope, onto a still burning pilot light. For this second case, a source of propane in the area of the envelope mouth, other than the main burner jets themselves, could possibly have been provided by one of the pilot lights being unlit, for although the leakage rate would be low the local air conditions were stagnant.

The pilot reported that his left tank had been depleted to about 35% of maximum and his right tank, which he had only just begun to use for the approach and landing would have been virtually full. Consideration was given to the possibility that the right tank might have been overfilled; this would raise the possibility that if ambient temperature increased after the time of filling then liquid propane rather than gas might escape through the bleed valve leading to the risk of a high, and possibly combustible, concentration of propane in the basket. The bottles had been recharged by someone other than the pilot on the day before the accident flight in the latter part of the afternoon when the temperature was probably about 35°C. The flight was conducted between 0635 hrs and 0715 hrs local time and the air temperature is reported to have been 25°C.

G-HOSI - Condition of fuel and burner systems

