AIRCRAFT INCIDENT SHORT REPORT

CA18/3/2/1218: Inflight engine failure resulting in an autorotation landing which was unsuccessful as the helicopter landed hard. Damage limited to the skids and no injuries were reported.

Date and time	:	19 September 2018; 0515Z
Aircraft registration	:	ZT-RAT
Aircraft manufacturer and model	:	Bell Helicopter Textron 206B Jetranger-III
Last point of departure	:	Wonderboom Airport (FAWB), Gauteng Province
Next point of intended landing	:	Lanseria Airport (FALA), Gauteng Province
Location of incident site with reference to easily defined geographical points (GPS readings if possible)	:	S28°50'38.92" E28°04'54.84" at an elevation of 4765 ft
Meteorological information	:	Surface wind: 120°/5kt, Temperature: 20°C, Dew Point: 1°C, Visibility: 10km CAVOK
Type of operation	:	Commercial (Part 127)
Persons on board	:	1 + 1
Injuries	:	None
Damage to aircraft	:	Skids damaged on impact

All times given in this report is Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to apportion blame or liability.***

Disclaimer:

This report is produced without prejudice to the rights of the South African Civil Aviation (SACAA), which are reserved.

Figure 1*:* A picture of a similar helicopter

1. SYNOPSIS

1.1. On 19 September 2018 at 0515Z, the pilot and a passenger were on a ferry flight from Wonderboom Airport (FAWB) to Lanseria Airport (FALA).

1.2. At approximately 14 nautical miles (nm) en route to FALA and above Atteridgeville township, the aircraft experienced an engine failure. The pilot identified an open field and performed an autorotation landing.

1.3. An on-site investigation revealed that the helicopter landed hard and sustained damages on the landing gear skids, which broke on impact with the ground. The pilot and passenger sustained no injuries.

1.4. The investigation concluded that the in-flight engine stoppage was caused by the failure of the Pc Safety Valve. This led to the reduction of engine governing air pressure, causing the fuel control unit (FCU) to reduce the amount of fuel to the engine. This resulted in a flameout. The pilot executed an autorotation landing and the helicopter landed hard, causing damage to the skids.

2. FACTUAL INFORMATION

2.1. HISTORY OF FLIGHT

2.1.1. On 19 September 2018, the pilot and a passenger took-off at approximately 0430Z from Wonderboom Airport (FAWB) on a ferry flight to Lanseria Airport (FALA).

2.1.2. The pilot stated that a pre-flight inspection was completed prior to the flight. Approximately 340 litres (90 US gallons) of fuel (Jet A1) was carried on-board. The helicopter departed FAWB from Runway 06 and climbed to 6000 feet (ft) above mean sea level (AMSL), routing for FALA. The departing phase was uneventful.

2.1.3. Thirty minutes into the flight, the helicopter was overhead Mooiplaas informal settlement and the pilot noticed the following engine parameters decreasing: gas producer (N1), power turbine (N2) and turbine outlet temperature (TOT). The engine lost power and stopped, The pilot then executed an autorotation landing onto an open field. The helicopter landed hard, causing the landing gear (skids) to break. The pilot and the passenger were not injured.

2.1.4. The accident occurred during daylight conditions at a geographical position determined to S28°50'38.92" E28°04'54.84" at an elevation of 4765 ft.

2.1.5. The helicopter was recovered and an approved aircraft maintenance organisation (AMO) conducted a detailed inspection on the engine to determine what caused the engine shutdown (flameout).

Figure 2: The helicopter as it came to rest — right-hand side

Figure 3: The helicopter as it came to rest — left-hand side

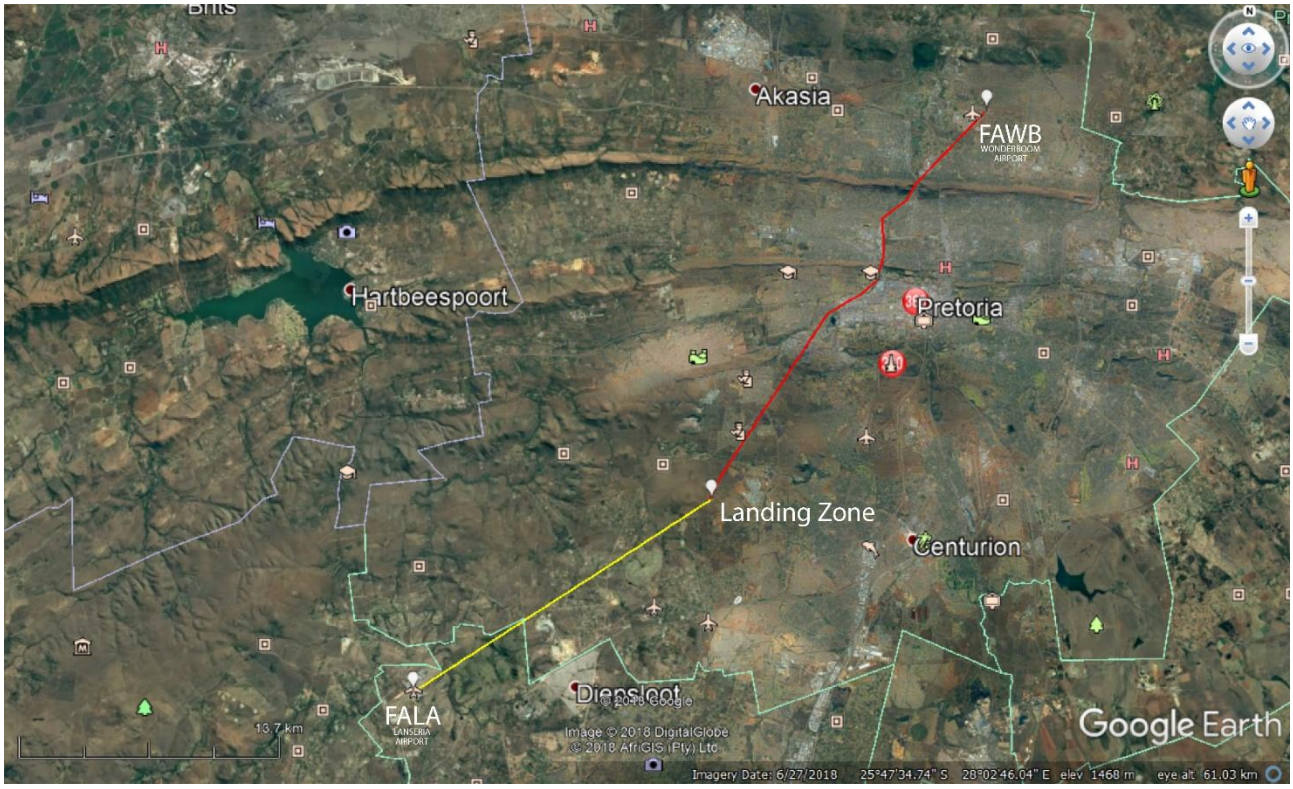


Figure 4: Google Map illustration of the helicopter path. The red line shows the path covered; The yellow line leads to the intended destination (Source: Google Earth)

2.1.6. The engine (Allison 250-C20J) flameout was caused by the Pc Safety Valve failure (valve stem broke off).

Figure 5 & 6: The Pc Safety Valve was found broken and the half stem could not be found. (Source: Approved Maintenance Organisation)

2.1.7. The Pc Safety Valve™ kit is an aftermarket product installed on the Allison 250-C20 series to provide a convenient method of isolating pneumatic pressure and sense lines during engine compressor water rinse and compressor chemical wash operations. The closing of these safety valves prevents water, washing solvents and other contaminants from entering such critical components as fuel controls, governors and bleed valves, and effectively reduces compressor wash/rinse time significantly in all engine applications. It closes off each applicable pneumatic line for the specific engine installation.

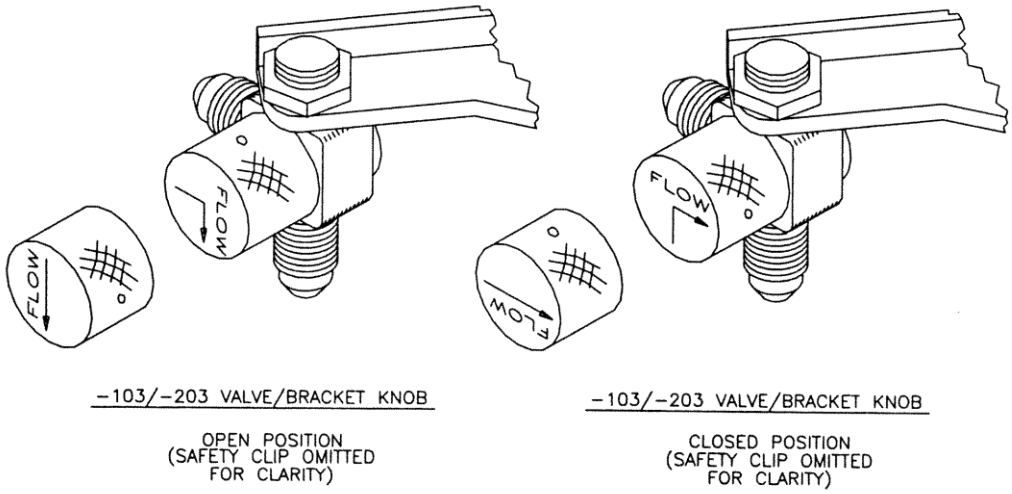


Figure 7: The Pc Safety Valve in the opened and closed position.
(Source: Aeronautical Accessories Continued Airworthiness Doc)

2.1.8. The Pc Safety Valve was fitted on the compressor scroll line. The back of the valve was broken into two separate pieces and the second half was not recovered. This would cause the governor to lose all Pc sensing pressure to itself and the FCU, reducing engine power to idle. A flameout can occur due to the FCU reducing the fuel flow (FCU will sense the Pc air pressure has dropped and will reduce the fuel accordingly). The Figure 8 shows the location along the fuel schematic.

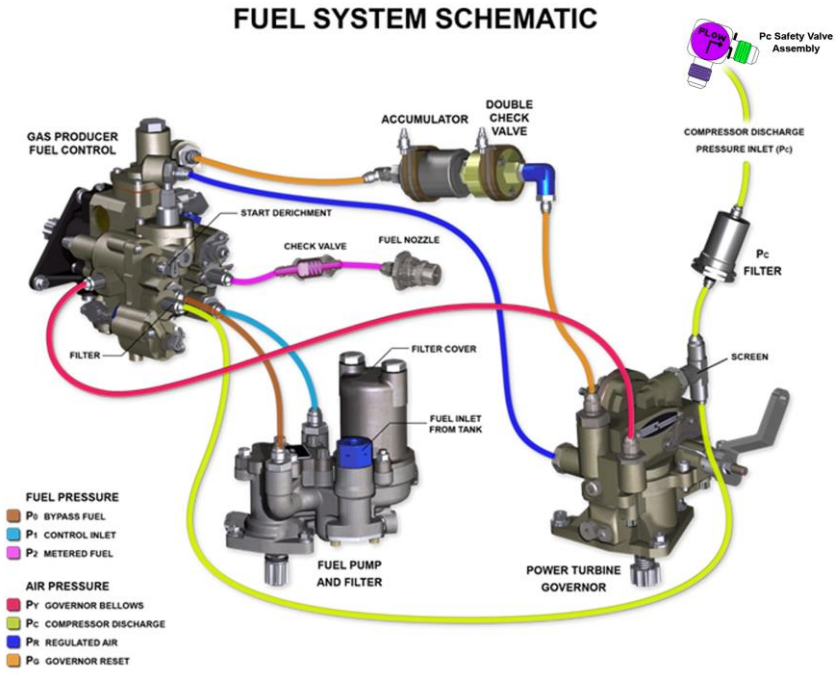


Figure 7: The Pc Safety Valve location (blue) in the fuel control system schematic.
(Source: Approved Maintenance Organisation)

2.1.9 The helicopter was previously registered and operated under the Brazilian Civil Aviation Authority. It underwent a registration process through the South African Civil Aviation Authority (SACAA) and was allocated a South African registration ZT-RAT. This process occurred between December 2017 and March 2018. The inspection/maintenance/overhaul record showed the Pc Safety Valve was installed on 17 November 2000 as a new component.

2.1.10 The manufacturer (Aeronautical Accessories) holds a STC SE5511NM (Supplemental Type Certificate) for the modification done to the engine, therefore a second review regarding the design, installation and maintenance schedule is not compulsory for the initial issue of the Certificate of Airworthiness (C of A) from the SACAA.

2.1.11 The manufacturer reported that there have been two other cases recorded where the Pc Safety Valve failed on the Allison 250-C20J engines.

THE FIRST CASE:

Tool markings were found on the valve stem head and adjacent valve body, evident of improper handling of the valve.

THE SECOND CASE:

Similar to this occurrence where it was a reported power loss and it was found that the safety valve was broken into two pieces.

2.1.12 The manufacturer issued an airworthiness instruction (AI) number AA-06107 which required that the Pc Safety Valve be returned to the manufacturer for overhaul after 3500 hours of operation and for those which were not tracked to be limited to 500 hours/year. This (AI) also required operators to inspect the Pc Safety Valve at every 100 hours. There was no evidence of conformance to this AI by the owner/operator of this helicopter.

2.1.13 The last inspection completed on the helicopter was a Mandatory Periodic Inspection (MPI) on 13 August 2018 at 3321.6 hours. The helicopter flew a further 0.6 hours after its last MPI.

FACTUAL INFORMATION

3 FINDINGS

3.1 The pilot was issued with a Commercial Pilot Licence on 13 December 2006, with an expiry date of 13 December 2018 and the aircraft type was endorsed on it. The pilot last did his skills test on 6 November 2017.

3.2 The pilot was issued with a class 1 medical certificate on 11 September 2017, with an expiry date of 30 September 2018.

3.3 The pilot had a total of 3948.6 flying hours, on which 191.2 hours were on type.

3.4 The aircraft was issued with a Certificate of Airworthiness on 7 September 2018, with an expiry date of 30 September 2019.

3.5 The airframe hours at the time of the accident were 3322.2 hours.

3.6 The last inspection completed on the helicopter was a MPI on 13 August 2018 at 3321.6 hours. The helicopter flew a further 0.6 hours after its last MPI.

3.7 The safety valve kit (Part No. 250-9549-105) IAW STC No. SE5511NM was installed on 17 November 2000 with a total engine time of 12.4 hours. The engine, serial number CAE - 270 893, had 2552.4 hours at the time of the accident.

3.8 The weather report for this occurrence was obtained at Mooiplaas. The weather did not contribute to this incident.

3.9 The investigation concluded that the in-flight engine stoppage was caused by the failure of the Pc Safety Valve. This led to the reduction of the engine governing air pressure which caused the fuel control unit (FCU) to reduce the amount of fuel to the engine. This resulted in a flameout. The pilot executed an autorotation landing and the helicopter landed hard, causing damage to the skids.

4 PROBABLE CAUSE/CONTRIBUTING FACTOR

4.1 The in-flight engine stoppage was caused by the failure of the Pc Safety Valve. This led to the reduction of the engine governing air pressure which caused the fuel control unit (FCU) to reduce the amount of fuel to the engine. This resulted in a flameout. The pilot executed an autorotation landing and the helicopter landed hard, causing damage to the skids.

5. REFERENCES USED ON THE REPORT

5.1 Technical report: Bell Engineering Laboratories – Report 20619M-012EXT.

6 SAFETY RECOMMENDATION

6.1 Safety message: Owners and operators of aircraft and helicopters are encouraged to conform to the Regulation and manufacturer's instructions to prevent occurrences such as this incident and a potential loss of life.

6.2 Safety action: Following this accident, the operator informed the investigating authority that they will, in future, not use the Pc filter on any of their helicopters.

7. ORGANISATION

7.1 Because of this occurrence, the aircraft operator has advised the AIID that they will not continue to use the Pc Safety Valve on any of their helicopters.

ANNEXURE 1

A Textron Company

Engineering Laboratories

SUBJECT: **EXAMINATION OF A MODEL 206B3 PC SAFETY VALVE FROM WARNE AVIATION IN SOUTH AFRICA**

History and Related Data:

1)	Part Name:	Pc Safety Valve
2)	Part Number:	250-954-106
3)	Part Serial Number:	4652
4)	Total Part Time:	2,552.8 Hours
5)	Helicopter Model:	206B3
6)	Serial Number:	4258
7)	Helicopter Time:	3,322.0 Hours
8)	CPR Number:	65074511

INTRODUCTION

A Model 206B3 engine compressor discharge pressure (Pc) safety valve was received in the Field Investigations Laboratory for examination of a fractured valve stem. It was reported that the aircraft experienced a sudden power loss enroute and autorotated to an open field. It was reported that the operator did not record the time of operation for the fractured Pc valve nor document any maintenance of it. If the safety valve was original to the aircraft that it was delivered on, the safety valve would have been manufactured circa 1992.

The purpose of the manually operated Pc safety valve kit is to isolate the engine fuel control system pneumatic sense line from the compressor bleed valve pneumatic sense line during required daily engine compressor washes without having to disconnect the valve and cap the line.

CONCLUSION

The valve stem head fractured as a result of overload. The fracture initiation area could not definitively be determined. Pre-existing cracks, most likely attributed to cyclic thermal exposure, were noted in the air passageway. There were no tool markings noted on the valve body or knob to indicate improper handling. There was no documentation of maintenance performed on the safety valve, which required a 100-hour inspection to confirm proper functionality.

DISCUSSION

The Model 206B3 Pc safety valve was received fractured as shown in Figure 1. The valve stem fractured in the air passage at the base of the valve knob. The valve stem, that possess the air passage and head, was not received. The knob was engaged with the valve body using a safety clip and was in the "open" position. In the "open" position, the valve stem air passage allows air flow from the engine scroll to the engine fuel control system pneumatic sense line. The air temperature is approximately 500-540°F with an air pressure of approximately 100 psi. The valve stem was reportedly machined from a piece of Vespel material, which is comprised of a resin base and a graphite filler.

The valve stem fracture surface is shown in Figure 2. The valve stem fractured as a result of overload. There were no arrest marks noted. The fracture features revealed two conflicting initiation locations. One initiation location was from the air passage at pre-existing cracks that measured 0.1 inch (3 mm) deep. The pre-existing cracks were most likely attributed to cyclic thermal exposure. A Pc safety valve examined in 2012 with a fractured valve stem initiated at this location at pre-existing cracks. The other possible fracture initiation location for the recent valve stem fracture was from the outer diameter surface, opposite from the air passage. These fracture features indicate it was the initiation location or that they were the result of multiple converging crack fronts. The fracture could not have initiated from both locations since the fracture progression was continuous and there was no intersecting line that would have been created. The outer diameter surface was smooth with no mechanical damage.

Figure 3 shows the valve body air passage. The valve body did not reveal any tool markings, which may indicate improper handling of the valve.

Per the Instruction for Continued Airworthiness for Pc Safety Valve Kits (AA-06107), the safety valve must be returned to AAI for overhaul after 3,500 hours of service. Valves not previously tracked for time toward overhaul should be assigned a usage rate of 500 hours per year of operation. Overhaul includes a replacement of the valve stem. It was reported that the operator did not record the time of operation for the fractured Pc valve nor document any maintenance on it. If the safety valve was original to the aircraft it was delivered on, the safety valve would have been manufactured circa 1992 and had 2,552.8 Hours. Bulletin AA-06107 also required a 100-hour inspection to confirm proper functionality.

Alert Service Bulletin (ASB) 206-07-112 was issued in response to a possible over-torque of the valve stem resulting in a shearing condition of the valve stem. The ASB warning stated that a minimum wait time after last engine operation before conducting the inspection is 45 minutes. This was attributed to thermal expansion of the valve restricting the rotation of the valve stem.

Aaron Slager, Engineer IV
Field Investigations Laboratory

Approved:

Robert Figueroa, Engineer V
Field Investigations Laboratory

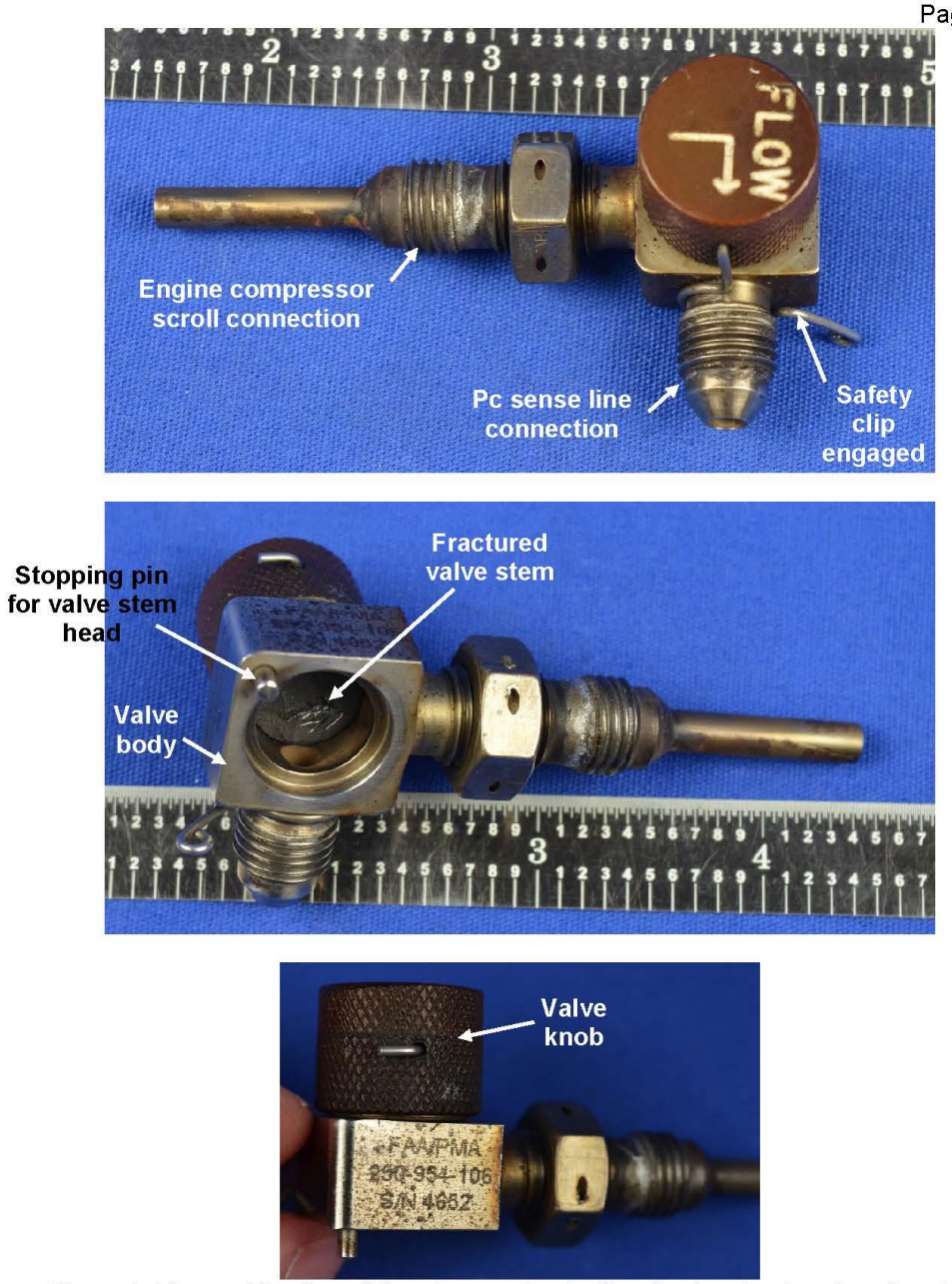
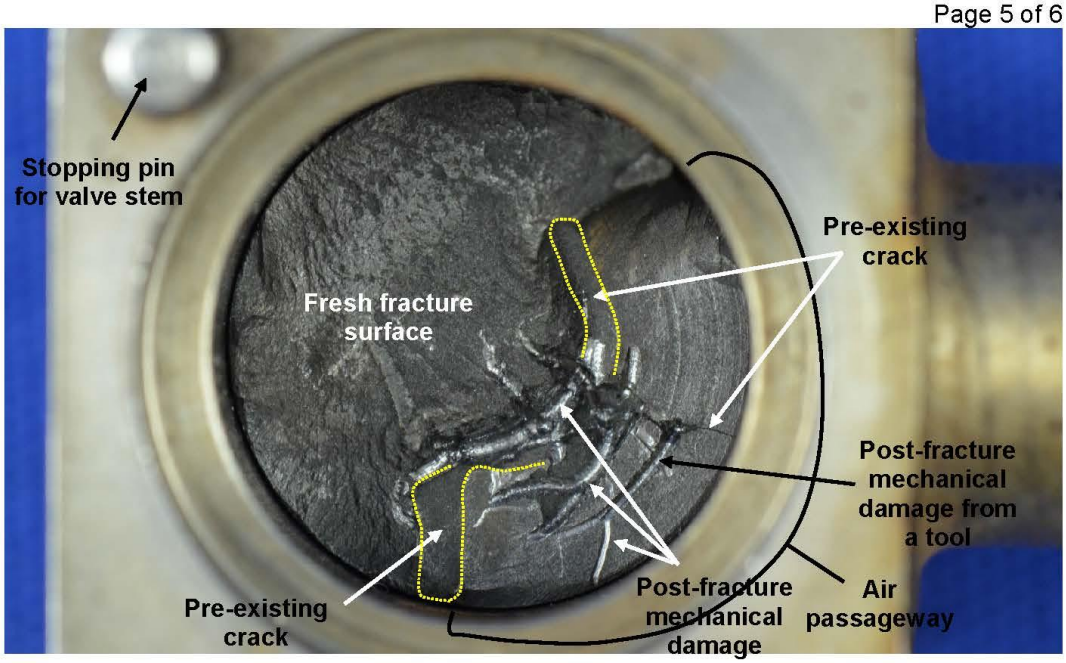


Figure 1: Views of the Pc safety valve received with a fractured valve stem (head not received).



Same orientation as shown above (knob removed from valve body and illuminated using directional lighting)

Fracture features indicate crack direction as shown with unmarked arrows

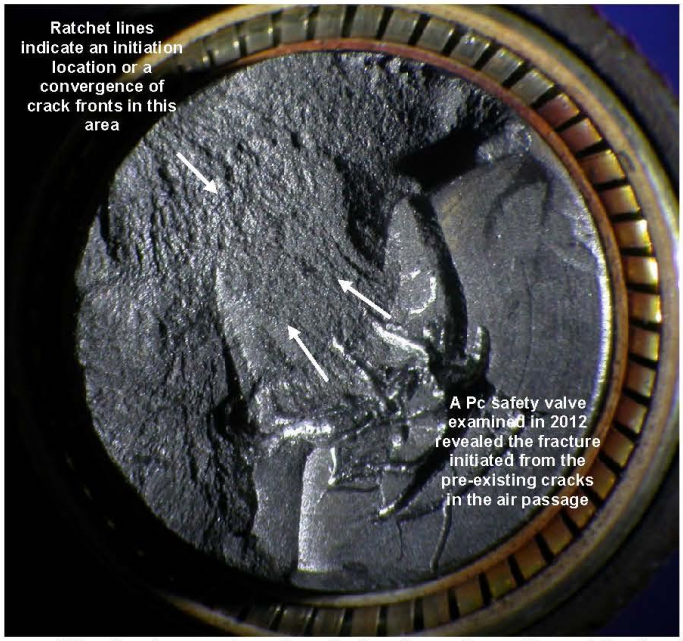


Figure 2: Views of the fracture valve stem in the "open" position. The fracture features revealed two conflicting initiation locations. Post-fracture mechanical damage was observed.

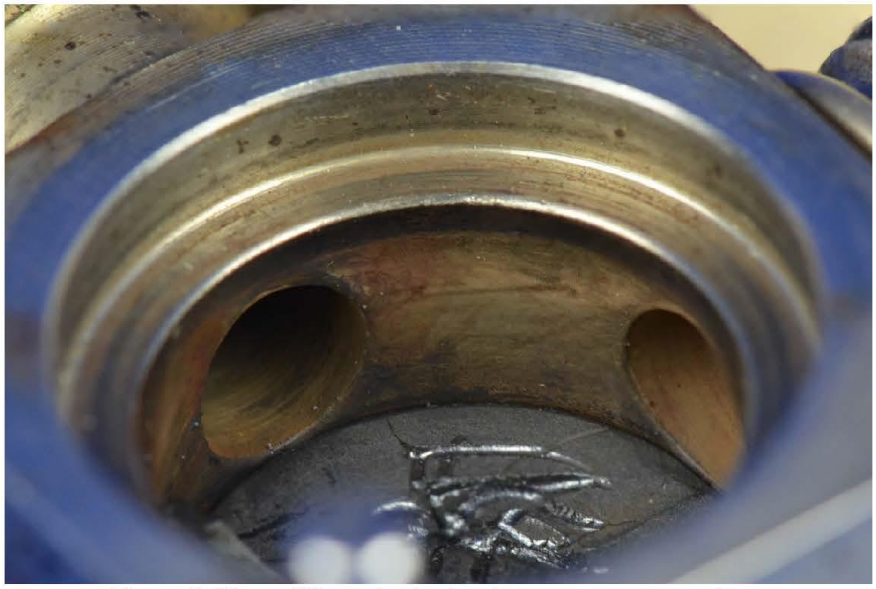


Figure 3: View of the valve body air passageway openings.