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Aircraft Accident Investigation Bureau AAIB

Final Report No. 1942 by the Aircraft Accident Investigation Bureau

concerning the accident

to the aircraft Zlin 143L, HB-TCD

on 8 August 2006

Löuwene, municipality of Reckingen/VS

approx. 70 km ENE of Sitten (Sion)/VS

Bundeshaus Nord, CH-3003 Berne

Ursache

Der Unfall ist darauf zurückzuführen, dass das Flugzeug wegen eines Leistungsverlusts des Motors infolge eines Fremdkörpers im Vergaser den Flugplatz nicht erreichen konnte, der Pilot eine Notlandung versuchte und dabei mit dem Flugzeug im Gelände aufprallte.

Zum Unfall hat die unzweckmässige Konstruktion des Wärmeaustauschers beigetragen.

General information on this report

This report contains the AAIB's conclusions on the circumstances and causes of the accident which is the subject of the investigation.

In accordance with Annex 13 of the Convention on International Civil Aviation of 7 December 1944 and article 24 of the Federal Air Navigation Law, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent future accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the accident investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All times in this report, unless otherwise indicated, follow the swiss local time format. At the time of the accident, Central European Summer Time (CEST) applied as local time (LT) in Switzerland. The relation between LT, CEST and UTC is: $LT = CEST = UTC + 2 \text{ hours}$

For reasons of protection of privacy, the masculine form is used in this report for all natural persons, regardless of their gender.

Final Report

Aircraft	Zlin 143L	HB-TCD
Operator	Swiss Flight Training Center, 6342 Baar	
Owner	Private	

Pilot	Swiss citizen, born 1949		
Licence	PPL (A)		
Flying hours total	522:28 h	during the last 90 days	11:39 h
on the accident type	4:16 h	during the last 90 days	4:16 h

Location	Löuwene, municipality of Reckingen/VS		
Coordinates	662 550 / 147 050	Elevation	1320 m/asl
Date and time	8 August 2006, 11:47 LT		

Type of operation	VFR private
Flight phase	Approach to runway 05 Münster aerodrome (LSPU)
Accident type	Emergency landing after engine failure

Injuries to persons

	Crew	Passengers	Third parties
Fatally injured	---	---	---
Seriously injured	1	---	---
Slightly injured or uninjured	---	---	---

Damage to aircraft	Badly damaged
Other damage	Crop damage

1 Factual Information

1.1 Pre-flight history and history of flight

1.1.1 Pre-flight history

On 7 August 2006, one day before the accident, aircraft HB-TCD was flown from Winterthur aerodrome to Münster aerodrome by the pilot who was subsequently involved in the accident. After the ferry flight, the pilot was prepared for the forthcoming towing tasks by tow pilot A from the Winterthur gliding group.

The local aerodrome association and the Winterthur gliding group were responsible for flight operations on Münster aerodrome.

On the day of the accident, two towplanes were in service.

The first glider tow flight on the day of the accident by tow pilot A as well as the second flight by the pilot involved in the accident was uneventful. Both flights took off and landed on runway 05 of Münster aerodrome.

During the second flight, the pilot, in his descent after releasing the glider, switched on the carburettor heating system. During the final approach on runway 05, he switched it off again.

1.1.2 History of flight

The flight involved in the accident was the third glider tow flight by aircraft HB-TCD on this day.

The take-off distance seemed to the pilot to be somewhat longer than on the previous flight.

During the subsequent climb, the pilot assessed the climb performance as worse in comparison with the preceding flight, even though the glider which was being towed corresponded to that on the previous flight in terms of weight. During the flight, the pilot carried out manipulations which were analogous to the previous flight, including operating the carburettor heating system. He reduced power twice during the descent.

On the approach to runway 05 at Münster aerodrome, he wanted to increase power. The engine spluttered and the engine speed increased only a little. Any changes to the position of the power lever, carburettor heater and mixer did not result in a power increase. On checking the instruments and controls in the cockpit, the pilot did not notice any anomalies. Nor could the pilot smell petrol or smoke.

Since the lack of engine power meant it would clearly not be possible to reach the Münster aerodrome runway, the pilot decided on an emergency landing on the terrain in front of him, which was clear of trees and apparently clear of obstacles.

The pilot then heard the stall warning sound. Shortly afterwards, the aircraft collided with the edge of the bank of a brook. In the process, the left landing gear was torn off. The aircraft skidded along the ground and came to a standstill after approximately 30 m. The pilot was seriously injured.

An eyewitness observed how the aircraft flew past him a short distance away and at low height. He heard an unusual engine sound and observed smoke coming from the belly of the aircraft.

1.2 Aircraft information

1.2.1 Aircraft HB-TCD

Aircraft type	Zlin 143L
Manufacturer	Moravan-Aeroplanes a.s., 76581 Otrokovice/CR
Serial No.	0022
Year of construction	1997
Swiss airworthiness certificate	11.07.1997
Operating hours	773 hours 39 min
Last 100 hour check	26.08.2005 at 735.2 hours
Last condition check	31.10.2005 at 745.4 h

1.2.2 Engine

Type	O-540-J3A5
Manufacturer	Textron Lycoming, Williamsport PA, USA
Year of construction	1997
Swiss airworthiness certificate	11.07.1997
Operating hours	773 hours 39 min
Last 100 hours check	26.08.2005 at 735.2 hours

The engine logbook certifies that on 01.10.2003 six airworthiness directives were carried out by the maintenance company on the carburettor manufactured by PRECISION Airmotive Corporation, type MA-4-5, P/N 10-5054, S/N 75062713. In order to do this, the carburettor had to be removed and re-fitted.

1.3 Meteorological information

According to the take-off controller's statements, the following weather conditions prevailed at the time of the accident:

The local weather conditions on Münster aerodrome and in the upper Valais were stable with sunny weather on the day of the accident.

The wind was blowing from the north-east, at 3-5 knots.

The air temperature on the aerodrome at the time of the accident was approximately 24 °C.

1.4 Wreckage and impact information

1.4.1 Wreckage

As a result of the impact, the propeller blades were torn off and the nose landing gear as well as the left main landing gear were separated from the aircraft.

As a result of the bank angle to the left, the shock of the impact had to be absorbed predominantly by the left main landing gear. This had caused the left wing to buckle and resulted in the left landing gear being torn off.

The damage to the propeller blades indicated that the engine was running at reduced power.

A visual check of the fuel level from the filler nozzle showed that there was substantially more petrol in the left main tank than in the right tank.

No fuel leak could be established at the site of the accident, during salvage or the subsequent transfer of the aircraft into a shelter.

1.4.2 Impact

The impact occurred at a slight bank angle to the left, onto the upper edge of the bank of a brook. The aircraft then skidded over the meadow behind it and came to a standstill after approximately 30 m.

1.4.3 Accident site

Coordinates: 662 550 / 147 050

Sheet No. 1250 Ulrichen 1:25 000, National map of Switzerland

1.5 Fire

Fire did not break out.

1.6 Technical investigations

1.6.1 Carburettor

The engine and carburettor were removed.

A PRECISION Airmotive Corporation carburettor, type MA4-5, was fitted. This was equipped with a metal float.

During the examination of the carburettor, a broken-off piece of a fin was found in the venturi channel, originating from the inside of the right-hand heat exchanger housing.

1.6.2 Heat exchanger and carburettor heating system

The examination of the heat exchanger and the carburettor heating system produced the following results:

- Inside the right heat exchanger housing, the spot at which the piece of the fin had broken off could be identified. The remaining part of the fin exhibited a distinct fracture near a rivet hole.
- Inside the right heat exchanger housing, a second fin from which a piece had broken off was found. It was not possible to find this broken piece of the fin in the course of the investigation.
- On the outside of the panelling of both heat exchanger housings, distinct traces of chafing, originating from vibration, were found.

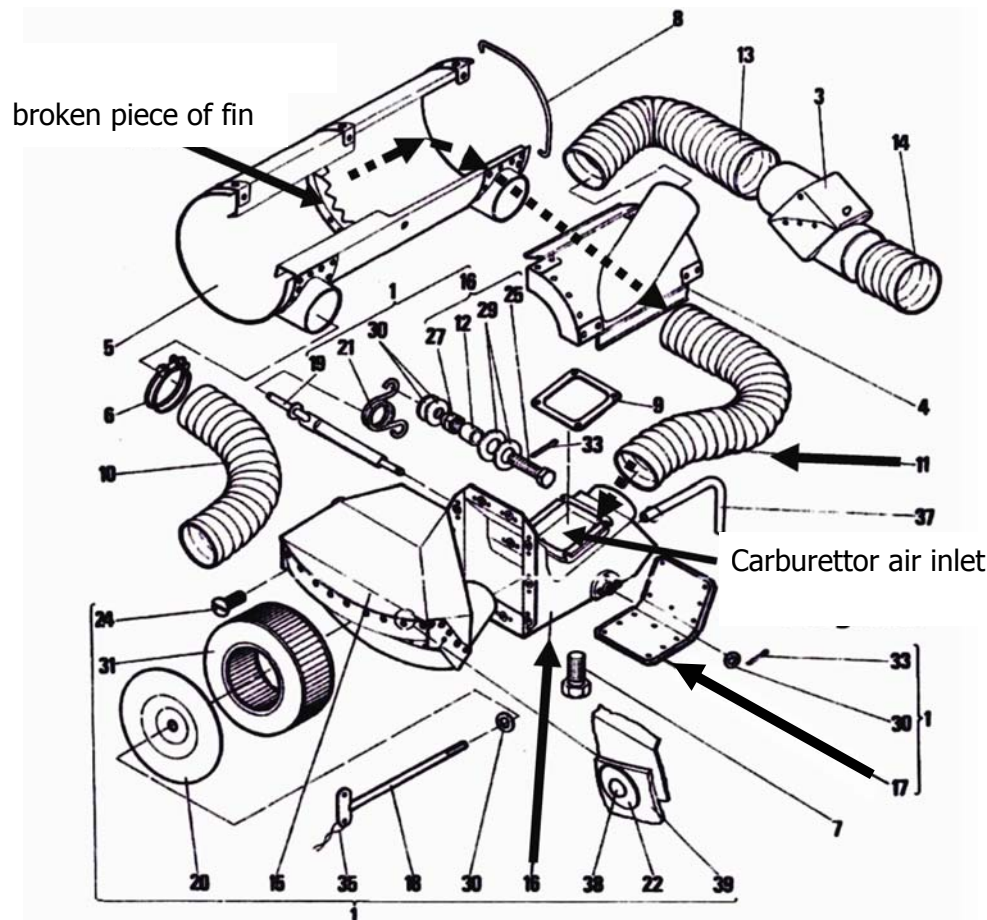


Fig. 1: Heat exchange system: On opening of the carburettor heating flap, item 17, the broken-off part of the fin was conveyed by the air current via the hose, item 11, and the air filter chamber, item 16, directly into the carburettor venturi channel. The broken-off part was caught in the venturi channel struts, got stuck between the petrol nozzle and the struts, and subsequently moved to a position which caused a massive deterioration in the air/petrol mixture. On approach, this prevented the desired increase in power from occurring and led to the observed spluttering and smoking of the engine.

1.6.3 Fuel system

The two main tanks were refilled on the day before the accident, at the end of flying operations, with 40 l of Avgas 100LL. The auxiliary tanks remained empty.

Both tanks were drained after the accident. The amount of fuel found was:

- Left tank 55 litres
- Right tank 16 litres

It was known that one-sided draining of the two main tanks could occur while operating the aircraft HB-TCD with the tank selector at the "L+R" position. This peculiarity had already been recorded in the flight log on 17.08.2005. The pilot's statements and the measured amounts of fuel indicated that this peculiarity still existed at the time of the accident.

According to the manufacturer's information in the aeroplane flight manual (AFM) for the aircraft type Zlin 143L, the difference between the left and the right main tank shall not exceed the amount of 15 l. If the difference exceeds 15 l, the pilot has to select either the left or the right tank in order to level out the fuel amount between the tanks. Furthermore the manufacturer prescribes that the tank selector switch shall not be in the "L+R" position for parking the aircraft. These procedures from the AFM had been taken over in the operator's checklist.

2 Analysis

2.1 Technical aspects

2.1.1 Broken-off fin from the heat exchanger housing

On both sides of the two heat exchanger housings, near the pipe links to the exhaust flange, distinct traces of chafing were found, originating from vibration. In addition, the fixing holes of the retaining clamps for fitting and removing the housing were considerably worn and had been partly repaired by doubling up with sheet metal.

The broken-off part remained caught in the venturi channel strut, got stuck between the petrol nozzle and the struts, and subsequently shifted to a position which caused a massive deterioration in the air/petrol mixture. On the approach, this prevented the desired increase in power from occurring and led to the observed spluttering and smoking of the engine.

The fracture of rip No. 1 (cf. figure 3) occurred at some unknown point in time before the flight which was involved in the accident.

It appears that the design of the two heat exchanger housings including the system for conveying the carburettor heating air from the heat exchanger housing into the air filter chamber does not meet the requirements for safe operation of the aircraft.

2.1.2 Fuel system

The aircraft's two main tanks, with a respective capacity of 61 litres, were each filled up with AVGAS 100LL to approximately 60 litres on the evening before the flight involved in the accident.

The amount of fuel found on draining the main tanks after the accident was 71 litres, which, given a flying time of 45 minutes, corresponded to a fuel consumption of about 49 litres. This consumption could be confirmed using the information in the "Flight Range and Endurance" table in section 5-17 of the Airplane Flight Manual.

According to the pilot's statements, all three flights were made with the fuel tank selector set to "L+R". On draining the aircraft's tanks after the accident, the following quantities were found:

- Left tank 55 litres
- Right tank 16 litres

With the remaining 16 litres of petrol in the right tank and the tank selector setting "L+R", adequate fuel supply to the engine was ensured. Lack of fuel could therefore be ruled out as the cause of the power loss which occurred.

3 Conclusions

3.1 Findings

- The pilot was in possession of the appropriate pilot's licences.
- On take-off and during the subsequent climb, the pilot noticed reduced power from the aircraft compared with the previous flight.
- When the carburettor was dismantled, a broken-off piece of fin from the inside of the right-hand heat exchanger housing was found in the venturi channel.
- It was possible to identify the spot at which the piece of the fin had broken off inside the right-hand heat exchanger housing.
- Distinct traces of chafing attributable to vibration were found on the outer panels of the two heat exchanger housings.

3.2 Causes

The accident is attributable to the fact that owing to a loss of engine power caused by a foreign body inside the carburettor, the aircraft was not able to reach the aerodrome; the pilot attempted an emergency landing and in the process crashed into the terrain.

The inappropriate design of the heat exchanger contributed to the accident.

4 Safety recommendations and measures taken since the accident

4.1 Safety recommendations

None.

4.2 Measures taken since the accident

Based on the investigation results the manufacturer decided to publish a mandatory service bulletin that prescribes the control of the respective fins at the heat exchanger housing. Furthermore the manufacturer intends to revise the maintenance handbook in order to guarantee a more detailed description of the respective control procedure.

Extract from his letter dated 25 January 2007:

„The heat exchanger, which supplies the carburettor heating system with warm air, is equipped with vortex inserts. These vortex inserts have been manufactured of duraluminium till Z 143L aircraft, S/N 0044. Due to some cracks have been found on the vortex insert on several aircraft, the material of the insert has been changed. From Z 143L aircraft, S/N 0045, vortex inserts are produced of stainless steel. This design change has been issued in 1999.

In the time of detailed solving the problem, we have assumed that any crack shall be discovered in time, during regular prescribed 100-hour inspections, and we have considered it sufficient. Therefore we did not considered necessary to prescribe mandatory replacements of duraluminium vortex inserts with the new of stainless steel.

Now, after the HB-TCD accident, it is apparent there exists a possibility that a crack is not found during regular 100-hour inspections for some reasons.

We consider necessary to issue a mandatory service bulletin that prescribes mandatory inspection of the vortex inserts inside the heat exchangers on each Z 143L aircraft from S/N 0001 to S/N 0044 (duraluminium inserts). In case a crack is found, the insert shall be immediately replaced with a new one made of stainless steel.

To have a certainty that a possible crack will be found in time, we think it is necessary to issue a revision of the Z 143L Maintenance Manual, where pertinent inspection shall be stated with more precision, with more detailed procedure description, for all Z 143L aircraft.

We are immediately starting works on above mentioned mandatory service bulletin and maintenance manual revision."

Berne, 16 March 2007

Aircraft Accident Investigation Bureau

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Annexes

Illustration of the cause of the accident



Fig. 2

Accident site, HB-TCD, Münster/VS 08.08.2006

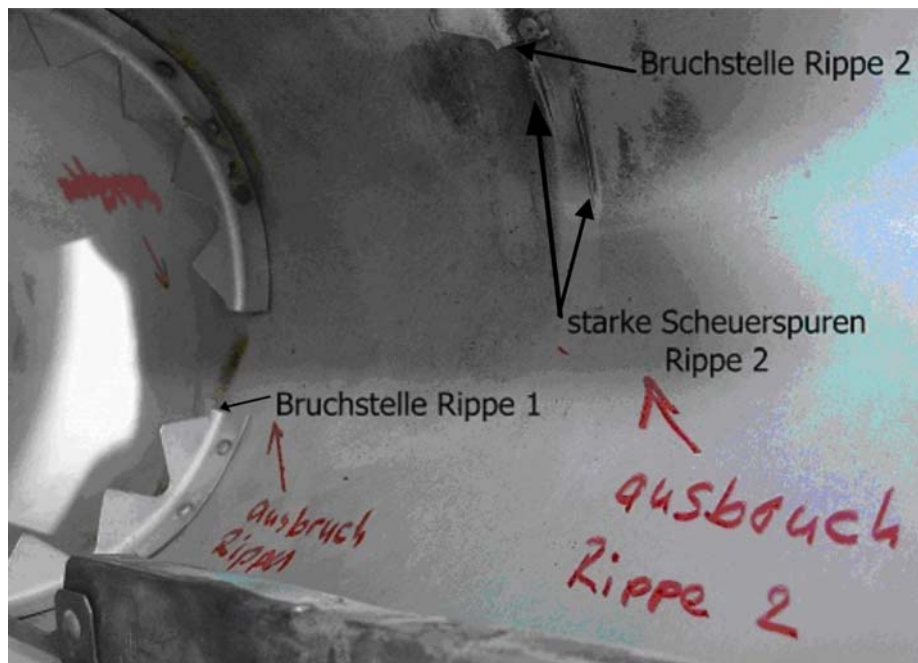


Fig. 3

Heat exchanger lining with defective panelling ribs. The crack at rib 2 starts near the rivet hole

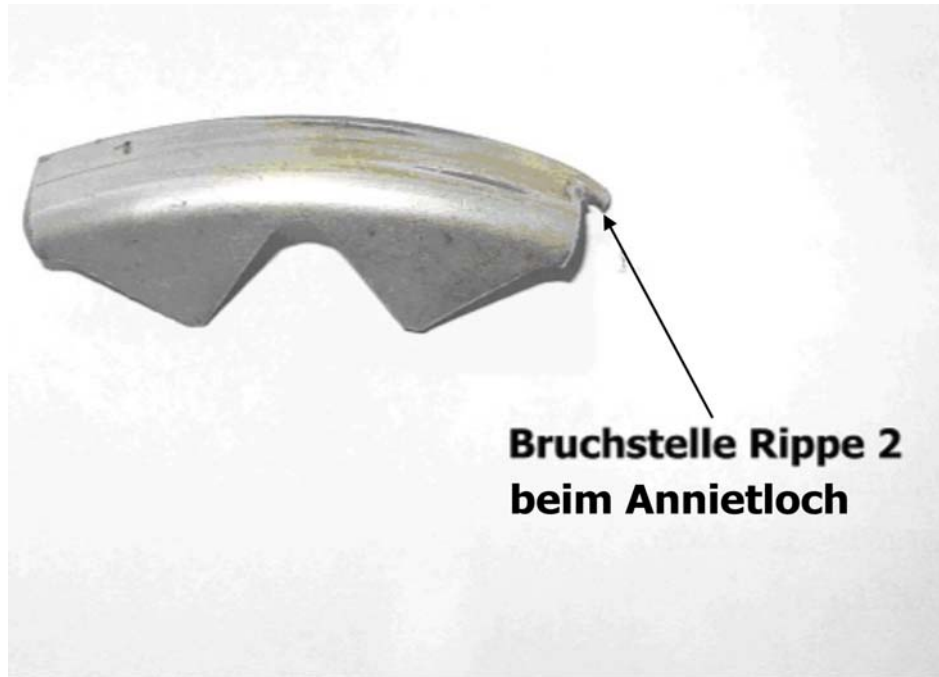


Fig. 4

The piece of the reinforcement rib which was caught in the carburettor's venturi channel

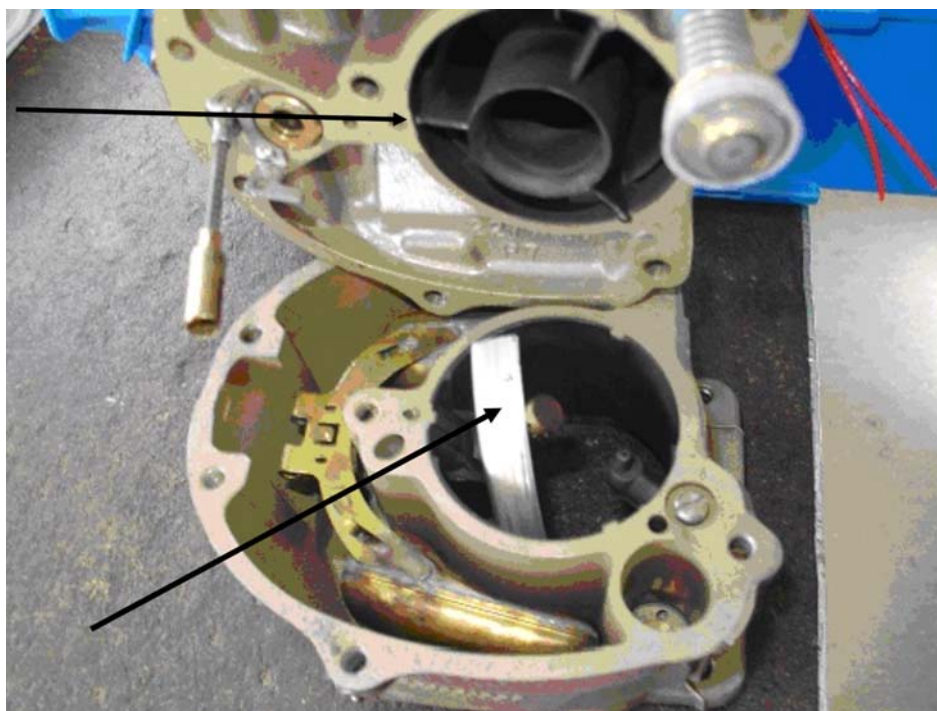


Fig. 5

Reconstruction of the piece of rib caught in the area of the fuel nozzle and the venturi channel. When the upper part of the carburettor casing was taken apart, rib 2 fell into the carburettor's float chamber.

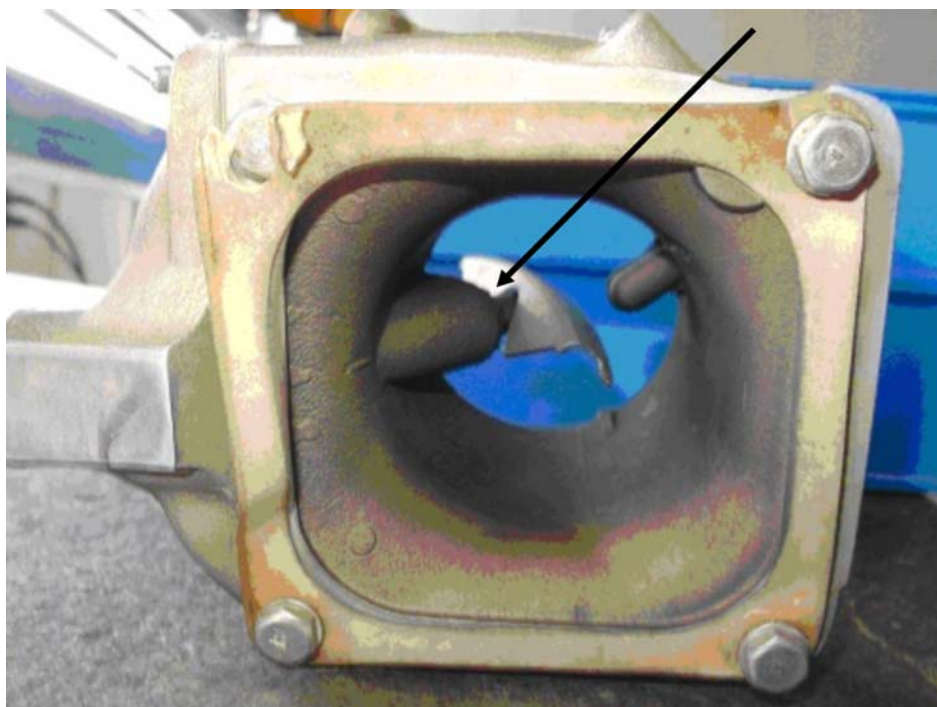


Fig. 6

View into the lower part of the venturi channel with a reconstruction of the piece of the rib that was caught.