VPM M16 Tandem Trainer gyroplane, G-YRAT, 23 February 1996

AAIB Bulletin No: 7/96 Ref: EW/G96/02/09Category: 2.3

Aircraft Type and Registration:VPM M16 Tandem Trainer gyroplane, G-YRAT

No & Type of Engines:1 Arrow GT1000R piston engine

Year of Manufacture:1992

Date & Time (UTC):23 February 1996 at 1320 hrs

Location:1 mile south west of Kemble Airfield, Wiltshire

Type of Flight: Private

Persons on Board: Crew - 1 Passengers - 1

Injuries: Crew - None Passengers - Minor

Nature of Damage: Damage to rotor blades, propeller, main frame, tailplane, fibreglassshell and nose wheel

Commander's Licence: Private Pilot's Licence with Flying Instructor Rating

Commander's Age:55 years

Commander's Flying Experience:405 hours (of which 380 were on type)

Last 90 days - 20 hours

Last 28 days - 9 hours

Information Source: Aircraft Accident Report Form submitted by the pilot

This gyroplane featured in a previous AAIB Bulletin, 4/95. Theprevious mishap involved a fatigue failure in the control forkwhich acts to transmit the pilot's control movements to the rotorhead.

The aircraft was departing from Kemble on a local flight and wasin level flight at 500-600 feet QFE when the pilot noted thatthe normal light back pressure on the control column had disappeared. The pilot asked the passenger whether he had touched the controls; the passenger confirmed that he had not and the pilot realisedthat the freedom of movement of the control column showed thatit was no longer connected to the rotor head.

The pilot found that the aircraft was remaining stable in rolland pitch and he established a glide angle of 3° to 4°at 60 mph and an engine speed of 5,000 RPM. He was able to controlthe aircraft

heading by use of the rudder and headed for an openfield, where he was able to head the aircraft into the wind (SWat some 20 mph) before it hit the ground. The pilot attemptedto use a burst of power to pitch the nose up just before impactbut the only effect of this thrust was to accelerate the machine,which struck the ground and rolled over. The aircraft was severelydamaged and the passenger (with a full restraint harness) sufferedminor injuries; the pilot, with lap belt only, was uninjured.

Examination of the aircraft after the accident showed that a bolthad come free in the flying control system, thus disconnectingthe control fork from the control columns; neither the bolt northe nut remained in the aircraft and were thus not available forexamination. In the VPM M16 design, this control fork acts asthe simple 'mixing unit' between the pilot's control column movementand the control rods which set the lateral and longitudinal positionsof the rotor head: its correct operation is, therefore, essentialto continued safe flight.

The nut originally supplied with the aircraft kit was all-metalof the ('Kayloc'-type) variety in which the upper threaded portionof the nut is formed out-of-round during manufacture to producea self-locking function. This nut had been replaced after G-YRAT'sprevious mishap, in which the control fork had suffered a high-stresslow-cycle fatigue failure (AAIB Bulletin, 4/95). The replacementnut was of an approved type, in this case a self-locking 'Nyloc'stiffnut, wherein a nylon insert applies friction between thenut and mating bolt. The pilot comments that the nut and bolthad been properly secured but would not routinely be in full viewon a 'preflight' inspection.

There have been a number of instances, particularly in light aeroplanes,where self-locking stiffnuts of various descriptions have comeundone. This topic is covered for light aeroplanes within theJAA's Joint Aviation Requirements (JARs) by JAR 23.607 (part ofSubpart D - Design and Construction):

"JAR 23.607 <u>Fasteners</u>

(a) Each non-self-locking bolt, screw, nut, pin or other fastenermust, if its loss would preclude continued safe flight and landing,incorporate an additional locking device.

(b) Fasteners and their locking devices must not be adverselyaffected by the environmental conditions associated with the particularinstallation such as temperature or vibration.

(c) No self-locking nut may be used on any bolt subject to rotationin operation unless a non-friction locking device is used in additionto the self-locking device."

Thus the use of self-locking stiffnuts, without a separate lockingdevice, is not precluded in flying control assemblies where, forinstance, the design incorporates a ball-and-race assembly toaccommodate the relative rotation. For small rotorcraft (JAR27 - Small Rotorcraft), however, the current design requirement(a) is slightly different in requiring *two*: separatelocking devices:

"JAR 27.607 <u>Fasteners</u>

(a) Each removable bolt, screw, nut, pin or other removable fastenerwhose loss could jeopardise the safe operation of the rotorcraftmust incorporate two separate locking devices. The fastener andits locking devices may not be adversely affected by the environmentalconditions associated with the particular installation.

(b) ....."

As G-YRAT was operating on a Permit-To-Fly issued by the CAA itsdesign is not certificated to JARs. The JAR excerpts above show,however, that for a small rotorcraft undergoing current JAR certification,self-locking stiffnuts, without a separate locking device, wouldbe precluded in flying control assemblies.