FINAL REPORT

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In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on the 23 November 2007, appointed Mr. John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this Incident and prepare a Synoptic Report.

Aircraft Type and Registration:	APEX DR400/140B, EI-SKL
No. and Type of Engines:	1 x Thielert TAE 125-01 (Centurion 1.7)
Aircraft Serial Number:	2611
Year of Manufacture:	2006
Date and Time (UTC):	23 November 2007 @ 12.25 hrs
Location:	Weston Airport, Co. Kildare
Type of Flight:	Training
Persons on Board:	Crew - Two Passengers - Nil
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	None
Commander's Licence:	Commercial Pilot's Licence (CPL)
Commander's Details:	Male, aged 31 years
Commander's Flying Experience:	500 hours, of which 79 were on type
Notification:	Weston Airport MOR (Mandatory Occurrence Reporting) Form
Information Source:	AAIU Pilot Report Form submitted by Pilot, AAIU Field Inspection

SYNOPSIS

The Instructor and pupil were conducting training circuits from Runway (RWY) 25 at Weston Airport when EI-SKL experienced a partial engine failure after take-off. The Instructor called an emergency, and turned back to land on the reciprocal runway. He successfully landed the aircraft on the grass to the left of that runway. EI-SKL rolled to a nearby taxiway and shut down. The aircraft sustained no damage and the pilots exited the aircraft in the normal way. Later, on engine examination, it was found that an induction pipe had worked itself loose.

FINAL REPORT

1. FACTUAL INFORMATION

1.1 History of the Flight

At 12.25 hrs, after 45 minutes of continuous circuits to RWY 25 at EIWT, EI-SKL experienced a partial engine failure after take-off. At the time the aircraft was in the climb, crossing the end of RWY 25 at approximately 200-300 ft. The Instructor called an emergency, and turned back to land. As there was no following traffic or other aircraft in the vicinity, it was safe for EI-SKL to turn back onto RWY 07. The pilot successfully landed on the grass to the left of the runway. EI-SKL rolled to a taxiway and shut down.

The crash alarm had been sounded and the crash rescue vehicle Rescue 1 arrived at the aircraft as the pilots were climbing out, less than one minute after landing. As the aircraft appeared to sustain no damage, it was then pushed back to the North apron. Neither the Pilot nor aircraft Operator notified the engine Manufacturer after the incident took place.

1.1.1 Instructor's Comment

"Having completed fifty minutes flying, doing touch and goes, we lost thrust during take-off. I took control of the aircraft and came back to land. I spoke with the control tower and did the standard call for this situation. We landed at 12.30 hrs local."

He said that he estimated the sudden loss of power to be 40 to 50% of take-off power and that there were no engine panel warnings prior to this loss of power.

1.2 Aircraft Information

1.2.1 The Airframe

The standard DR 400/140B is a full four seat aircraft built by Avions Pierre Robin in France and now taken over by Air Apex. It has a non-retractable landing gear, conventional ailerons and rudder and all moving tailplane. The structure is of wood with a single box spar with ribs threaded over the box. A polyester fabric covers the whole structure. In its standard form, the aircraft is powered by one Lycoming 160 HP petrol engine driving a fixed pitch two-blade wooden propeller.

1.2.2 The Engine

In this particular type, however, the aircraft is powered by one Thielert TAE Centurion 1.7 diesel injection engine at a rated 135 HP. The engine installation is approved under the EASA STC A.S.01380. On the DR400, the STC is factory installed on new aircraft. The engine is an in-line four-stroke 4-cylinder turbocharged motor, is liquid-cooled, and has a FADEC (Full Authority Digital Engine Control) system with electronic data logging. There is one central single-lever control for all settings of engine and propeller. Either diesel (DIN EN 590) and/or JetA1 aviation fuel (ASTM 1655) can be used with a fuel consumption of 4.5 gal/hr. The engine is certified by EASA (TC E.055) and FAA (TC E00069EN). The engine is currently installed in Diamond Aircraft DA 40 and DA 42 aircraft and is approved under Supplemental Type Certificate (STC) for installation in Cessna 172 and Piper PA 28 aircraft. The STCs are held by the engine manufacturer.

The engine is fitted with a 3-blade constant speed MT-Propeller driven through a reduction gearbox/clutch from the engine output shaft (Ratio 1:1.69). It incorporates mechanical vibration damping and propeller overload release. The high compression of the diesel engine results in much better fuel efficiency. Also, the higher RPM (in comparison to conventional aircraft piston engines) allows higher power to be developed from smaller cylinder displacement. The turbocharged engine also allows greater power to be developed at altitude in comparison to a naturally aspirated engine. The engine has an electrical self starter and an alternator. The engine requires an electrical power source for its operation. For this reason, a back-up alternator excitation battery is installed to ensure that the alternator continues to function even if the main battery should fail.

1.2.3 Engine Life Extension Programme

Engine maintenance is governed by a component life extension programme. The recommended engine life is 1,000 flight hours or 12 years, whichever comes first, according to service Bulletin TM TAE 125-0001 Rev. 2 - Lifetime. The high pressure fuel pump and the alternator have a Category 1 (Safety) inspection/replacement requirement endorsed by EASA Airworthiness Directive AD D-2008-0128. The reduction gearbox and clutch assembly are also included in this programme. The excitation battery of the alternator is replaced every 12 months.

1.2.4 Aircraft Servicing

The aircraft was first registered on 30 November 2006. At the time of the incident, the hours flown since new were 932 hours. On 14 November 2007, a 300 hour inspection was carried out on the aircraft in accordance with Schedule 366 MS. The gearbox, clutch assembly and feed pump were time expired and removed for return to the engine manufacturer. Replacements were installed along with a new gearbox oil filter, an engine oil filter and a fuel filter.

1.2.5 Pilot Operating Handbook (POH)

The Supplement POH states that in flight total engine failure could occur if the battery and alternator fail simultaneously. Page 3-2 of the same supplement states that on engine failure or loss of power immediately after take-off, the pilot should land straight ahead and incorporates a warning which states:

"Never try to turn back to the runway, as altitude just after take-off is seldom sufficient."

1.3 Meteorological Information

The ATIS forecast conditions were as follows:

Wind:	250/12kt
Visibility:	10 km
Significant Weather:	None
Cloud:	SCT 020
Temperature/Dew point:	10/08

1.4 Inspection of Engine

An inspection of the engine following the incident revealed that the silicone hose from the turbocharger to the intercooler had become loose at the turbocharger outlet thus allowing ambient air to enter the engine intake instead of the normal compressed air flow. A Wiggins clamp (Jubilee clip), which secures the end of the hose to the turbocharger outlet was found tightly clamped in situ on the displaced hose. The hose was replaced on to the turbocharger outlet and re-clamped in situ (**Appendix A**). The aircraft was then released to service.

The Manufacturer commented that a loose clamp results in the reduction of manifold air pressure as the pressurized air coming from the turbocharger is partially blown off. If the turbo outlet hose is fully detached and disconnected, ambient air only will enter the engine.

1.5 Tests and Research

In March 2007, the engine manufacturers issued a Service Bulletin (Category 1-Safety) for the Cessna 172 (No. TM TAE 601-0006) and Piper PA28 (No. TM TAE 651-0006) with the TAE 125-01 engine installed. The purpose of the bulletin was to ensure:

" Prevention of slipping of the silicone hoses from the pressure pipe and the intake manifold"

The pressure pipe in this case is the pipe between the intercooler and the engine intake manifold. Its installation ensured that two clamps (**Appendix B**) were installed at the end of each hose instead of one, tightening the clamps to a specified torque, application of sealant to all clamps and the marking of a slip line at the end of each hose for a later slip check. This SB did not apply to the DR400/140B.

At the same time, the engine manufacturers issued a Service Bulletin (Category 1-Safety) for this aircraft type, the DR400/140B (No. TM TAE 671-0001). The purpose of the bulletin was to ensure:

" Prevention of slipping of the air hoses between the turbocharger and intake manifold."

This SB issued instructions for the installation of two clamps at the turbocharger pressure pipe, two clamps at the intercooler, another two clamps on the intake manifold and one clamp only at the outlet of the intercooler (total 7 clamps).

In June 2007, only 3 months later, the engine manufacturers re-issued the Service Bulletin for the DR400/140B (No. TM TAE 671-0001 Revision 1) The re-issued SB gave instructions for the removal of the double clamps and reinstallation of a single clamp at the turbocharger pressure pipe and at the intercooler (**Appendix B**). It included the final tightening of the clamps to a specified torque, application of sealant to all clamps and the marking of a slip line at the end of each hose for a later slip check. The torque and slip marks were to be checked between 3 and 6 flight hours after the incorporation of the Service Bulletin, with torque values and slip marks checked every 25 flight hours thereafter. Part B of this SB referred to the replacement of the intercooler at the next maintenance check or within the next 100 flight hours, whichever occurs soonest. On EI-SKL, Part A was carried out on 18/06/07, 29/06/07 and on 09/07/07 with Part B installed on 06/07/07.

1.6 Additional Information

The engine manufacturer stated that the addition of the second clamp did moderately increase the resistance to hose slip, but that proper installation of the second clamp was complicated due to geometrical and accessibility constraints. In order to effectively improve resistance to slipping, the design of the pipes was modified. The inlet and outlet of the new intercooler as well as the turbocharger outlet pipe were grooved in the area where the clamp is positioned. The revised SB describes the installation of the intercooler with the grooved inlet/outlet pipes. The turbocharger pipe was not exchanged, since there were no known occurrences related to disconnected/slipped hoses.

2. ANALYSIS

With the engine type in the development stages it is reasonable to expect that in-service problems will occur more frequently than with long established aircraft engines of the normal aspirated or injection type. Components being removed regularly at low hours for return to the manufacturer, increases the risk of interconnecting and coupling failures. In this case the issue and re-issue of servicing bulletins would also increase the risk.

The Revised SB does not explain why the manufacturer reverted to single clamps or why a new intercooler was required. The Operator carried out the SB instructions but this did not guarantee the safe security of the hose and pressure pipe connections. In service, some oil and other contaminants are carried in the airflow from the turbocharger and these in time help to contribute to an increase in hose slip. Unfortunately the hose will tend to disconnect at high power settings, such as at take-off when the power and vibration are maximum. The engine manufacturer should re-examine the turbocharger pipe/hose connection design so as to improve its security.

EI-SKL has now been returned to the aircraft manufacturer for an engine re-fit to the TAE 125-02 standard.

The Instructor did have some power available and felt confident that he could return safely direct to the airfield. He must be complimented on his ability to land the aircraft without any subsequent damage or injury to persons.

3. CONCLUSIONS

(a) Findings

The aircraft suffered power reduction during take-off.

(b) Cause

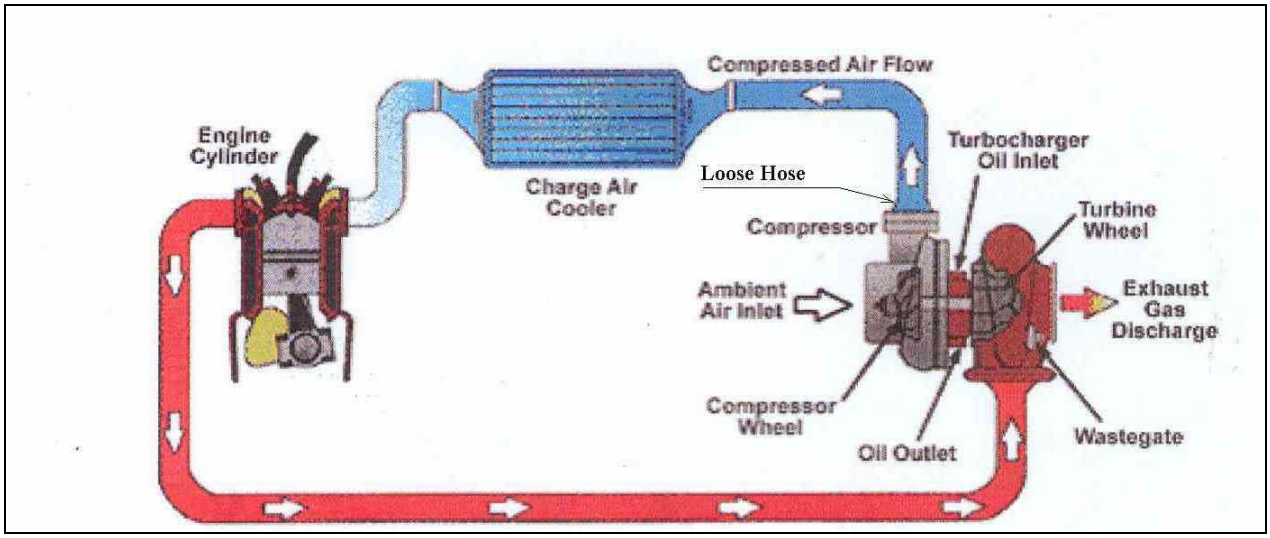
The air connection from the turbocharger to the intercooler failed when the adjoining hose slipped off.

4. SAFETY RECOMMENDATIONS

It is recommended that:

The engine manufacturer should re-examine the turbocharger pipe/hose connection design in order to improve its security. **(SR 25 of 2008)**

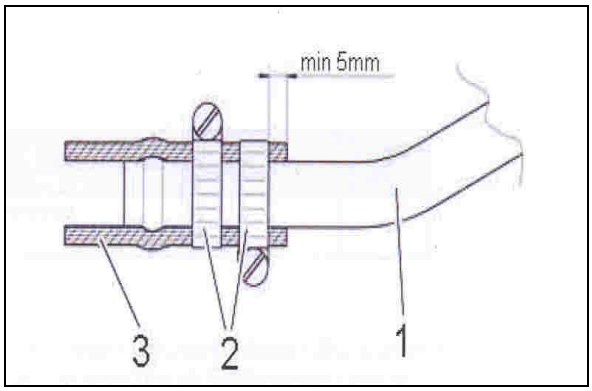
APPENDIX A



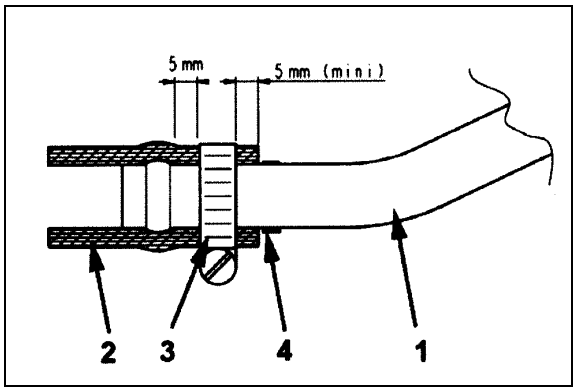
The turbocharger consists of a radial compressor and a centripetal turbine, which are connected with a common shaft. The exhaust gases of the engine drive the turbine. Position of loose hose is shown. ***(Sketch, courtesy manufacturer's Repair Manual).***

Blue arrow indicates the single clamp, which became loose, leading to a rapid deterioration of engine power.

APPENDIX B



1 - Pressure pipe, 2 - Clamp, 3 - Hose.
SB (No. TM TAE 671-0001) initial issue requiring two clamps.



1 - Pressure pipe, 2 - Hose, 3 - Clamp, 4 -Slip Mark.
SB (No. TM TAE 671-0001 Revision 1) requiring only one clamp and a slipmark.

- END -