AAIB Bulletin No: 9/95 **Ref: EW/C95/4/3** **Category: 1.3**

Aircraft Type and Registration:	Midland Ultralights Sirocco 377GB, G-MNFC	
No & Type of Engines:	1 Rotax 377 piston engine	
Year of Manufacture:	1985	
Date & Time (UTC):	28 April 1995 at 1815 hrs	
Location:	2 nm south-south-east of Bromyard, Herefordshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - Fatal	Passengers - N/A
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilot's Licence (Microlights)	
Commander's Age:	67 years	
Commander's Flying Experience:	61 hours (of which 4 were on type) Last 90 days - 1 hour Last 28 days - 1 hour	
Information Source:	AAIB Field Investigation, and metallurgical and materials laboratory reports	

The pilot had originally learned to fly glider aircraft during the 1970s and reached Bronze 'C' standard. He commenced a training course for the issue of a Private Pilot's Licence (PPL) for Microlight aircraft in December 1990. Initial training was on a Thruster Microlight, but he then began to fly a Tiger Cub 440 aircraft, which he eventually purchased and still owned at the date of the accident. He gained his PPL in May 1992. In the summer of 1993, he also purchased the Sirocco aircraft. After flying 2.5 hours on this aircraft during three flights from Long Marston Airfield in September 1993, the aircraft was flown to the pilot's own landing site in July 1994. A total of 1.5 hours were flown during two flights in July 1994, the last entry for which indicates that a tyre burst occurred on landing. This was the last flight in this aircraft recorded in the pilot's log book. Two subsequent flights were undertaken in the pilot's Tiger Cub aircraft, the last one being on 1 October 1994.

According to family members, flying from the private landing site, near the pilot's home, was not possible during the winter months because of wet ground. A few days before the accident, the Tiger Cub was apparently taken for a brief flight in order to check on the surface condition of the field.

The pilot took off in the Sirocco at approximately 1815 hrs on the day of the accident. The strip was oriented in a SE/NW direction, and the takeoff was carried out into the prevailing light southeasterly wind. The aircraft was observed by eyewitnesses to climb straight ahead after takeoff. Whilst in the climb at a few hundred feet above the ground, about one minute later, a white object was seen to fall from the rear of the aircraft, thought by one witness to be the aircraft's tailplane. The engine noise ceased, and the aircraft began a turn through about 90° to the left. It initially pitched down to a 45° angle but then steepened into an almost vertical descent into the ground. The pilot was wearing a full harness, but sustained fatal multiple injuries. There was no fire.

The aircraft was a single seater, and was loaded within the normal operating limitations for this type.

The pilot was correctly licensed, and held a current medical certificate. The post-mortem examination did not reveal any condition which may have caused any incapacitation of the pilot prior to the accident.

An aftercast from the Met Office indicated that there was an anticyclone centred over the North Sea, producing a southeasterly surface airflow over the area at the time. The surface wind was estimated to have been from 120°/7 kt, and the wind at 2,000 feet amsl from 160°/15 kt. There was good visibility and only insignificant scattered patches of high cloud.

The aircraft wreckage was lying on a sloping hillside with the tailplane and the rudder some 120 feet down track from the main structure, and approximately 20 pieces of tailplane foam rib structure located down wind from the tailplane. The wreckage plot is shown at Figure 1. The ground marks at the site of the main wreckage indicated that the approximate angle of descent had been 65°.

The main wing structural members comprised a composite leading edge and an aluminium box section which formed the rear spar; this had failed symmetrically at two places on each wing, and in a downwards direction. This failure mode was consistent with the loss of the tailplane in flight.

When examined by the AAIB, both the ignition and the fuel were ON, and the throttle was found fully to the rear. The fuel tank had taken a compressive load and had crumpled; the fuel filler cap was open and would not close due to distortion, but there was some fuel inside in spite of a leak in the tank caused by the accident. The police reported that a strong smell of fuel was present at the accident site on the previous day. The two-bladed propeller had light, low speed, ground strikes on both tips and had broken into several large pieces which were mainly distributed between the aircraft and the tailplane. The flying controls had all been connected before the loss of the tailplane and rudder.

The Permit to Fly requires a current Certificate of Validity, which must be applied for within 28 days of the check flight. An independent check flight had been carried out on 8 Jul 1994, and the certificate of validity, issued on 13 July 1994, contains the statement:

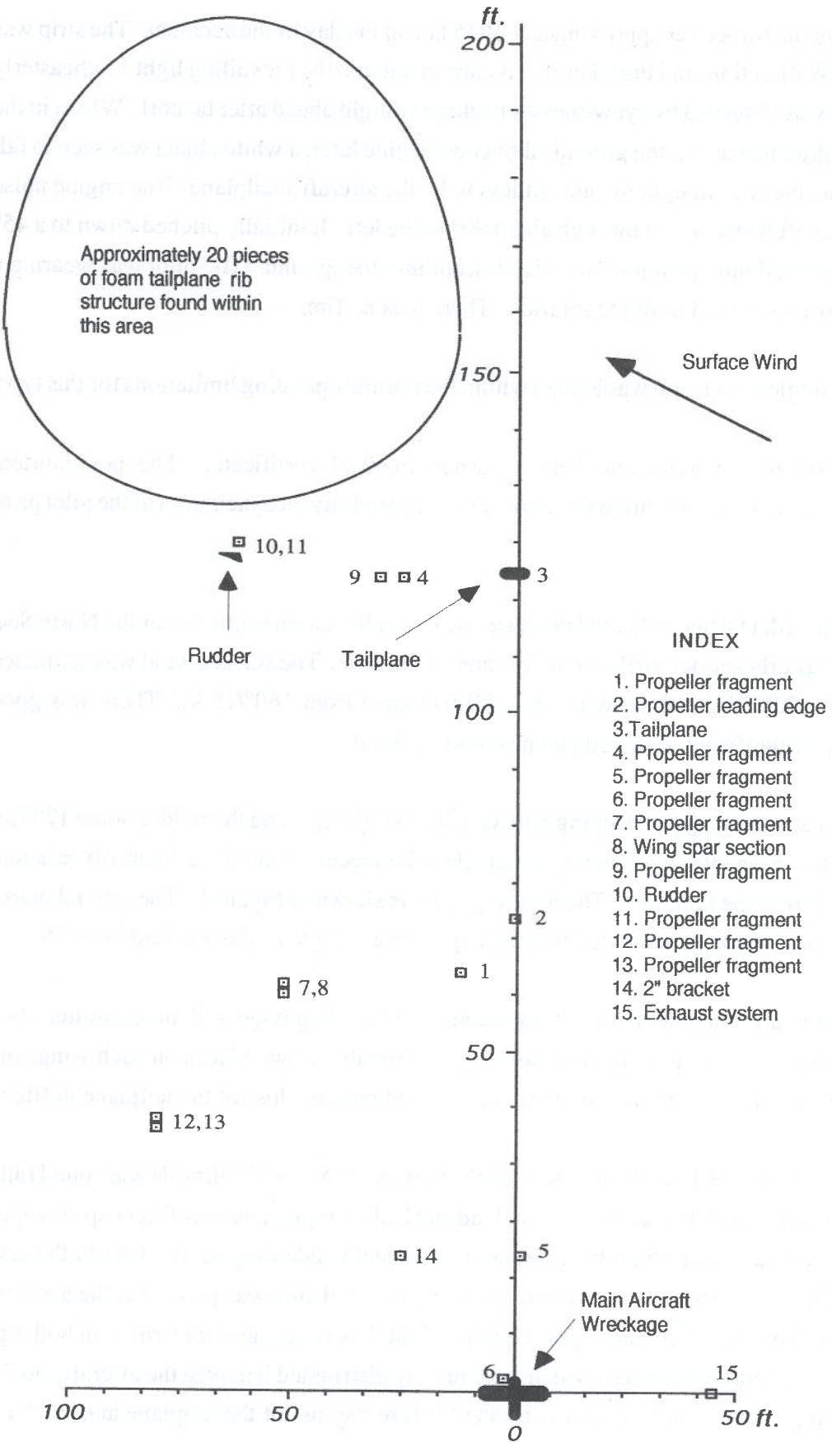


Figure 1 Wreckage Plot

'It is hereby confirmed that the above mentioned aeroplane has been examined by the British Microlight Aircraft Association and was found, at the time of its inspection and flight testing, to be in a satisfactory and airworthy condition.'

The general purpose inspection schedule which had been used called for a check of the tailplane leading and trailing edges, and they had been found to be in satisfactory condition. However, when the wreckage was examined by the AAIB the leading edge bonded joint was covered with tape which would have prevented the inspector from seeing the joint line. It is understood that it has been the practice of the UK distributor of the aircraft to remove this tape before delivery. The tailplane had been replaced in February 1988.

The elevator pushrod clearance, defined in Letter to Owners No 1389, had been examined by the owner and was not relevant to the accident.

The elevator consisted of an all moving tailplane connected to the control stick by a push rod. The tailplane was constructed from an upper and lower glass reinforced plastic moulding containing rigid foam ribs, and was attached to the tailplane axle, the ends of which fitted into cut-outs in the locating ribs on either side of the tailplane centreline. The tailplane was retained in the cut-outs by two locking pins (see Figure 2).

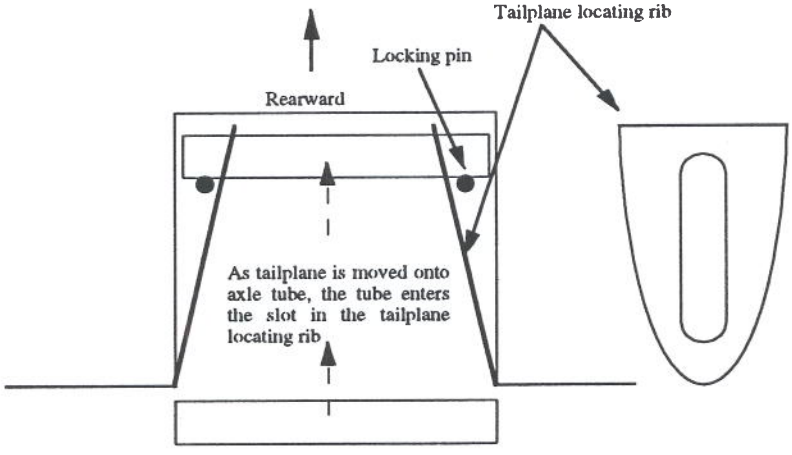
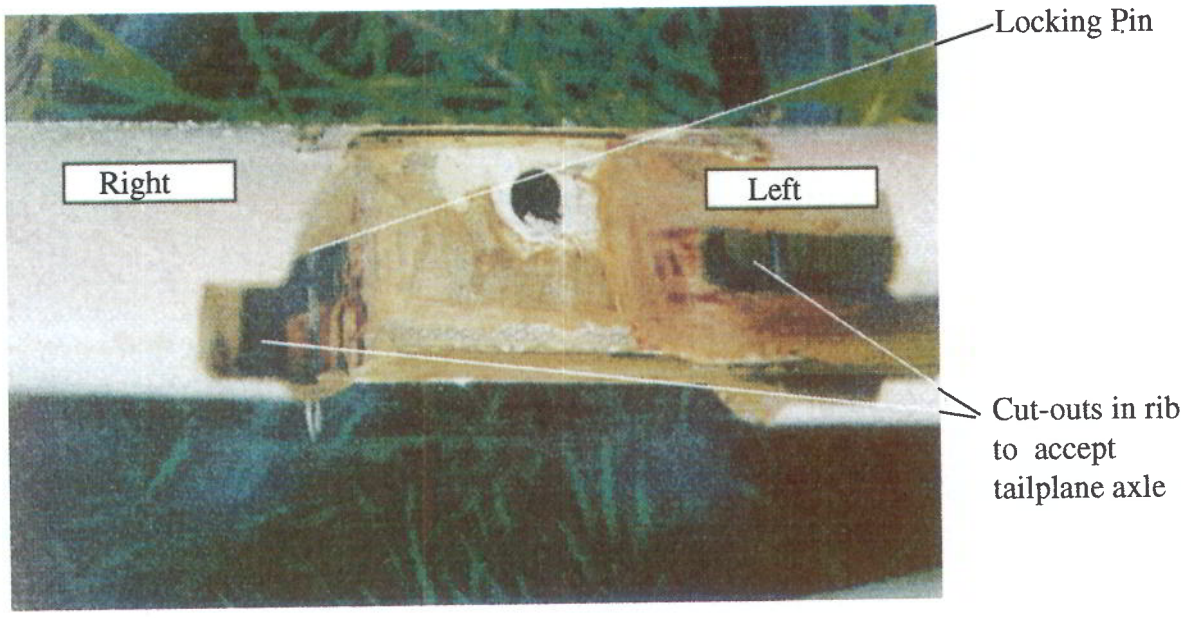
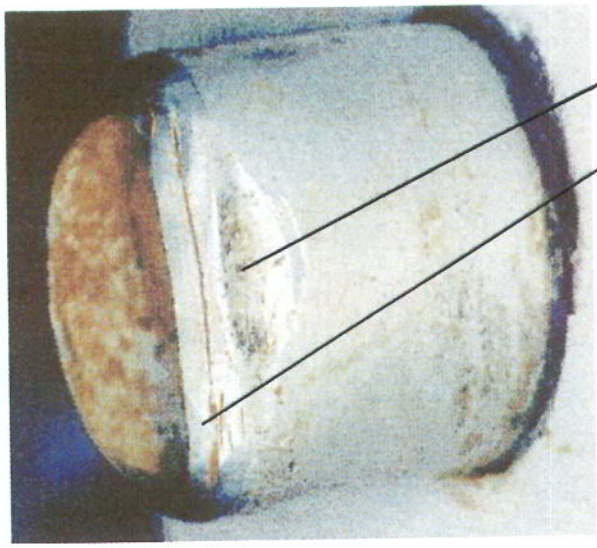


Figure 2 - Schematic showing method of fitting tailplane axle to tailplane

The tailplane had been correctly located and was reported to have been fitted without undue force. When examined on the accident site the left-hand tailplane locating rib was found to have become unbonded from the tailplane structure, and was solely retained by its locking pin (Photo 1).



Photograph 1 - The two tailplane locating ribs and cut-outs.



The cross-section of both ends of the tailplane axle had been flattened adjacent to the locating pin witness marks, and visual examination showed that the ends had been crushed by loads reacted against the locking pins whilst they were in place (Photo 2).

Photograph 2 - Left hand end of axle tube

The left hand end diameter of the tube had been reduced from 20mm to of 17.4 mm, allowing fore-and-aft movement of the tailplane axle in the cut-out. The length of the tailplane axle was found to be 166.5mm: the drawing calls for 170mm, but does not give a tolerance.

Witness marks made by the locking pins on the ends of the tailplane axle tube showed that the pins had been positioned 4.5mm from the ends of the tube, which had a 2.5mm chamfer *machined* on to them at an angle of 30°. This machined chamfer was not a feature of axle tubes supplied with the aircraft, which merely had the edge taken off the ends of the tube by hand.

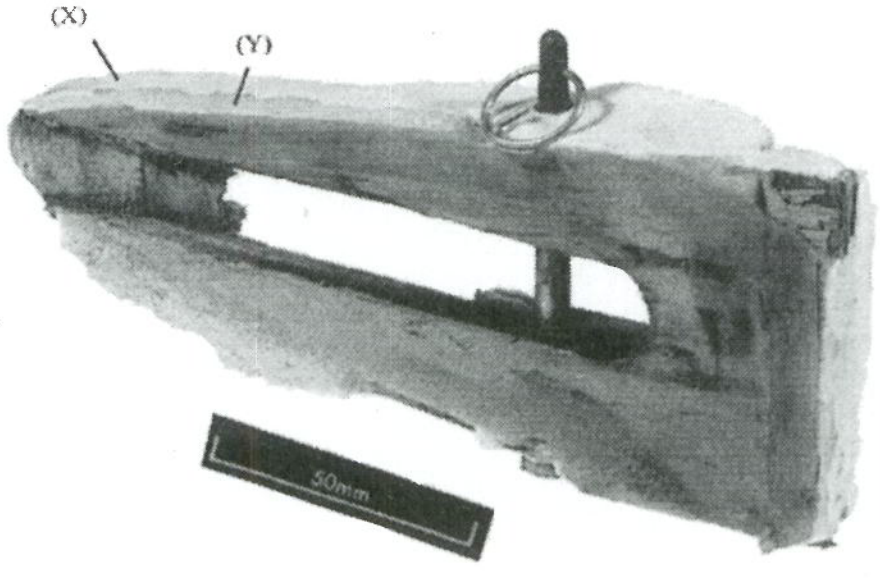
The tailplane locating ribs were placed at an angle to the tailplane centreline so that as the tailplane was moved onto the axle, the axle ends moved further into the slots provided for them (see fig. 2).

As there appeared to be some variation between aircraft in the exact location of the tailplane ribs, there would also be some variation in the position of the locking pins relative to the ends of the axle tube. However, the important dimension is not the length of the axle tube, but rather the distance between the ends of the tube and the locking pins.

As there was angular convergence between the ribs, any interference between the cut-out and the axle ends will be reacted by the rib, through its bonding, to the tailplane. As the angle of convergence is small, the lateral forces on the ribs could be significantly higher than the force exerted on the tailplane to mate it with the aircraft. Such an interference had been increased by the crushing of the tube ends which had increased the diameter at right angles to the pins from 20 mm to 20.75 mm, the corresponding cut-out dimensions were measured on the detached rib at the accident site and found to vary between 19.36 mm to 20.83 mm. Whilst this dimension could vary with the moisture content of the wooden rib, some evidence of long-term interference, in the form of a black deposit from the aluminium tube on the surfaces of the cut-outs, was seen. This deposit was said to be heavier on FC than that normally encountered.

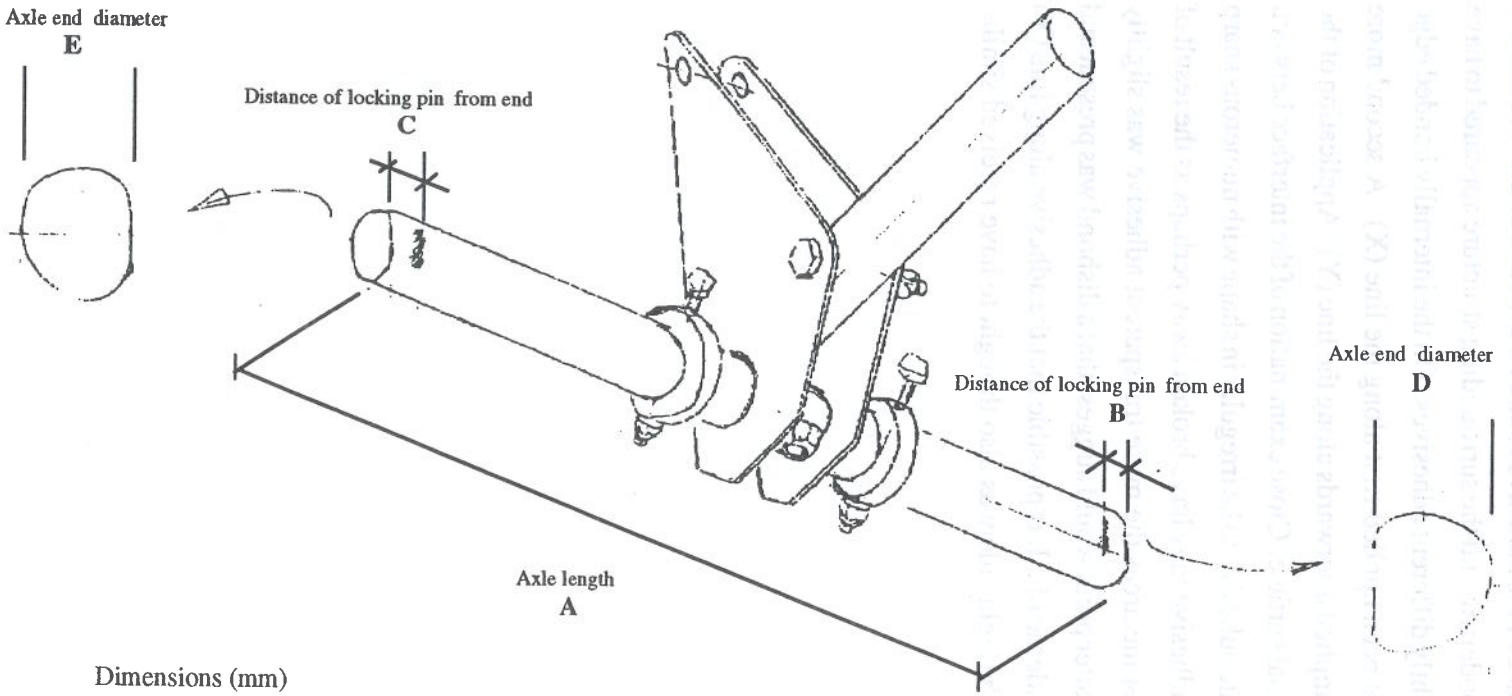
Not only would the crushed axle tubes have allowed fore-and-aft play when fitted, but the method of retaining the tailplane, using a locking pin to bear on a point contact on a tube, had been degraded in effectiveness by the reduced distance between the pin and the end of the tube, and by the chamfer at the end. In order to assess the significance of this degradation, the axle tube dimensions of seven other Siroccos were obtained. These dimensions are summarised at Figure 3.

The tailplane was examined by a materials scientist from DRA Farnborough, who produced a comprehensive report. In particular he made the following comments about the adhesive joint attaching the left tailplane locating rib:



Left tailplane locating rib showing possible adhesive repair

'.....The photograph shows the smooth surface of the adhesive found on the back of the wooden rib. It was noted that the bonding between the wooden rib and the surrounding structure appeared to have been undertaken in two stages using two slightly different adhesives. On the internally bonded edge of the rib, a white adhesive appeared to have been applied first along the line (X). A second more transparent adhesive appeared to have been applied afterwards along the line (Y). Application of the second adhesive was probably from the external surface. Close examination of the interface between the two adhesives showed the edge of the white adhesive to be irregular in shape with numerous sharp edges. This suggested that the edges of the adhesive may have broken away perhaps as the result of an earlier disbond. It appeared also that in some areas the more transparent adhesive was slightly proud of the white coloured adhesive. This latter point would suggest that a disbond was present and that the transparent adhesive was inserted underneath. It is possible that the adhesive along line (Y) was applied as part of a repair. The rib on the right side was also thought to have received similar treatment.'



Dimensions (mm)

	A	B	C	D	E	F	G
Drawing	170	*	*	20	20	nil	nil
G-MNFC	166.5	4.5	4.5	18.2	17.4	2.5	2.5
1	170	6.0	6.5	18.5	17.0	1.0	1.0
2	170	5	6	19.5	19.5	0.25	0.25
3	170	6	6	19.5	19.5	nil	nil
4	171	6	6	19.7	19.7	1	1
5	166	4	4	19.9	20.1	2	2
6	170	6	6	20	20	2	2
7	171	6.6	6.0	19.4	19.2	0.8	0.8

* Not available from drawing

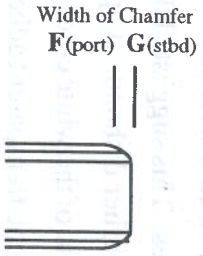


Figure 3 - Dimensions associated with Sirocco axle tube