FINAL REPORT

AAIU Formal Report No.2005-003
AAIU File No: 2003/0026
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In accordance with the provisions of SI 205 of 1997, the Chief inspector of Accidents, on 7 June 2003, appointed Mr. John Hughes, Inspector of Accidents, as the Investigator-in-Charge to conduct an Investigation into this occurrence and prepare a Formal Report .

Operator:	Private
Manufacturer:	Enstrom Helicopter Company
Model:	280FX
Nationality:	British
Registration:	G-OPDM
Location:	Glenbeigh, Co. Kerry
Date/Time (UTC):	7 June 2003 @ 19.00 hours

SYNOPSIS

The helicopter, with two persons on board, had just taken off from a private helicopter pad at the owner's premises at Glenbeigh. At 600 ft the pilot heard noises from his rear, witnessed a drop in engine RPM and decided to autorotate for an immediate landing on the beach. On touchdown, one of the helicopter's left skids collapsed and one of the main rotors struck the sand. The tail rotor assembly separated from the helicopter and the tail boom structure tore from the fuselage. The occupants exited the helicopter unaided.

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 Pilots Comments

The pilot said that he and his passenger decided to go for a "run" in the helicopter. He got the owner's permission to take out the helicopter and they went down to the yard where it was kept on the owner's premises. He conducted his pre-flight examinations, showed his passenger the seat-belt procedures and both strapped in. He started the engine and brought the helicopter up into the hover for 10/15 seconds, hover-taxied back a bit, and took off into wind.

He climbed out in a straight line up to 500 ft and took a right turn out. They proceeded up towards Killorglin. He brought it up to 600 ft as he crossed the small estuary. He had just crossed the channel, was watching the gauges, when he heard noises from the rear which did not sound normal. He observed that the engine RPM and rotor RPM were correct. A few seconds later, the engine RPM pointer started to deviate down from the rotor RPM pointer. He dropped down the collective in order to check out the engine RPM. It continued to drop and he decided to enter autorotation. He looked forward for a place to land. The wind was behind him and he was over the edge of the water. He did not want to turn in because there was an embankment of rocks close to the Dooks golf links and he was afraid of hitting these rocks and not making the grass. He therefore elected to carry out a near downwind approach to the beach. The pilot had estimated the wind to be 270º at 7 to 8 kt.

As he flared the helicopter struck the sand quite hard. At this location on the beach the ground was sloping down from the pilot's right to left side. There was a loud bang and the helicopter spun to one side. The skid on the left side collapsed and the pilot fell against the left hand door. He pulled the "emergency stop" behind him and switched off all the electrical systems to prevent fire. He verified that the rotor had stopped rotating and then he followed his passenger out through the right hand door.

He telephoned the owner who arrived within 15 minutes.

1.1.2 Owner Actions and Comments

The owner notified ATC Shannon, who contacted the AAIU. The owner said that prior to autorotation the pilot had experienced a drop in engine manifold pressure. As the tide was coming in at the time, the Investigation gave permission to the owner to move the helicopter to a covered location for further inspection. The Investigation inspected the helicopter at that location the following day.

The owner subsequently informed the Investigation that the helicopter was on its way to collect him from a house-warming party in Killorglin when the accident occurred.

1.1.3 Witness Observations (Appendix A)

1.1.3.1 No. 1 Witness

The witness and his party were coming down the 11th hole at Dooks Golf Course and were about 200 yds from the teebox. This witness indicated that the helicopter had come from the Glenbeigh direction and traversed across the most western tip of the golf course. It then back-tracked parallel to the coast before turning again and crashing on to the sand.

He said that the helicopter had been turning severely left and right before the landing. Someone in the helicopter was waving at them. He also said that, *in his opinion,* he thought he was behaving in a very unprofessional manner. Both occupants were wearing white teeshirts, he thought, and both were fit looking.

At one stage, he thought they were going to put down on the rocks. Following the crash on to the sand, a piece from the helicopter fell on to the 11th fairway 15 yards further along and came to rest in the rough between the 10th and 11th fairways. He said that a member of their party picked up this tubular piece of twisted metal. It was about 10 ft in length and 1 inch in diameter.

1.1.3.2 No. 2 Witness

The witness, who had just teed-off on the 10th hole, informed the investigation that the helicopter flew from Glenbeigh direction over the western tip of the course and back-tracked along the coast towards the 11th men's tee box. The witness said that the helicopter hovered over the 11th ladies' tee box facing down the fairway. It was at a height of approximately 20 ft when it veered off left. It went on to the beach facing out to sea. There was a loud bang. A long piece of the helicopter, about 12 ft in length came flying across the fairway. Another golfer brought the piece back to the helicopter. A tractor and trailer took the helicopter across the 11th fairway. The witness said that there had been a lot of helicopter flying over the course during the previous two months and this was a bit of a nuisance for those playing on the course.

1.1.3.3 No. 3 Witness

This witness, who was on the 6th fairway, indicated to the Investigation that the helicopter came from the Glenbeigh direction. It made a horizontal 360º turn over the beach before aligning with the 11th fairway and crashing on to the beach adjacent to the ladies teebox. He was one of the first to arrive on the scene. He asked if the crew needed help. He said they were both very cool despite what had happened to the helicopter. They did not appear to be injured. He remarked to them how fortunate they were to have survived the crash.

1.1.3.4 No.4 Witness

A photographer, working for a local agency, said afterwards that he was prevented from taking pictures of the helicopter by those associated with the helicopter at the scene.

1.2 Injuries To Persons

The pilot reported a minor injury to the passenger.

1.3 Damage To Aircraft

One main rotor blade was damaged during the impact and is beyond repair. The left skid was broken at the cabin fixture. Control links on the main rotor hub were also broken. The tail boom and the complete tail rotor assembly were severely damaged. The tail rotor drive shaft and gearbox were found thrown from the helicopter. The shaft was found on the golf course. The left windscreen was cracked and the left floor window broken.

1.4 Other Damage

Although components of the helicopter were found on the golf course, no damage to the course was reported by the course Secretary.

1.5 Personnel Information

1.5.1 (Commander)

Personal Details:	Male, age 17 years
Licence:	UK/PP/424362E/H
Last Periodic Check:	7 March 2003
Medical Certificate :	11 February 2003

Flying Experience:

Total all types:	87.06	hours
Total all types PI:	47.00	hours
Total on type:	36.10	hours
Total on type PI:	31.55	hours
All Types: Last 90 days	41.10	hours
Last 28 days	13.15	hours
Last 24 hours	1.00	hours

1.5.2 (Passenger)

The passenger said that he had flown various types of microlight aircraft and gliders and had flown previously as a passenger in G-OPDM.

1.6 Aircraft Information

1.6.1 Leading Particulars

Aircraft type:	Enstrom 280FX
Manufacturer:	Enstrom Helicopter Company
Constructor's number:	2021
Year of manufacture:	1988
Certificate of registration:	7 January 1998
Certificate of airworthiness:	16 May 2001
Total airframe hours:	1,142 hours
Engine:	1,142 hours
Maximum authorised take-off weight:	2,600 lbs

Actual Take off weight:	1,757.5 lbs
Estimated weight at time of incident:	2,238 lbs
Centre of Gravity limits (at incident weight):	92 to100 inches aft of datum
Centre of gravity at time of incident:	91.66 inches aft of datum

1.6.2 General Information

Accommodation is for a pilot and two passengers, side by side on a bench seat. The helicopter has a high inertia, three-blade fully articulated rotor head with blades attached by retention pin and drag link. The control rods pass inside the tubular rotor shaft to a swashplate inside the fuselage. It has a two-blade teetering tail rotor. The drive from the horizontally mounted engine to the transmission is through a grooved rubber belt.

Skids are carried on oleo-pneumatic shock-absorbers. The power plant consists of one 225 hp Lycoming HIO-360-F1AD flat-four engine with a Rotomaster turbocharger. Two fuel tanks each contain 21.0 US gallons of 100LL fuel.

A twist grip-type throttle is located on the collective pitch control stick. The throttle is connected to a mechanical throttle correlation device which coordinates throttle control for changes in collective pitch settings. The throttle correlation linkage is connected to the fuel servo throttle valve on the engine. The correlator will compensate for changes in collective pitch when manifold pressure is above 25 inches Hg and will maintain RPM within the operating range for normal hover manoeuvring.

The turbo unit has only one moving part, a rotating shaft with a turbine wheel on one end and a compressor impeller on the other, all precision balanced and each contained in its own housing **(see Appendix B)**. The turbine wheel, driven by exhaust gas energy, drives the impeller which compresses intake air to a density greater than sea level and delivers it to the engine intake. This maintains rated engine power from sea level to 12,000 ft. The maximum continuous power is 225 hp at 3050 RPM, 39 inches of Manifold Pressure (MP) from sea level to 12,000 ft altitude.

1.6.3 Throttle and wastegate control

The wastegate is a valve that controls the amount of exhaust gases directed to the turbocharger **(see Appendix B)**. The valve is located on the exhaust manifold just upstream of the turbine inlet. Wastegate control is effected by a mechanical linkage from the fuel servo, which moves in sympathy with the pilot's throttle. A demand for more power not only schedules more fuel to the engine but via this link also moves the wastegate towards the closed position. This increases the exhaust gas flow to drive the turbine, increasing the compressor output (manifold) pressure, with a consequent increase in engine power. This link is designed to be collapsible such that should the wastegate become seized, particularly in the open position, then normal use of the throttle would remain available, although engine power would be limited.

The helicopter Flight Manual states that should turbocharger or wastegate failure occur, the engine could still produce sufficient power to sustain level flight.

The collapsible link is formed by a rod which could slide within a tube, but is held in a fixed relative position by a detent. This detent is effected by a spring loaded plunger, mounted on the outer tube, which engages with a groove on the inner rod.

1.6.4 Transmission System

The main transmission unit provides an RPM reduction ratio of 8.678 to 1.0 between the engine and the main rotor. The transmission incorporates a free-wheeling unit in the upper pulley assembly which is mounted on the pinion input shaft. The free-wheeling unit provides a disconnect from the engine in the event of a power failure and permits the main and tail rotors to rotate in order to accomplish safe autorotation landings.

Rotor RPM Limitations

Power On	Min	334 RPM
	Max	351 RPM
Power Off	Min	334 RPM
	Max	385 RPM

Operating the helicopter below 334 RPM with the collective off the down stop will automatically activate a warning horn.

1.6.5 Aircraft History

The servicing history for this helicopter over the last three years is as follows:

Inspection	At hours	Date In	Date Out	Duration	Hrs flown
*Annual(UK)	1006	9/12/00	10/5/01	6 months	00.0
50 hr (UK)	1025.3	4/8/01	23/2/02	6 months	19.3
Annual(UK)	1025.9	23/2/02	26/7/02	5 months	19.9
50 hr (UK)	1058.4	18/1/03	23/1/03	5 days	52.4
100 hr +	1109.8	30/3/03	20/5/03	2 months	103.8

The current Certificate of Airworthiness in the Transport Category (Passenger) was issued following the above Star (*) Inspection. The engine cylinder compression figures during the above servicing were as follows:

Cylinder No.	No.1	No.2	No.3	No.4
At the Annual Inspection (26/7/02)	70/80	70/80	70/80	65/80
On delivery to 100 hr inspection	40/80	20/80	20/80	20/40
Following 100 hr inspection + top o/h	71/80	73/80	71/80	74/80
Following the accident	64/80	71/80	61/80	68/80

It was reported by the ferry pilot that the helicopter lacked engine power on the flight to the maintenance contractor for the 100 hr inspection and that it was almost impossible to control the helicopter in the hover. This was discovered to be due to a lack of oil in the main rotor dampers.

1.7 Meteorological Information

1.7.1 The pilot reported that he obtained the following forecast from www.metoffice.com at 18.00 hrs on the day of the accident.

Wind:	270/ 7 to 8 kt.
Visibility:	10+ km
Weather:	Dry
Cloud:	Broken
Temp:	15 to 16º C

1.7.2 Aviation Services Division at Shannon Airport supplied the Investigation with the following weather information for 1800 hrs on 7 June 2003.

General Situation:	A low pressure system south of Iceland maintained an unstable southwesterly airflow over the area.
Wind:	2000FT 24020KT SFC 21010KT OCNL 22015G25KT
Weather:	Occasional moderate rain showers, risk of isolated heavy showers.
Visibility:	10Km
Cloud:	SCT 2000FT SCT 3000FT OCNL SCT 1000FT BKN CB1800FT
Surface Temp/Dew-Point:	14/10 degrees Celsius
MSL Pressure:	1009hPa
Comment:	Tephigram analysis suggested the potential for occasional heavy showers. Radar analysis confirmed that there were isolated heavy showers, at least to the east of Glenbeigh.

1.8 Aids to Navigation

Not applicable

1.9 Communications

Not applicable

1.10 Aerodrome Information

The helicopter took off from a private field at the rear of the owners premises.

1.11 Flight Recorders

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1.11.1 Cockpit Voice Recorder

The helicopter did not carry a cockpit voice recorder nor was this required.

1.11.2 Flight Data Recorder

The helicopter did not carry a flight recorder, nor was this required.

1.12 Wreckage and Impact Information

The helicopter impacted the sand with the left skid which broke off at the cabin shock absorbers. One of the main rotors struck the tail boom of the helicopter which partially separated from the aircraft. Parts of the tail including the tail rotor drive shaft left the helicopter on impact, and were recovered from the fairways of the nearby golf course.

1.13 Medical Information

Not applicable

1.14 Fire

There was no fire

1.15 Survival Aspects

Both pilot and passenger had a 3-point shoulder harness. They both exited the helicopter through the right hand door in less than 20 seconds.

1.16 Tests and Research

1.16.1 No Load Engine Test

The helicopter was brought to the AAIU facility at Gormanston where in the company of a licensed aircraft engine engineer the Investigation carried out an initial examination of the helicopter. Despite the extensive damage to the airframe, the engine bay was in relatively good condition.

Samples of fuel were taken from the filters and the fuel found satisfactory. The air filters were also found to be satisfactory. The turbocharger was checked for freedom of rotation. The engine oil was clean as the oil had been changed prior to the accident. No.4 ignition lead was found loose but not enough to cause an engine problem. There were screws missing from the cylinder heads and rocker box covers.

With the main rotor blades removed and the clutch disconnected, the engine was run. The engine started very easily. The oil came up to the correct pressure and the cylinder head temperatures were normal. A magneto drop of 175 RPM was achieved for both magnetos at an engine speed of 1475 RPM. Although the engine ran well, compression checks on the cylinders indicated some considerable cylinder wear considering that only 48 hrs had been flown since a top overhaul of the engine had been carried out.

1.16.2 Engine Test On Load

The engine was removed from the helicopter and sent to a UK engine overhaul facility. It was not possible to fit the engine on a test cell with the turbocharger attached. The engine was attached to a dynamometer to simulate rotor head loads. A full test was carried out on the engine and all measured parameters indicated that the engine was capable of delivering power over the full range up to 3050 RPM.

1.16.3 The Turbocharger and Wastegate linkage assembly

During the removal of the engine from the helicopter, the tube end of the wastegate collapsible link broke away from the gate valve due to heavy corrosion of the rod end **(Appendix C)**. The turbocharger was inspected at the UK facility and considered serviceable. However, the collapsible link between the fuel servo and the wastegate on the turbocharger was found to have had recent scoring of the rod at a point where the rod is secured to the tube by the plunger. This scoring was indicative that the rod had, at some time, been moving in the tube. These marks indicate that the collapsible or "breakaway" function of the linkage was operative in the recent past. The rod was also slightly bent at the fuel control end.

1.17 Organizational and Management Information

The helicopter had three previous US Registrations, N8627Q, N650P6 and N9609 and was also registered in the Netherlands as PH-GBL before being registered by a company at Goodwood, UK on 7 January 1998. The helicopter was initially given a UK Certificate of Airworthiness (C of A) in the Passenger Category.

The owner and the pilot received their initial helicopter training in the US early in 2003 and both obtained an FAA Student Pilot licence on 14 Jan 2003. The owner returned to Ireland and the pilot completed 46 hours training on a Robinson R22B helicopter.

On 25 February 2003, the pilot obtained a UK PPL (H) licence and commenced training on G-OPDM in March 2003. He completed 4.15 hrs training on this helicopter, of which 45 minutes were devoted to autorotational training. It was sold to its present owner on 14 March 2003 and a qualified pilot ferried the helicopter to Ireland. The pilot completed a further 31 hours as pilot in command.

On 3 June 2003 a qualified UK flight instructor arrived in Ireland to carry out 2 days of flight training with the owner of the helicopter. A total of 9 hours of instruction was carried out during this time with dual controls fitted. The owner indicated that dual controls were fitted on the helicopter when he flew on the day prior to the accident. The pilot stated that dual controls were not fitted at the time of the accident. However, there is no Flight Manual requirement to remove dual controls when a non-rated passenger is sitting in the co-pilot position. These controls were found stored in the helicopter when inspected the day following the accident.

1.18 Additional Information

In December 1981, the helicopter manufacturer issued a Service Directive Bulletin (SDB No.0054) for the F-28F and 280F models in order to replace the wastegate linkage assembly. Under certain flight conditions it was possible for the "breakaway" function of the assembly to allow temporary loss of wastegate control until a landing was made and the linkage reset. Installation of the new assembly was mandatory on receipt. The breakaway force was to be checked as part of each 100 hr inspection from then on. The Maintenance Manual requires that the wastegate system be checked for freedom of operation and security of connection every 50 hrs.

The SDB had not been issued for the 280FX model as this helicopter model was not certified until 1985. In February 2002, SDB 0054 Rev 1 was issued and this was effective for all models including the 280FX. It included an improved method for checking the breakaway force and this to be checked at every 100 hr inspection. It also stated that all maintenance was to be conducted in accordance with 28F/280F Maintenance Manual with the 280FX Supplement. The Investigation could not find any record of this check having been carried out at any time.

The helicopter manufacturer could not find the owners name or the maintenance contractors name on their database for technical publications. The owner of the helicopter is responsible for the correct maintenance of his helicopter.

The 280FX Rotorcraft Flight Manual (RFM) for this helicopter also calls for the pre-flight checking of the wastegate linkage for being in detent and free with unrestricted motion with throttle movement. The pre-flight check should also include the area around the turbocharger for evidence of corrosion due to heat damage.

1.19 Useful or Effective Investigation Techniques

1.19.1 Wastegate linkage tests

The wastegate linkage was removed from the engine and brought to a materials laboratory for testing. An Instron tensile testing machine was used to apply an axial tensile force to the wastegate linkage to measure the force needed to pull out the rod.

They found that a very high force was needed, of 1535 Newtons (N), which is approximately 345lbs and much larger than the specified detent force of 15-20lbs. This lead the Investigation to conclude that the screw had been tightened down too far and wire locked, preventing the rod from moving except at the very high force.

1.19.2 Fuel Servo Tests

The UK CAA notified the Investigation that a UK registered helicopter had previously suffered from a loss of engine power in a high hover in May 2000 and incurred extensive damage on landing. The follow-up examination of the engine fuel servo on its engine revealed a heavy deposit of brass dust in the diaphragm chamber. The dust from the bellows needle bush caused closure of fuel supply to the idle position and a consequent reduction in power.

As a result, the investigation forwarded the fuel servo from G-OPDM to a UK contractor for examination. They found a very small amount of brass contamination on the air diaphragm which is due to wear from the variable needle orifice. However, the contractor stated that it was unlikely that this small amount of debris could have caused any problem, given that the engine ran perfectly on test.

2. ANALYSIS

2.1 Technical History

Prior to being sold to the present owner this helicopter had only flown 52.4 hours in two years in the UK. During this time it had spent 17 months on the ground whilst servicing was being carried out.

The figures for cylinder compression in July 2002 were satisfactory. A total of 51 hours was completed prior to the helicopter being ferried to Ireland. A change of ownership was not notified to the CAA and two changes of ownership had not been notified to the manufacturers of the helicopter. Records show that manufacturers documentation was still being sent to the original UK importer. A further 30 hours were then completed in Ireland before the helicopter was brought to a contractor in Dublin for a 100 hr. servicing. On the ferry flight from Glenbeigh the ferry pilot, who was not associated with G-OPDM, reported that the helicopter lacked power and that it was difficult to control in the hover. This was due to a lack of oil in the main rotor dampers. An engine cylinder compression check also confirmed very low compression in three engine cylinders. All four cylinders were removed from the engine and sent to a facility in the UK for a rebore.

The contractor carried out four test flights covering a total of 10 hours during 21, 22, 23, and 24 May 2003. The helicopter was handed over to the accident pilot who also conducted an air test. He was satisfied and then ferried the helicopter back to Glenbeigh. A further 22 hours were flown locally, before the accident.

Immediately following the accident, and with the main rotor assembly disconnected, the engine started easily and without a problem. Verification of the engine status was made when the engine was dispatched to a UK engine overhaul facility. Without the turbocharger fitted, the engine was found to be capable of delivering rated power over the full range.

2.2 The turbocharger

When the turbocharger was examined it was found that the wastegate linkage spring plunger had been screwed tight into its detent. There were recent score marks on the rod which would indicate that the "breakaway" action was functioning at some stage prior to the spring plunger being screwed down tight. This detent is required in flight in a case where the exhaust gate valve sticks. The exhaust temperature is in the region of 890º C and the valve may seize in the exhaust line. The pilot should in such a case be able to control the flow of fuel to the engine but only if the detent is operating correctly and free to "breakaway". There is no evidence to show that the valve in the exhaust pipe did seize at the time of the accident. The throttle would have been stiff to rotate if this happened. This was not evident on the no-load test run immediately following the accident and was not mentioned in the pilot's report. The valve was functioning normally, when examined by the Investigation at the UK facility. It is concluded that the incorrect setting of the wastegate linkage could not have contributed to a loss of available engine power prior to the accident.

2.3 Maintenance Responsibilities

The owner is responsible for the proper maintenance of his helicopter. However, he would not receive copies of Service Bulletins or any other documentation if he had not informed the manufacturers of the change of ownership. In February 2002, a Service Bulletin was issued to check the detent breakaway force every 100 hours of flight. Neither the owner or contractor were aware of the existence of the manufacturers SB covering this area.

2.4 Operational

The purpose of the flight is not clear. If the purpose was to collect the owner at a nearby town then there was no requirement to fly near the golf course. All of the witnesses who observed the helicopter from different angles, indicated that the helicopter traversed the edge of the golf course and backtracked before turning again at low altitude prior to crashing on the beach. One of the witnesses observed that the helicopter hovered over a teebox. However, the pilot indicated that he went on a straight down wind approach and at the end flared, to make a landing on the beach.

There is also a difference in the weather forecast as obtained by the pilot prior to the flight and the aftercast provided by Met Eireann. If the helicopter had been flying at low altitude between the mens and ladies teebox on No.11 hole, as reported by witnesses, then the helicopter would have been under the influence of tail gusts of between 15 and 25 kt. Maintaining control of the helicopter in a hover under these circumstances would have been most difficult. If the pilot attempted to transition away downwind it is likely that he would have run in to power and transitional lift problems.

The pilot, who was 17 years of age, had 32 hours flying experience as Pilot In Charge (PIC) of this particular helicopter type. Although permitted to carry passengers, the Investigation is of the opinion that, in general, the carrying of passengers by young and inexperienced helicopter pilots is not good aviation practice.

General Flight Rules state that an *aircraft shall not be flown closer than 150 metres (500 ft) above the ground or water.* Aeronautical Information Circular (AIC Nr9/99) issued by the IAA specifically refers to low flying over golf courses. An aircraft should be flown at a height as would permit, in the event of the failure of a power unit, a safe forced landing to be made. In this event the observations of the witnesses on the golf course would suggest that the aircraft was flown at less than 500 ft above the course.

3. CONCLUSIONS

3.1 Findings

3.1.1 There is conflicting evidence between eyewitnesses and the pilot regarding the actual flight path of the helicopter prior to impact.

3.1.2 Examination of the helicopter and engine found no evidence of a pre-existing defect or failure that would have caused the helicopter to suffer a loss of power.

4. SAFETY RECOMMENDATIONS

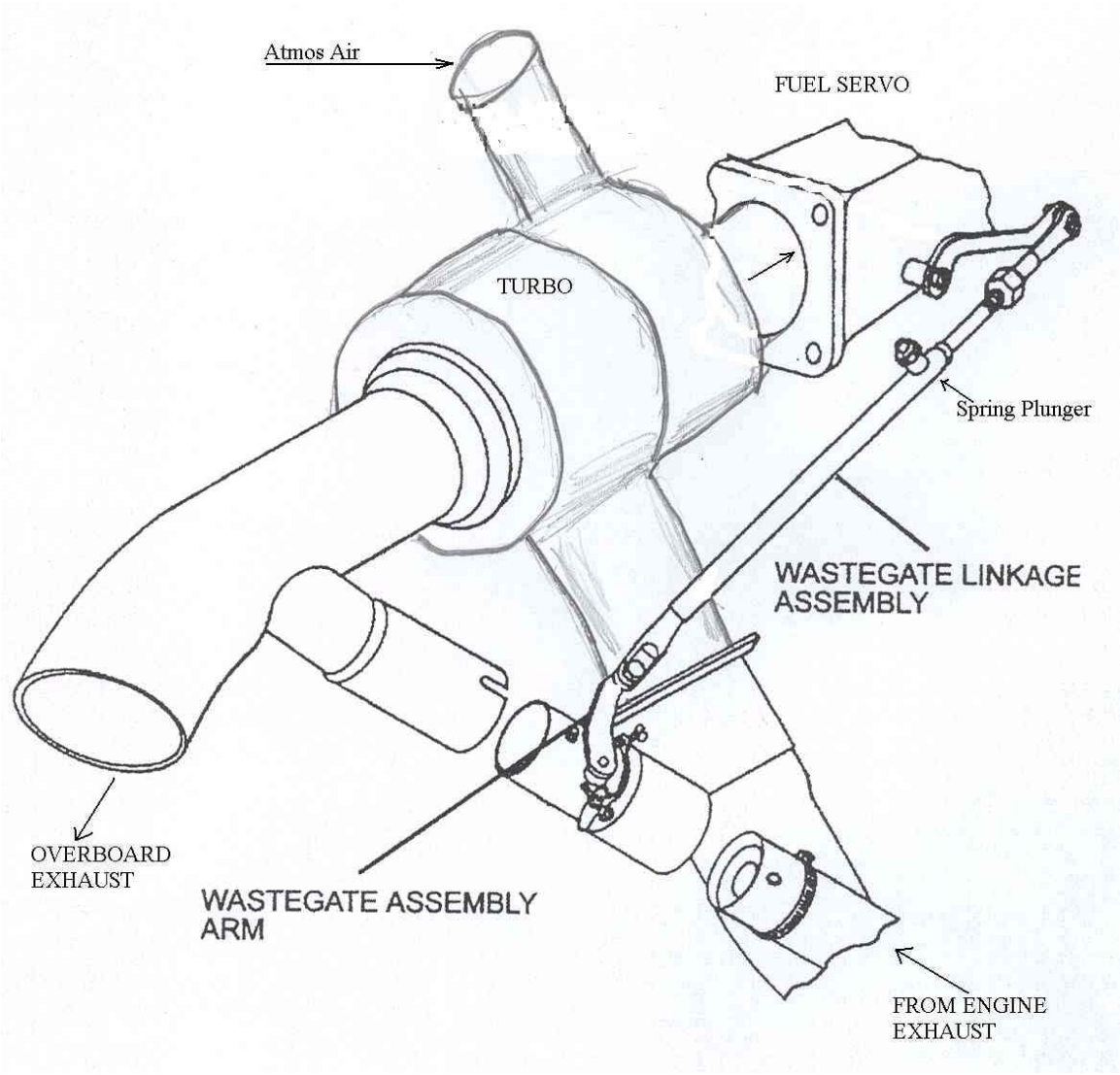
This Report does not support any Safety Recommendations.

APPENDIX A

Plan of section of the golf course showing the pilot's reported track of G-OPDM (colour black) and the track as observed by three witnesses positioned at their relative locations throughout the course (1,2 &3 in blue,red & yellow).

(Drawing not to scale.)

APPENDIX B


Atmos Air
FUEL SERVO
TURBO
Spring Plunger
WASTEGATE LINKAGE ASSEMBLY
OVERBOARD EXHAUST
WASTEGATE ASSEMBLY ARM
FROM ENGINE EXHAUST

APPENDIX C

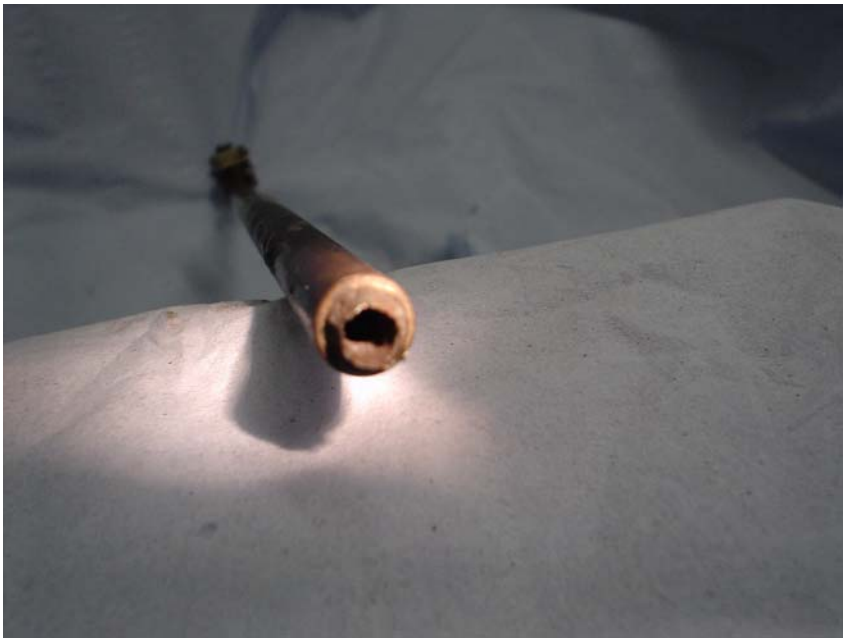


Photo showing corrosion on butterfly end of wastegate linkage.

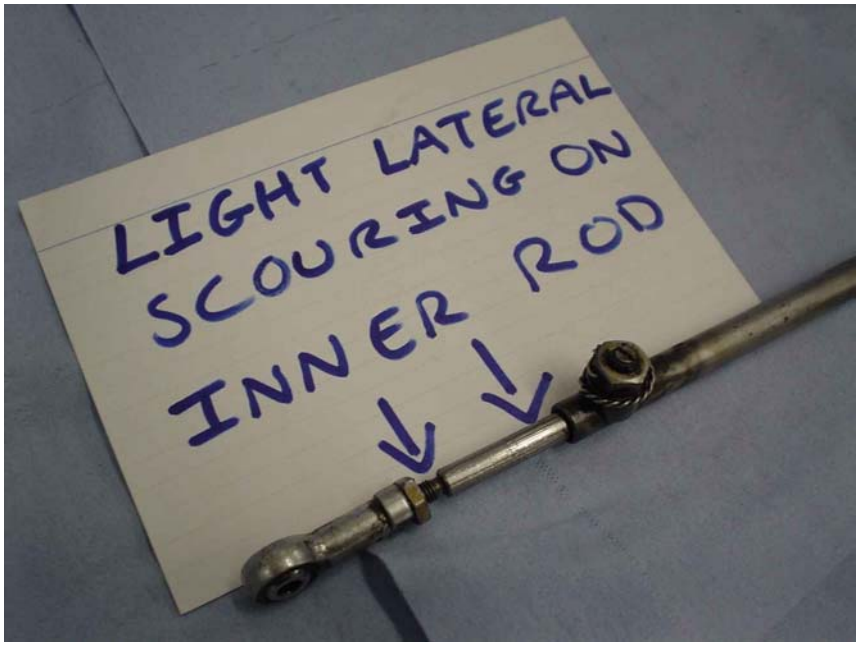


Photo from engine contractor showing other end of linkage with score marks on inner rod.