Plane across the grain —

Tiger Moths and the crosswind

by Martin Burdan

"WHAT DO YOU MEAN, *CROSSWIND*?" may well have been the response in the early days of powered flight. At that time the concept of taking off and landing across the wind did not exist. When the Tiger Moth first flew in 1931 it wasn't much advanced from the designs of World War 1 aircraft which effectively had no crosswind capability. Pilots, like birds, instinctively understood the need for operating into wind.

Compare today's Visual Flight Guide with its 1936 equivalent, The Air Pilot, Department of Defence, Civil Aviation Branch. Back then the airfield maps were simple boundary outlines with occasional obstacles such as trees indicated. Nothing remotely resembling a formal runway featured. Uncluttered, square shaped airfields prevailed, allowing all takeoffs and landings to be made into wind as nature intended.

Although runways came to exist in the era of the Tiger, the sense of the wind on the nose still dominated the stricter runway sense of a later aviation generation which places importance on fastening the nose to a centre line. Whereas the into-wind direction was once the centre line, today's pilots are channelled down a narrow corridor fixed to the ground. However, the fact that the prevailing wind might be anything up to 90 degrees either side of the tarsealed path isn't so critical today, because modern aircraft design assists rather than complicates crosswind handling. Crosswinds up to the Tiger's maximum can virtually be ignored without harm by a trike pilot. Try that in any taildragger, particularly a Tiger, and an otherwise safe landing can quickly turn into a catastrophe.

Just picture a Tiger parked next to a tricycle trainer. Compare the CG behind the main wheels, the tailskid, absence of brakes and narrow undercarriage. Now consider the low wingtip to ground clearance and large fuselage cross section. Observe the generous wing area, noting the relatively small ailerons. Finally contrast the greater height of heavy items like engine and crew, along with a further 137 lbs of fuel perched some nine feet up at the highest point of the aircraft. This formula makes the Tiger highly unstable when moving along the ground. Throw in a crosswind and watch its claws come out.

The Tiger Moth then is not really a crosswind aeroplane and we should always be mindful of this fact. Although it has a "demonstrated maximum crosswind capability" of 10 mph, whoever did the demonstration would have been working hard, and that's with large amounts of experience and currency. By comparison most of us occasional open-cockpit aviators are low on both.

The Tiger will notice the slightest crosswind and need accurate compensation. So if a crosswind can't be avoided, let's make things easier by reducing the crosswind component. Rather than feeling rigidly bound by an imaginary grass centre line, angle across the runway to align more into wind if the geography of the airfield safely allows — taking care, of course, to alter track down the runway once airborne.

An important thing to bear in mind is that both the takeoff and landing will use more runway than when there is no wind. Although a crosswind will provide some headwind component, this will be more than offset by three other factors as we shall see: extra drag due to crossed controls; higher airspeed at liftoff and touchdown for greater control; and impaired effective lift as a result of holding the wing down. We therefore need to reconsider runway length carefully in a crosswind and short field operations in particular.

With beckoning skies we're ready for takeoff but are stuck with a persistent crosswind. Our aim in taking off or landing must be to keep the Tiger Moth tracking down the chosen runway, despite the crosswind urging otherwise. The key thing when in contact with the ground is to eliminate any sideways drift which will rapidly lead to an upset pilot and aeroplane. Let's now look at techniques to keep both happy.

Crosswind takeoffs

Full power for takeoff provides a very responsive rudder, and maintaining directional control in a crosswind shouldn't be difficult for an alert pilot. Weathercocking can be expected, with a crosswind from the right increasing the swing to the right and therefore the amount of left rudder required. By contrast, a crosswind from the left will tend to cancel out the natural right swing. In the event, do whatever is required with the rudder to keep straight. Eyeball the windsock before opening the throttle and spend a moment anticipating the likely reaction of the aeroplane. Certainly it's going to feel different from having the wind on the nose.

Aileron response is a different matter, being the least effective Tiger Moth control surface. Do nothing with the ailerons and we risk the upwind wing lifting which initiates a turn away from the wind with the downwind wing stalled. Alternatively, the wing lifts and the wind striking the fuselage, rudder and vertical fin weathercocks the aircraft into wind. Either way we're heading off the runway with crunching noises soon to follow. The point then of holding aileron into wind is to prevent the upwind wing lifting by reducing the lift imbalance caused by the crosswind. As speed builds up we allow the upwind wing to lower to a safe attitude and hold it there until liftoff.

It's important to hold full into-wind aileron before opening the throttle. Failure to do so is a common error. Furthermore, a Tiger will need as much aileron leverage as possible throughout the takeoff to prevent a wing lifting. Remember, there are two eager wings presenting a large lifting area to a crosswind, countered by the opposing effect of only one relatively small aileron.

Keep full aileron applied as long as possible throughout the takeoff, rather than progressively reducing aileron as is usually advised. Full aileron will only begin lowering the wing just before the point of liftoff. It is this moment when the aileron is felt to "bite" when we reduce aileron to hold the wing down in the desired position. It is safer to act on a down-going wing, rather than react to it going up. Like prising open the lid of a paint tin, once the wind begins lifting a wing, it becomes an exponentially easier task for it to continue the exercise. In manageable crosswinds full into-wind aileron will prevent a wing lifting but will be hard pressed to stop it if application is delayed until the wing has already begun rising.

It's worth noting at this stage that the controls will be crossed. More so in a crosswind from the right when we're using extra left rudder to offset weathercocking, against full right aileron to convince the wing down. The temptation is to operate the controls in

the wind-on-the-nose mould of securely familiar positions and pressures. However, we must respond beyond that comfort zone by obstinately doing whatever is required with the controls to maintain the desired line of projection. Out of wind the Tiger Moth is going to make us sweat, so it's got to be assertive seat-of-the-pants flying rather than rote.

Liftoff must be a singular event. A multiple event invites unhealthy directional possibilities which go with skipping sideways across the runway. Rather than letting the aircraft fly itself off in the normal slightly tail-low attitude, we hold it on the ground longer by raising the tail just a little more. This lowers the angle of attack and enables us to achieve a higher airspeed before liftoff. Positive stick-back pressure will then ensure a clean transition from ground to air.

The bit that needs care is not to get the tail too high. Accept no more than a level aircraft attitude. Remember, the high CG just aft of the mainwheels is now cheerily poised to upset the applecart if given the chance.

Immediately airborne, apply drift correction by crabbing the Tiger into wind with rudder. We simultaneously uncross the controls by levelling the wings, check the airspeed is rising, and assume the climb attitude after 66 mph is reached. It's important to continue reassessing accuracy of the extended centre line track until the turn onto crosswind. We don't want to be drifting off track, particularly if parallel runways are involved.

Now let's enjoy ourselves until the bit the crowd will keenly gather to watch — our crosswind landing!

Crosswind landings

The crosswind takeoff was the relatively easy part. Now the fun comes with the landing. Any landing can be broken into three stages: approach, touchdown and landing roll. Mix a Tiger Moth with a crosswind and the knuckles tend to whiten for all three.

As with the takeoff, the aim of a crosswind landing is to keep the aeroplane tracking down the intended path at every stage. The easier part is tracking when airborne; the harder part, tracking along the ground. The critical event is the touchdown which connects the two. The key thing to avoid at this crucial point is touching down sideways. There are three reasons for this.

Firstly, on a tricycle aircraft the CG is forward of the main wheels. If the aircraft touches tracking down the runway but angled into wind, the position of the CG will tend to swing it towards the intended heading, effectively straightening it along the runway. However, with a taildragger the opposite is the case. With the CG behind the main wheels, sideways movement on touchdown will initiate a swing away from the intended heading. Any swing will be further exacerbated by the tendency of the aircraft to weathercock into wind. Events then rapidly accelerate towards a groundloop.

Secondly, touching down with sideways drift will encourage the upwind wing to lift, thanks this time to our high CG. Once a wing lifts horrible noises are literally around the corner.

Thirdly, undercarriages are not primarily designed to withstand side loads and are unlikely to appreciate being smeared sideways. A very short landing could be the result of excessive side load.

On the plus side, Tigers prefer grass rather than seal. With less traction between a grass surface and the wheels, particularly if the grass is wet, a certain amount of any drift or swing will be absorbed. This is because when the wheels slip the inertia of the aircraft tends to carry it in a straight line, so the aeroplane will tend to skid sideways rather than twitch its tail. There can be some forgiveness in operating off grass rather than seal then, but we can't count on it as a saviour of sloppy technique when it comes to crosswinds.

Wheeler landings suit crosswind conditions best. Although in light crosswinds a Tiger can be coaxed into a three-point landing (two-point really, being one main wheel and tailskid), wheeler landings are safer as they allow greater control by spreading out the important steps rather than clumping them into one event. There are basically three methods of crosswind wheeler landings.

Method number one is the crab into wind, wings level, and kick straight just before touchdown. This relies for success on one perfect, split-second judgment, being the moment of kicking straight. Too early and the aircraft will be drifting sideways; too late, and the offset heading will also mean a side load on touchdown.

The problem with this method then is the difficulty in guaranteeing precision at the required instant. This difficulty increases the stronger and more gusty the crosswind. Remember, a tricycle undercarriage aircraft will be far more tolerant of drift on touchdown than a biplane taildragger with low wing loading and a high CG. Furthermore, if the wings are kept level at touchdown there is a greater chance of the wind lifting a wing and, again, our slow biplane is far more susceptible than a faster monoplane. Avoid this method unless you're about to rebuild the aircraft.

Method number two involves sideslipping into wind on short finals and touching down on one wheel. This has the advantage of giving us greater time to assess the conditions in advance of attempting the touchdown. In a sideslip condition on the approach, with the aircraft both tracking and heading down the runway, we can more accurately judge the strength of the crosswind while making any compensations for changes in drift. The aircraft is set up at altitude, rather than close to the ground, and then flown to touchdown in this condition. Essential judgment calls are made with the safety of altitude and not focused into one specific moment close to the ground, as with the kick-straight-before-touchdown method. Especially important is that in a sideslip the wing will be down into wind, lessening the chances of the wind lifting it by overcoming the limited effects of aileron.

Method number three is the preferable one for a Tiger Moth and combines the useful bits of methods one and two. Crabbing into wind on finals before sideslipping will minimise discomfort, not to mention improving the view ahead (there had to be a crosswind benefit somewhere!).

However, the point on approach of adjusting to the sideslip, where the aircraft heading becomes coincident with the runway, will vary, depending on experience and ability. Perhaps it will be at some point approaching the fence or just over it. For a start it's a good idea to practise the technique from a height of about 300 feet, gradually making the transition lower as our confidence and skill increase. In time we might angle into wind virtually until roundout, smoothly ruddering the nose to the desired heading while simultaneously rolling the wing down onto one wheel just before touchdown.

A common mistake is not getting the wing down enough to offset drift as the nose is ruddered around to the desired heading. Unless the wing goes down the appropriate amount we at once begin slithering sideways.

Real determination and assertion are required to bully the Tiger into accepting the sideslip condition at this significant phase. Part of it is overcoming the squeamish feeling that goes with our cornflakes sloshing to one side, but there's also the niggling worry

that the wingtip might strike the ground. The Tiger, however, does have more dihedral built into the lower wings than the top to provide some reasonable margin. If the wingtip is scraping the grass we've either over-controlled, touched down too slowly or exceeded the crosswind limit.

As with any unfavourable wind situation, a crosswind approach should be made with power on for greater elevator and rudder response and at a faster airspeed for greater aileron control. The touchdown too will be at a higher speed than we might need for a wheeler in more ideal conditions. Aim for a longer final with a flatter approach, controlling airspeed with power. Be aware of the need for more power to overcome the extra drag and maintain airspeed upon assuming the sideslip. The flatter approach not only makes for a smaller roundout angle prior to touchdown, but the lower descent rate means more time to react to any wind changes due to friction and/or mechanical turbulence.

While any wind will tend to decrease nearer the ground due to friction, it may also increase in unpredictability due to mechanical turbulence. The approach, roundout and landing will be a constant adjustment of stick, rudder and throttle to maintain the required profile. Loosening the throttle friction nut will help provide finer throttle control. A useful practice exercise is to overshoot the approach and fly the length of the runway with the fuselage aligned to it by keeping the into-wind wing down.

Touchdown should be made on one wheel, and the other will follow soon after due to rapidly decreasing lift on the leeward wings. Various books and articles on landing taildraggers advise checking forward on the stick at touchdown to raise the tail, thus lowering the angle of attack and reducing the risk of ballooning back into the air. Thereafter, they continue, keep pushing the stick forward to hold the tail up until it runs out of lift and drops of its own accord. In a Tiger Moth this technique is a good one if your propeller, crankshaft, cowls, fuel tank, centre section, top wings and rudder are all due for replacement, because sooner rather than later it will guarantee exactly that. Maybe even a new rear fuselage too, if the thump as the Tiger goes over on its back is hard enough.

The CG in a Tiger is both high and close to the main wheels. The tail does not need to be raised to hold the main wheels on the ground if the correct rate of sink and touchdown profile are flown. Never keep pushing the stick forward once the wheels are on the ground. It's tempting fate in the form of a soft patch of grass or a gust of wind. Picture the high tail and fully-down elevators just before the tailplane runs out of lift and drops. Now along comes the gust of wind and suddenly the tail has plenty of lift. Over she goes.

The correct crosswind elevator technique is exactly the same as for any wheeler landing in a Tiger. Fly the aircraft on, kiss the wheels onto the grass, touching down with minimum vertical sink in a very slightly tail-low attitude. As the wheels touch hold the stick in that position and she will stay put. As the tail loses lift and begins to drop, follow it down with the stick. Pull the stick hard back once the tail is on the ground and hold it there.

To summarise: The first rule for operating Tiger Moths in crosswinds is **don't**.

Use as much into-wind aileron as possible after touchdown, without lowering the wing further. Remember, it's important to prevent the wing from rising because once it starts the leverage of the wind increases dramatically and events can rapidly become complicated. Full aileron should certainly be used by the time the tail is beginning to lower.

The instant the Tiger contacts the ground it will begin to weathercock. This will become particularly noticeable slowing down when the tail lowers, and in a reasonable crosswind full rudder will not prevent the aircraft weathercocking in the latter stages of the landing roll. A well-timed burst of power may provide the necessary corrective airflow over the tail to straighten things out.

A compromise, allowing the aircraft to weathercock into wind under some semblance of control, is wise if runway width permits. Gently curving into wind in the last moments of the landing roll means a reduced risk of a wing rising once stationary.

We're rolling out on three points when suddenly a gust lifts the wing. What now? We have two basic choices. Assuming full into-wind aileron is applied, we could rudder the Tiger into wind as much as possible to reduce the lifting component on that wing. It will be wanting to weathercock this way anyway. A burst of power will be useful to assist.

The second technique to consider is making that high centre of gravity work for us. Remember that with either or both wheels on the ground the Tiger is now a ground vehicle. This time the theory is to give her full rudder away from the crosswind, steering towards the lower wing. By steering the Tiger away from the crosswind the high centre of gravity rolls the rising windward wing down. In practice this may not work if the wind is strong because we are trying to turn against the weathercocking effect. Again, a measured amount of power will help.

Landing on the runway leeward side will leave the whole of the runway width to safely track across, should weathercocking become uncontrollable once the tail is down. It may initially seem more logical to land on the upwind side to allow for drifting across the runway, but it is far easier to prevent drift before touchdown than it is to prevent weathercocking in the final stages of the landing roll.

Finally, avoid trying to salvage a crosswind landing going wrong. Be especially prepared for an overshoot. If things aren't looking right the decision to go around again needs to be made at the earliest instant, whether it be on approach or after touchdown.

To summarise: The first rule for operating Tiger Moths in crosswinds is **don't**. Take off and land into wind because the crosswind environment can be very unhealthy for an aeroplane basically not designed for it.

Secondly, if a crosswind can't be avoided, then reduce the crosswind component as much as possible by redefining the runway. Create one that suits the Tiger, rather than using a fixture meant for aircraft belonging to a completely different set of rules. If necessary, in extreme circumstances, forget the runway altogether and use a taxiway or any safe aerodrome patch that is into wind. Better the explanation afterwards in one piece than in several. Don't mangle a perfectly serviceable aeroplane through having chosen an effectively unserviceable runway.

Lastly, whenever the wheels transition between ground and air eliminate drift **totally**. This is especially important during landing. The key event critical to crosswind landing success is the touchdown. At this instant be absolutely resolute in nailing the nose to the intended heading with rudder and aileron.

Plane straight!!