CANTERBURY GLIDING CLUB

Turbo Dynamic - DYT

Standard Operating Procedures

Document Control

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1.

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Introduction

This SOP is <u>not</u> intended to be a definitive document on operating the aircraft or towing operations and must be read in conjunction with the aircraft flight manual, engine operating manual, CGC SOP, GNZ documentation and flight training (your type rating).

This SOP is to help ensure we operate our Turbo Dynamic tug, DYT, consistently and to best known practice. This is to ensure:

- We operate safely
- We ensure the life of the aircraft and towing equipment is optimised
- We provide the best possible service to our customers – the glider pilot and all members of the Canterbury Gliding Club
- We work together as a professional team of tow pilots

It is not intended to replace, override or diminish any other document. The aircraft flight manual should be fully read, understood and adhered to.

All and any feedback on how we may improve our towing operation and this document is always welcome. However, putting new ideas into practice must only occur post formal approval being given by the club.

There is a one pager reference at the end of this document which summaries a number of the often used references in a form that makes it easy to carry in your flight gear and aircraft.

1. General Towing Operations

1.1 Rules and equipment

In addition to the rules set out by CAA and GNZ our club has a few operating requirements and recommendations. This section is a guide to assist safe and efficient operations.

In the glider towing environment the role equipment consists of:

- The release and its mechanism including the operating handle.
- The rear view mirror.
- The tow rope and associated components (weak link, tow rings, etc)

As pilot in command of the tow aircraft your responsibility extends to include this equipment, it's up to you to ensure everything is in order and operational before beginning towing.

In particular pay attention to:

- That the tow hook has fully closed once the tow rope has been connected - The tow hook is a simple over centre mechanical lock that holds the beak of the release closed. To prevent excessive opening (release) forces under high load the mechanism is designed to be <u>just</u> over centre when <u>fully</u> closed. The only force holding the release closed is created by a spring within the tow hook mechanism (Tost Hooks). This spring has two arms that jointly provide the closing force, if one arm fails or if there is high drag in the system caused by dirt or grime in the tow hook assembly itself or excessive drag in the actuating cable system this can prevent full closure, the hooks are typically fitted in a manner to prevent dirt and grime entering the mechanism, unfortunately this can also makes it difficult to see if the hook is fully closed. This can be a hazardous trap so be vigilant when hooking the rope on.
- Make sure the rear view mirror is correctly adjusted for you before you begin, the mirror body can move up and down, the mirror itself can be moved independently of the body. Don't be tempted to put your arm out the canopy window to do this, we will end up with a cracked canopy. Open the canopy and make any adjustment.
- Make sure the rope is in good order, no knots, rings look and sound right with no viable cracks and the weak link isn't part distorted from an overload.

1.2 Airfield safety

On any given gliding day there are people that are new to aviation on the field. Propellers and tow ropes seem to attract their interest, make very sure before start up that there isn't anyone or anything that could be adversely affected by the thrust, taxi well clear of other objects especially if you are turning as the tow rope won't follow your path, it will drag inside any turn and potentially contact other objects, keep the tow rope in sight as much as possible. Avoid taxiing over the tow rope when turning. Park the tug away from the operation base.

Members of the public and even club members can take the opportunity to use the airfield as a dog run. It is not safe to operate when unleashed dogs are anywhere near the operational area and you should not start up if dogs are present.

Glider pilots have a habit of parking side by side if space allows to allow individuals to launch at their convenience. This in not your concern unless they extend to a point you can no longer land or go around (if landing back in the opposite direction) without flying over a glider or vehicle or people.

Your tow rope can cause serious damage or injury or even death if the end hits someone. Do not take off if you cannot land or go around safely.

If winching is to take place in parallel to towing there must be clear and understood operation areas and communication requirements agreed before towing starts.

Mowing operations, airfield maintenance work, vehicle movements, livestock, etc can all cause significant hazards. Do not operate if for any reason the operational area is compromised and it is not safe to do so.

1.3 Taxi and line up

Make sure all take offs are from the very start of the runway or launch point, don't let the gliders creep down the field (Springfield especially, not so bad at Omarama for example due to the length available).

When taxiing toward the glider to be towed do so in a manner that gives you a good look at the full glider but doesn't put your prop wash over the glider or others parked nearby.

Before taking up slack, look for and check:

1. That the tail dolly and any wing walker are off.
2. That the canopy is fully closed.
3. Is the glider towing on a nose or belly hook?
4. Are the airbrakes closed or held open deliberately as some pilots do on initial ground roll?
5. How much if any water ballast are they carrying.
6. How competent is the wing runner likely to be?

Once connected to the glider and the wing runner is signalling for take up slack, line up directly in front of the glider, there is nothing more off putting for a low time student than having the tow plane off to one side before you start. This can be judged using the mirror, lining up the tail fin and nose of the glider. Make sure you line up in front of the right glider. Taxi very slowly forward until the rope is tight and the wing runner is signalling all out. In our club the wing runner has responsibility for the launch once the glider is hooked on to the rope so no radio calls will be given, only hand signals.

It's important that as the rope comes up tight you don't accidently pull on the glider with enough force to move it forward, if the glider is fitted with a belly hook this can cause the glider to overrun the rope and the rope to go back under the main wheel, generally causing the tow rope to be released as the belly hook back release is activated.

1.4 Ground roll and climb out

Prior to take off the glider pilot will have likely advised you of their tow requirement, this will normally just include a place and height but may also include a speed if they are either heavily ballasted or alternatively an older glider requiring a slower tow speed. It's important to plan the climb path to the release point so that you reach release height at the same time you arrive at the release point, this will need to be varied dependant on the climb performance with differing gliders, don't follow the same climb path all day, try and vary it a bit so homes or people on the ground aren't annoyed.

If the gliders airbrakes are closed but not locked, they tend to suck open late in the glider's ground roll or just as the glider is getting airborne, it's likely you will still be on the ground at this point. It is

always best to release the glider if safe to do so rather than hope you will get airborne in good time and the glider pilot will eventually realise their mistake and rectify it.

Once given "all out" monitor the following key parameters:

1. The wind direction and speed.
2. The power output of the engine via associated gauges. (Manifold pressure and fuel pressure)
3. The position of the glider.
4. The rate of acceleration and take off performance.
5. The airspeed.

Whilst all of the above items are important the items you are paying most attention to will change during the take-off roll. At the start of the take-off it's pretty much as written, mid ground roll it's more the reverse 5,4,3,2,1. Getting airborne it may be more 3,5,2,4,1.

If there are issues arising from items, 1, 2 or 3 this has an impact on 4 and 5. It is helpful to have performance points or markers before beginning the ground roll, these are ground reference points to be achieving specific speeds by, if something is wrong you can safely abort the take off. In the event of an aborted take-off, and on the basis this is due to the glider rather than the tow plane (they got out of position, a ground loop or the acceleration just isn't going well but engine performance is normal) it's generally better if you continue with your take off or if plenty of room roll well clear and forward, if you brake heavily and stop you could end up with the glider running into you.

Once airborne and going well your manoeuvrability is significantly reduced as the glider needs to be able to follow you. It's important that turns on tow whilst gentle are positive with a roll in and roll out.

1.5 Towing to release point

You should be well aware of the emergency signals. There are three: rolling the tow aircraft from side to side if you require the glider to release; waggling the rudder from side to side if you see the airbrakes are out in the rear-view mirror; and the glider flying out to your left and rolling from side to side indicating they can't release. Whilst these need to be known the radio is also a great tool to communicate with.

Remember, we are towing gliders with a micro light aircraft, a bit like towing a caravan with a small albeit powerful car. Don't muck about if the glider is starting to pull your tail about get rid of the glider early. If training flights want to box the tow etc make sure this is all carried out above 1000ft agl.

What you don't want to do when you are towing a lot of gliders to a known lift area is arrive there low and end up climbing in the lift amongst other gliders to the height your glider has requested.

As a rule of thumb glider pilots are more likely to release once they have reached the launch height they had requested than when they are in good lift. This won't be true for experienced glider pilots but you'll find most club pilots (as opposed to private owners) do this and club tows will in general be the bulk of tows you do on any given day.

Build a mental picture of where the gliders are as the day progresses, combined with a good look out. Note how good is the lift? Do you expect to see the glider you previously towed at or below tow height if conditions are weak?

If there are gliders at your height in a thermal you are towing to, aim to fly just to the left side of it allowing the glider on tow to release and join the thermal with the other gliders and upon release you are free to turn away from the thermal and start your descent.

1.6 Return and landing

Remember you need to be high enough on approach to avoid the rope ending up in a fence or other obstruction, it is a good idea to ask for feedback from those on the ground occasional – "How far was the rope above the fence on that tow?" if you're operating at a site where the approach is over a public road or where the public can gather to watch (people seem to always stand or park right on the centre line of any approach, 09 at Omarama is a good example) then always add extra, don't risk hitting a person or vehicle with the tow rope.

1.7 Parking up between tows

When parking the tow plane between tows park in a position that will not hamper gliders towing out or gridding, but close to the front of the grid is always good to reduce taxiing and give a good view of what is happening and when the next tow may be required.

When parked the tow plane the tow rope must at all times be pulled in behind the tow plane within the wing width to avoid damage from passing vehicles, gliders or other equipment that may get entangled with the rope.

As much as it is best to park into wind to aid cooling and reduce prop cavitation from a tail wind it is also better to park into the sun to avoid the canopy acting as a magnifying glass and burning the top of the cockpit area, as noting also in section 2.2. This is particularly an issue in winter with the lower sun angle.

2. Aircraft Operation Turbo Dynamic

2.1 Overview

TCU (Turbo Control Unit)

This aircraft is equipped with a turbo charger. The turbo is managed via the TCU which you have no direct control over. The TCU has an off / on switch that is caged and locked, this must always be turned on, the only exception is in an emergency where the TCU has failed.

The TCU manages the boost pressure by controlling the turbo's waste gate relative to operating conditions and throttle setting. The TCU can struggle to keep up if you add the power very rapidly, except when going from 100 to 115% boost (35 to 40 inches hg). Remember the turbo is running all the time but only providing a gain in performance when the boost pressure goes over 29.5 inches hg (based on sea level ops). Full power (referred to as 100% in the manual) will produce 35 inches so the engine is being boosted at this power level. In a normally aspirated engine as you gain height the manifold pressure reduces, whereas in this aircraft the TCU will slowly close the waste gate to maintain manifold pressure until it reaches full power height where the waste gate is shut and the turbo can no longer maintain manifold pressure.

Should the TCU fail - orange caution light flashing, the best course of action is to immediately reduce power to ensure boost pressure remains below design limits. A failure of the TCU or any component on the system may mean the turbo waste gate will remain fully shut. In this case boost can still be provided by the turbo, but must be controlled by the throttle setting alone and thus caution is required.

A solid orange caution light indicates a periodic surge in boost and may clear, but the aircraft should be landed as soon as possible and not flown. If required for safety the TCU can be turned off and back on in under 5 seconds to try and clear this fault. Note, as the waste gate will likely fully close when turning off the TCU ensure throttle setting and rpm are reduced first.

Failure of the turbo itself may result in significant oil loss, perform an emergency landing as soon as possible.

Fuel pumps

This aircraft has no engine driven mechanical fuel pump relying on two electric pumps, a main and boost pump (labelled 'Fuel Pump'). The main pump requires the master switch and either mag switch to be on to operate before start, however, once the engine is running the main fuel pump will continue to operate being feed directly from the engine alternator, even if the master switch and key switch are turned off or battery is flat. The boost pump required the master switch, key switch and the yellow 'Fuel Pump' switch to be on to operate.

The boost pump such be on for the full climb period of any tow as an engine failure with a glider on tow could result in a tow upset or collision.

Fuel selector – This can be tricky to access, so suggest you limit tank changes to on ground until comfortable with this. Note that vertical down is off!

2.2 Pre-flight and ground handling.

The aircraft is of similar construction to that of a glass fibre glider, with respect to the airframe the pre-flight inspection is limited to checking the airframe for hangar rash and any signs of other

damage along with normal control checks. There are several bolts under the wing that support the flaps, the pitot head is located under the starboard wing, this protrudes a long way down so don't taxi over anything that could hit it, static vents are on the side of the fuse behind the cabin, other than that not a lot can be readily seen. Like a glider the airframe skins are quite thin, don't lean on or push the aircraft on the skin as this could leave bruises in the glass finish, treat it as you would a fabric covered aircraft.

Do not leave the forward opening canopy open unless getting in and out, there have been issues with sunlight refracting through the open canopy and causing burns to the cockpit area, these can be seen on the top of the instrument panel in DYT. When you close the canopy latch it too please.

You must stick to the marked areas for entry and exit at the wing root.

The engine requires to be "burped" to check the oil level and this can take some time (up to 50 over compressions) so be patient as failing to burp the engine properly can lead to over filling. If the oil level after burping is at the bottom of the range, it only takes about 200ml to bring it up to mid-range, so be careful not to over-fill. The second inspection hatch is used for general inspection and checking the coolant level.

You can view the turbo from under the engine by looking forward, this is worth doing to check there are no oil leaks etc.

The ground tow bar makes moving the aircraft simple, please NEVER leave it on, once you've used it, remove it. Also be careful not force the tow bar sideways beyond the steering limit, or you may bend it.

2.3 Fuel and fuelling

There are two (left and Right) 37 litre fuel tanks in the centre section of the wing, each tank has a drain valve under the wing to check for water, these can leak when shut, if this happens a slight turn on the fitting can stop it.

When at Springfield, check or have checked the fuel tanker early in the day so it can be filled if needed in good time for fuelling the aircraft at or before the end of the day. If the tanker is below 100 litres, fill with an additional 300 litres. 95 RON minimum.

2.4 Weight and Balance

The aircraft is permitted to operate to a maximum take-off weight of 600kg. DYT has an empty weight of 302kg, adding full fuel (76 litres = 57kg) gives significant crew and baggage capacity.

The maximum single seat load is 120kg and minimum total pilot load is 70kg. The Baggage max is 10kg.

DYT has a very forward C of G and actually requires a minimum pilot weight of 88 kgs without ballast. By adding 10kgs of ballast the pilot weight can be at the minimum of 70kg.

Fuel is forward of the C of G and pilots just behind so fuel burn improves the C of G slightly. Baggage is well behind the C of G so ballast can easily be added to allow for lighter pilots, noting ballast should be secured using the fitting in the right side of the baggage compartment.

You always need to ensure the C of G is within the limits of the aircraft and a spreadsheet is available to aid calculation of this.

2.5 Pre-Start / Start.

Warning -This is not a full check list, it just covers the extra items and any notes pertinent to this aircraft and needs to be incorporated into your existing check list.

- Wheel brake– two notches for start-up.
- Master - on – push the 'test" button to check fuel tank low level lights, fuel pump light and charge light.
- Prop – select manual mode, use prop pitch switch to cycle prop, course first and then fine. Both limit lights need to illuminate confirming prop has reached its cycle range and mechanism stopped running, confirming prop stops are working. (This only needs to be carried out once each day). Leave in full fine (max RPM) and return to constant speed ops.
- Set engine rpm to max 5700. **All our normal operations will be conducted in constant speed mode**. In manual mode there is no over speed protection, you are effectively operating a fixed pitch prop, an over speed of 200 RPM requires the prop be returned to the manufacturer!
- TCU – Check this is switched on. **The TCU switch should not be touched, you can see it's in the on position, don't turn it off to check.**
- Fuel pump check – master on, turn ignition key 1 click to illuminate all instrument and warning lights – check all work. Turn on one mag and listen for the electric fuel pump and confirm fuel pressure - turn that mag off - then turn on the secondary fuel pump (yellow switch) and listen for the second electric pump and confirm pressure.

Cold start

Should only be needed first start of the day

- No throttle needed – i.e., **throttle should be on the stop**
- Choke half – full depending on the day
- Oil temp control (blue knob) – shut
- Start procedure as per your normal system, remove choke steadily after start, on cold days you may need to leave the choke out for up to a minute.
- Set idle RPM to 2500 until engine oil has warmed to 50 deg C prior to doing your run up or flying

Warm start

- Set throttle (about quarter - half a turn in from fully shut)
- No choke
- Start procedure as per your normal system

2.6 Run up

Use a standard procedure as for any aircraft, but without the pitch check as this is done pre-start.

Mag check – 4000 rpm, max drop 500, max differential 150

2.7 Pre-Take off, take off and initial climb

Normal pre-take-off check list is suitable, noting:

- Boost pump – on
- Flaps – normally at 1, make sure fully in the notch

- Trim – neutral for take off

For normal (non-towing) operations it should not normally require boosting past the turbo gate – 100% power, noting the turbo does provide some boosting up to the gate and will provide up to 35 inches MP (Manifold Pressure).

Ground roll and take off and initial climb:

- Power slowly to 100% (confirm 35 inches MP)
- Airborne – establish climb at 70 kts.
- Remove flap (can be done once passing 60 kts)
- Reduce RPM to 5500
- Reduce power to 31 inches MP

This aircraft will climb very rapidly if left at 100% (35 inches MP) you will likely climb into the circuit joining traffic passing over the extended centre line.

Cruise / climb

- Boost pump off
- 25 inches and 5000 RPM is normally plenty, but cruise setting as required. Recommended for cross country is 31 inches.

2.8 Circuit and landing

The aircraft is slippery and getting it slowed to flap speed and configured for landing will require a power reduction to about 12-13 inches MP. Make sure you do this in good time, so you are not rushed into a cramped landing approach, especially on short tows since some power should be left on initially to allow even engine cooling.

Standard downwind checks are suitable.

Flap notch 3 can be difficult for some people to achieve as a long way back, notch 2 is adequate and if a lighter pilot with significant fuel it can be difficult to affect a fully flared landing in notch 3.

Approach speed 65kts, 60kts over the fence

It is easy to wheel on, make sure you get the stick fully back before touch down

2.9 Emergencies

Smoke in the cockpit – Turn each electrical item off using its switch, (not the master switch). The circuit breakers aren't the pull out type so not much you can do there. If you suspect a fire turn the fuel off and keep the throttle wide open to try and suck any fire into the engine, turn the master off.

Engine failure – Airspeed to 70kts, turn pump 2 on (yellow switch) and check fuel pressure, change tanks, try to restart. To make glide the best, drop tow rope if attached, select prop to manual mode and hold switch in course until max pitch light illuminates (as this is electric it can be done even if the prop isn't turning) turn master off, carry out forced landing.

3. Towing Operation with the Turbo Dynamic

3.1 Prior to towing for the day

It is best, but up to pilot discretion that the tow pilot on the day do a circuit prior to towing begins to ensure all engine components are warm before the engine is run at full boost (40 inches Hg). Also, on days when turbulence may be a safety issue a circuit at reasonable height to 'test' the conditions is recommended and this should be discussed with the duty instructor.

This circuit need only be at a maximum power of 35 inches with the oil flap closed. This flight should only be completed immediately prior to towing ops beginning as the engine will cool and conditions can change quickly.

All towing will be carried out with the oil flap fully open (pushed forward). The oil flap should remain open, there is no need to close on descent or when sitting on the ground.

Should the aircraft subsequently sit stopped for a long time (many hours depending on the day) it may be necessary to re warm the oil, for this, on restart just close the oil flap and wait at idle until the minimum oil temp is returned (50 deg C) then fully open the oil flap before commencing towing ops.

3.2 Pre-Take off, take off and climb

Up until line up the aircraft can be managed as per General Aircraft Operation, checking the mirror to ensure it is appropriate for your seated position.

At the all-out signal steadily increase power using the slide travel of the throttle control until you reach the 35 inch stop, as soon as manifold pressure is steady at 35 inches, depress the turbo switch to the left and roll the power on further using the Vernier to 40 inches without hesitation – the turbo does not like running between 35 and 40 inches. Using the Vernier for this last bit just makes it a little slower and helps the TCU keep up.

The aircraft will get airborne at 45 to 50 kts, flaps away steadily once at 60 kts and accelerate to 70 kts to climb.

Once the combination is stable, climbing comfortably at a minimum of 70kts and you are happy, reduce the power to 35 inches and then the RPM to 5500. Typically, this will be around 200 ft agl. Ensure that the throttle is back enough for the turbo latch to release, because the turbo controller is less stable past the latch position. It is best to bring the throttle back enough to feel the latch release, then advance the throttle up to the latch position.

Note – The engine is only rated for 5 minutes over 35 inches and/or 5500 rpm and running above these should be minimised.

Continue the climb until the glider releases at these settings. Watch the oil temperature does not climb too high which can happen on hot days when doing high towing, a small increase in air speed helps cooling considerably and should normally be held between 70 and 75kts. Oil temperatures into the bottom of the Yellow are normal on long tows.

3.3 Glider release and descent

After glider release, the initial and immediate power reduction should be to 30 inches MP.

Start the descent and trim as required, reduce prop RPM to 5000.

You can then immediately throttle back to 25 inches and then steadily and slowly throttle back further if required for a normal descent keeping airspeed well within the green arc if conditions are rough - below 120 kts.

Depending on your distance from the airfield and height the aircraft can and should if possible be throttled back to 15 inches MP, but no lower until in circuit. If any distance from the field 20 -25 inches MP may be more useful to allow a faster return speed.

The circuit must be one you are comfortable with and should be standard until very familiar with the aircraft and towing operation. Once comfortable a lower, faster and tighter circuit is acceptable if clear of all other aircraft and safe to do so. This reducing air time and turnaround time on busy days, stressing again it must be safe and well within your capability, competency and comfort zone.

The engine must be left running at or below 15 inches MP for 3 minutes (approximately) before shutdown. This should be able to be achieved during the descent, circuit and taxi so require minimal or no idling before shutdown. This is to try and preserve the turbo condition, but being mindful the engine life is based on run time, not air time.

3.4 General notes on towing in DYT

Fuel burn when towing is around 26 – 30 litres an hour. Be wary of the gauges, at quarter full indicated you can be near empty as they vary greatly as do most aircraft between climb and descent.

Keep an eye on the oil and water temps. Conditions vary and can have a big impact on engine temperatures, such as winter and summer operations, high tows and low tows, glider weights and types, etc.

4. End of day

The aircraft should always be cleaned thoroughly at the end of flying each day. Cleaning needs to be done with water, warm and soapy is best and/or simple green. Not petrol or solvent based cleaners as this removes the waxes from the finish.

Refuel the aircraft. At Omarama and Springfield this should be done to within approximately 25mm of the top on each side. At other fields which may be shorter in length, have longer or thicker glass or an uneven surface, less fuel may be desirable to reduce aircraft weight.

The engine air intakes will be a real problem to clean out should birds nest in them, please ensure the cover is fitted every night.

Fill in the Techlog with name and hours flown and any issues. Please notify the CTP of any issues.

5. Roster

All active tow pilots will be included on the roster as best as possible to suit requests. Once a roster is released it is the person on the roster for the day or period to either do the towing duty or find a replacement. In the event of an agreed roster swap it becomes the replacements responsibility to do the duty for find another replacement.

Remember, without you the club doesn't fly.

6. Reference and Summary for towing with Turbo Dynamic (DYT) 'One Pager'

Pre-flight:

1. Mag check – 4000 rpm, max drop 500, max differential 150.
2. Towing fuel burn is around 26-30 litres an hour
3. Oil flap open at all times during towing operates

Climb out

1. 60kts flaps away
2. 70kts climb rate minimum unless requested otherwise by the glider pilot
3. Reduce to 35 inches MP and 5500 RPM once established in the climb (Max cont)

Descent and landing

1. Initial descent throttle to 30 inches MP
2. RPM back to 5000
3. Throttle to 25 inches MP
4. Reduce slowly and steadily to 15 inches MP if decent profile allows
5. 65kts approach, 60kts over the fence
6. Engine must run at 15 inches or below for 3 mins before shutdown