AAIB Bulletin No: 4/95 **Ref: EW/C95/1/5** **Category: 2.3**

INCIDENT

Aircraft Type and Registration:	VPM M16 Tandem Trainer, G-YRAT	
No & Type of Engines:	1 Arrow GT1000 2-stroke piston engine	
Year of Manufacture:	1993	
Date & Time (UTC):	21 January 1995 at 1540 hrs	
Location:	In-flight, landed at Windrush Airfield, Oxfordshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Cracked and distorted fork component in flying control system	
Commander's Licence:	Private Pilot's Licence with Instructor Rating	
Commander's Age:	54 years	
Commander's Flying Experience:	250 hours (of which 235 were on type) Last 90 days - 20 hours Last 28 days - 10 hours	
Information Source:	AAIB Field Investigation	

The aircraft was a gyroplane (or autogyro) of a type part-manufactured in Italy and imported in kit form for assembly under the auspices of the Popular Flying Association. Photographs of a similar VPM M16, G-BVRD, are shown on page 26 in this edition of the AAIB Bulletin, 4/95.

G-YRAT was being flown on a cross-country flight from Kidlington Airport when the pilot became aware that increasing movement of the control stick to the left was being required in order to prevent the aircraft from rolling to the right. He was close to the airfield at Windrush and was able to make a precautionary landing there, managing to keep the aircraft upright during the landing although the stick was, by now, being held against the left-hand control stop.

In the VPM M16 design, the pitch and roll commands from the pilots' sticks are transmitted to the rotor head control rods by means of a welded steel fork (examples shown in Figures 1 and 2, the control layout shown in Figure 3). Examination of the fork from G-YRAT (Figure 1) after the incident showed that one arm had almost totally separated at the elbow weld and the resulting distortion had

caused the loss of control authority. The fork from G-YRAT was submitted for detailed metallurgical examination. An identical component from G-BVRD, the VPM M16 involved in an accident at Cranfield on 12 January 1995, was also submitted for examination at the same time.

The fork from G-YRAT (Figure 1) showed distinct plastic deformation around the elbow area and a large crack close to the weld bead on the 'port' side of the aircraft; the paint had also cracked and flaked from the corresponding area on the opposite ('starboard') side of the fork. Examination of the crack faces showed that the fracture was typical of that resulting from high-stress low-cycle fatigue and magnetic crack detection tests showed a small crack to be present adjacent to the corresponding weld bead on the opposite ('starboard') side of the fork.

Examination of the fork from G-BVRD (Figure 2) showed similar plastic deformation to that found in the fork from G-YRAT, including paint cracking and flaking, although to a lesser degree. In order to investigate the quality of the welding and the material strengths of the tubing, metallurgical sections from both forks were prepared and examined by microscope and microhardness test; this examination showed that the welding was of good quality and satisfactory form and strength.

From these examinations it is apparent that the damage to both forks had resulted from in-service loading of a high order, approaching, and periodically exceeding, the elastic limits of the tube material. The occurrence of these high loads on both forks was confirmed by the examination of the bearings in the control rod attachment arms, with heavy damage to the bearing raceways on the fork from G-YRAT and lighter damage in the same areas on the fork from G-BVRD.

Analysis of the normal in-flight loads in the flight control system indicate that they would not be large enough to cause the damage observed in the forks either in G-BVRD or G-YRAT. It is more likely, therefore, that the damage to the control fork from G-BVRD was caused during the dynamic flapping excursions which resulted in the accident to that gyroplane and that the initiation of the damage to the fork from G-YRAT was the result of a similar, but earlier, incident. As a result of these examinations the CAA has advised owners of VPM M16 gyroplanes that, before further flight, the fork should be subjected to an inspection including crack detection and that this should be repeated following any incidence of excessive blade flapping.

There is a lack of quantitative experimental data on the control loads in light gyroplanes during the flight and ground phases of operation, although it is suggested that high control loads can be developed during operation over rough ground. It is recommended, therefore, that the CAA take advantage of the current light gyroplane flight test programme to generate quantitative flight test data on control forces during the flight and ground phases of operation. [Safety Recommendation 95-7]

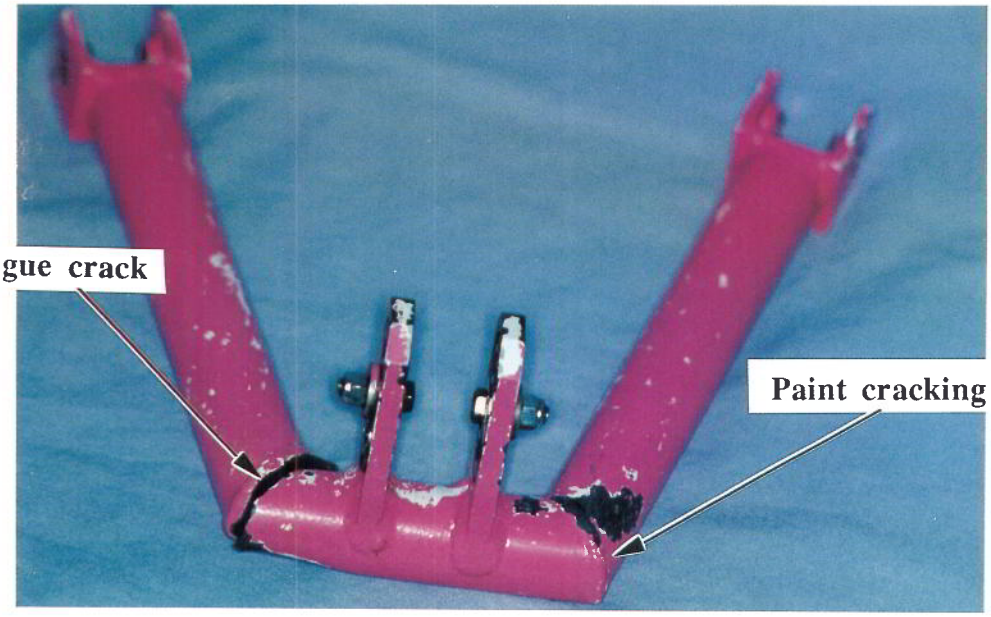

Figure 1 - Fork from flying control system of VPM M16, G-YRAT

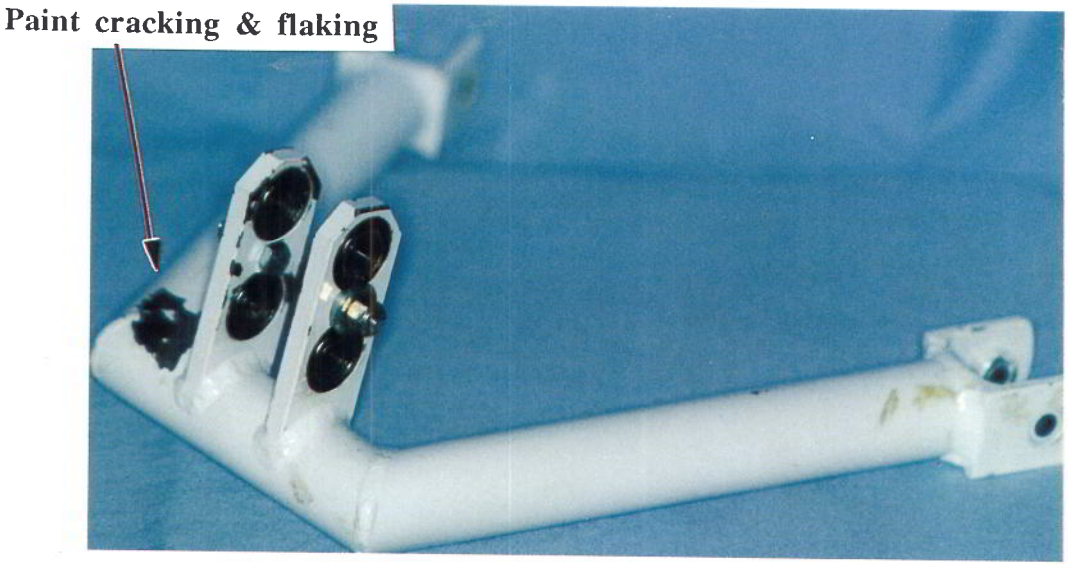

Figure 2 - Fork from flying control system of VPM M16, G-BVRD

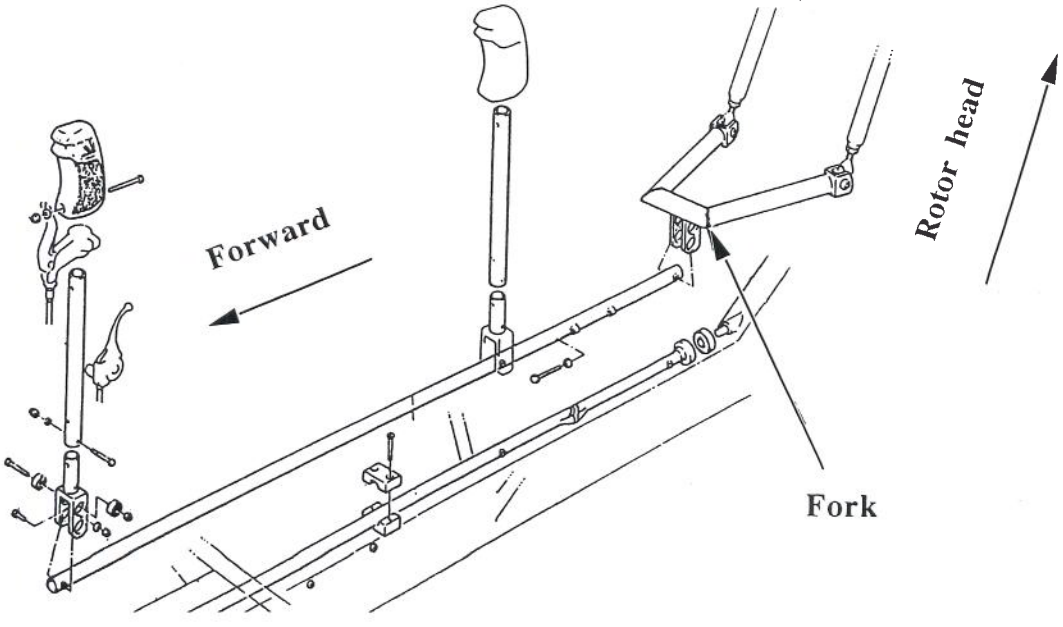

Figure 3 - Layout of flying control system in VPM M16 gyroplane