

# Piper PA-38-112 Tomahawk, G-BTOD

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Category: 1.3

<b>Aircraft Type and Registration:</b>	Piper PA-38-112 Tomahawk, G-BTOD	
<b>No &amp; Type of Engines:</b>	1 Lycoming O-235-L2C piston engine	
<b>Year of Manufacture:</b>	1978	
<b>Date &amp; Time (UTC):</b>	9 November 2002 at 1500 hrs	
<b>Location:</b>	Thorpe Salvin, near Netherthorpe Airfield, Nottinghamshire	
<b>Type of Flight:</b>	Private	
<b>Persons on Board:</b>	Crew - 1	Passengers - 1
<b>Injuries:</b>	Crew - 1 (Minor)	Passenger - 1 (Serious)
<b>Nature of Damage:</b>	Aircraft destroyed by fire	
<b>Commander's Licence:</b>	Private Pilots Licence with Night and IMC Ratings	
<b>Commander's Age:</b>	40 years	
<b>Commander's Flying Experience:</b>	162 hours (of which 60 were on type)	
	Last 90 days - 4 hours	
	Last 28 days - 2 hours	
<b>Information Source:</b>	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

## Synopsis

The aircraft was departing from Netherthorpes Runway 24 in calm wind conditions. It failed to accelerate to an appropriate speed for takeoff but became airborne when the pilot rotated some 20 metres before a low hedge at the airfield boundary. It touched this hedge but when faced with the prospect of clearing a higher hedge and a barn at the end of the next field, the pilot decided to land in that field but penetrated the hedge. The impact tore off the right wing and a fire ensued. The pilot and passenger received burn injuries but were able to exit the aircraft. Given the aircraft's performance, its weight, the weather and the runway surface conditions at the time, there was insufficient runway length available for the aircraft to become safely airborne. No safety recommendations were made.

## History of the flight

The pilot and his passenger had flown in from Retford (Gamston) Airfield and had spent about half an hour at Netherthorpe Airfield before undertaking to return to Retford. Netherthorpe is a small airfield with two short grass runways. It had been raining over the previous few days but at the time of departure the sky was clear and the wind was calm. The pilot elected to depart to the south-west from Runway 24 which has a take-off run available (TORA) of 490 metres and a total runway length of 553 metres. The pilot described the runway surface as damp and Runway 24 has an upward gradient of 1.9%. The aircraft was loaded to approximately its maximum take-off weight of 1,670 lb with the centre of gravity within limits.

After completing the pre-take-off engine power checks, which were satisfactory, the pilot waited for four aircraft ahead of him to depart. After approximately five minutes the pilot taxied onto the runway but did not use the entire length leading up to the displaced threshold. The flaps were set to 21 degrees (one notch of flap) which is the recommended setting for a short field or soft field takeoff. After turning on to the runway he applied full power from a slow taxi speed. The sun was shining in the pilots face and he wasnt wearing sunglasses. The low sun reduced the runway visibility and required the pilot to concentrate to maintain the runway centreline. He raised the nosewheel off the ground as soon as it was possible in accordance with the soft field takeoff technique. When he had covered approximately two-fifths of the runway length he checked the airspeed. The airspeed indicator was difficult to read due to the bumpy runway surface but he thought it was reading 40 kt. When he was halfway down the runway he checked the airspeed indicator again and he thought the speed was still reading 40 kt. The pilot considered aborting the takeoff but then dismissed the idea as being over cautious.

[The recommended rotation speed of the aircraft is 53 kt for a normal or a short field takeoff. For a soft field takeoff the flight manual recommends that the pilot *ease back on the control wheel just enough to raise the nose wheel from the ground as soon as possible, and lift off at the lowest possible airspeed* and then accelerate just above the ground to the best angle or best rate of climb speed.]

The pilot anticipated achieving 55 kt by the time he was two-thirds of the way down the runway but when he realised that he was only doing 46 kt, he was most alarmed. He then tried to raise the nose further to lift the aircraft off the ground. Due to the poor visibility caused by the sunlight, the end of the runway was suddenly closer than he had realised. There was a 2-foot hedge and a road at the end of the runway. The aircraft lifted off approximately 20 metres in front of the hedge with an airspeed at or below 50 KIAS. The stall warning horn activated for two seconds and the wheels grazed the hedge. The pilot then lowered the aircrafts nose to try to accelerate in ground effect with the airspeed indicator reading approximately 48 kt. As he was flying in ground effect over a field, he noticed another hedge, approximately 7 feet high, approaching with a barn on the other side. At this point the aircrafts engine was still set to full power and the pilot believed it to be performing normally but he decided not to risk trying to jump the hedge and thereby possibly stall the aircraft. He deliberately touched down in the field approximately 30 metres short of the 7-foot hedge. Just in front of the 7-foot hedge was a road running perpendicular to the aircrafts track, and in front of the road was another smaller hedge. The aircraft passed through the first hedge at approximately 55 kt and then it crossed the road and cut through the 7-foot hedge before coming to a rest a few metres to the right of the barn, in a yard covered with loose bricks and rubble.

The impacts tore off the right wing and ruptured the right fuel tank. Within one second of the aircraft coming to rest the released fuel vapour ignited. Both the pilot and the passenger

immediately began to vacate the aircraft. The pilot estimated that they were clear of the aircraft within 12 seconds of the aircraft coming to a stop. Despite their rapid exits, the pilot received minor facial burns but his passenger received serious burns to his face and hands. The fire service arrived at the scene within five minutes and extinguished a smouldering fire.

## **Weather**

The wind was very light at the time of departure. The METAR for Leeds/Bradford Airport, 37 nm north-west of Netherthorpe, reported a wind of 1 kt from 360 degrees, 10 minutes prior to the accident and the same wind 20 minutes after the accident. The METAR for East Midlands airport 30 nm south of Netherthorpe reported a wind of 0 kt, 10 minutes prior to the accident and the same wind 20 minutes after the accident. The approximate temperature and dewpoint in the Netherthorpe area at the time of the accident were 9°C and 5°C respectively and the mean sea level pressure was 1008 mb (QNH). The total rainfall for the Netherthorpe area in the previous nine days including the day of the accident was 43.8 mm. The total rainfall the day before the accident was 8.7 mm and an additional 7.4 mm of rain fell on the day of the accident.

## **Take-off Distance Calculation**

The Tomahawk flight manual contains a chart showing the take-off distance to a height of 50 feet assuming the following: one notch of flaps, lift off speed 53 KIAS, full power before brake release, paved level dry runway, and maximum take-off weight of 1,670 lb. Assuming zero wind, a temperature of 9°C and a pressure altitude of 400 feet (Netherthorpe conditions at the time of the accident) the published take-off distance to a height of 50 feet is 1,300 feet which equals 396 metres.

The flight manual contains a CAA change sheet that requires that the reported take-off distance figures be factored by 1.05 because flight tests established that the Tomahawk failed to achieve the reported performance. Therefore, the actual take-off distance to 50 feet is  $(396) \times (1.05) = 416$  metres. This figure assumes a dry level paved runway. Runway 24 at Netherthorpe was damp, sloped uphill and had a grass surface. The flight manual does not provide correction factors for these conditions but the CAA Safety Sense Leaflet 7B *Aeroplane Performance* does provide factors.

The following factors in the Safety Sense Leaflet are to be multiplied by the take-off distance to a height of 50 feet:

<b>Condition</b>	<b>Factor</b>
A 2% uphill slope	1.1
Dry grass	1.2
Wet grass	1.3
Additional Safety Factor	1.33

Runway 24 at Netherthorpe had a 1.9% uphill slope and therefore a factor of 1.095 is appropriate. The grass runway was described as damp and therefore a factor of 1.25, which is halfway between the dry grass factor and the wet grass factor, could be reasonably assumed. The CAAs 1.33 safety factor is designed to account for variations in take-off technique and a reduction in performance compared to published figures due to wear and tear on the aircraft and engine. If a flight manual does not already include approved factored data, then the 1.33 safety factor should be applied. Applying these three factors to the take-off distance results in:

$$(416 \text{ metres}) \times 1.095 \times 1.25 \times 1.33 = 757 \text{ metres}$$

This figure is the estimated take-off distance required to achieve a height of 50 feet given the conditions at the time of the accident.

The Aeronautical Information Publication (AIP) does not publish a TODA (Take-Off Distance Available) figure for Netherthorpe airfield. TODA is the sum of the useable runway length plus any clearway. A clearway is an area beyond the end of the runway which is clear of significant vertical obstacles; this area is always wider than the runway. The AIP entry reports a TORA (Take-Off Run Available which means the useable length of runway) of 490 metres and states that the total length of the grass strip is 553 metres. Since there is a road and a hedge at the end of Runway 24, the take-off distance required of 757 metres significantly exceeded the take-off distance available.

The pilot performed a take-off distance calculation prior to departure. He applied a 1.1 factor for the uphill slope, a 1.2 factor for the grass surface and a 1.33 safety factor. However, he mistakenly applied these factors to the take-off ground roll distance in the flight manual rather than the take-off distance to a height of 50 feet. The take-off ground roll distance he used was 213 metres and applying the 1.1, 1.2 and 1.33 factors gave him a 375 metres take-off ground run distance which is less than the TORA of 490m. In addition, the pilot assumed a 5 kt headwind in his calculations; he assumed a dry runway and he did not apply the 1.05 factor required by the CAA change sheet.

The CAA safety sense leaflet on take-off performance only provides factors for calculating take-off distance required and does not provide factors for directly calculating take-off ground run required. The leaflet includes a note, referring to the factors for dry grass, wet grass and 2% slope, which states: *Effect on Ground Run/Roll will be greater.*

## **Discussion**

Given the aircrafts performance, its weight, the weather and the runway surface conditions at the time, there was insufficient runway length available for the aircraft to become safely airborne.

In his report the pilot was very honest and admitted that he had underestimated the take-off distance required in his calculations. He had on a previous occasion departed safely from Netherthorpe airfield in the same aircraft on his own and that may have affected his confidence. In addition, witnessing four aircraft departing safely in front of him also convinced him that the conditions did not present a problem. He also stated that he made a mistake in not aborting the takeoff at the halfway point when it was first apparent that the aircraft was not accelerating sufficiently.

The CAA does not publish correction factors for calculating the take-off ground run required. The factors in Safety Sense Leaflet 7B must be applied to the take-off distance to a height of 50 feet. The same factors and guidelines are also included in Aeronautical Information Circular AIC 67/2002. AIC 67/2002 states: *The pilot should always ensure that, after applying all the relevant*

*factors including the safety factor, the take-off distance to a height of 50 feet (TODR) does not exceed the runway length available (or TODA if known). The TODR in this case was 757 metres and the total published runway length was 553 metres.*