



T2 144, 154

Owner / Service Manual

February 2007 - Third Edition



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Introduction

Thank you for purchasing a Wills Wing glider, and welcome to the world wide family of Wills Wing pilots. We are a company of pilots and aviation enthusiasts, and our goal is to serve your flying needs now and in the future, as we have done for pilots throughout the world since 1973.

We encourage you to read this manual thoroughly for information on the proper use and maintenance of your Wills Wing glider. If at any time you have questions about your glider, or about any aspect of hang gliding that your Wills Wing dealer cannot answer, please feel free to give us a call.

Because there is no regulation that requires the registration of hang gliders, Wills Wing has no way to maintain an accurate contact list of the owners of the hang gliders we manufacture. As a result, Wills Wing has no reliable way to contact owners directly about service and safety issues. It is therefore, of necessity, your responsibility as an owner to check periodically for service advisories and technical updates that relate to your glider. You can do so most effectively by going to our web site at www.willswing.com. The site features extensive information about Wills Wing gliders and products, a Wills Wing Dealer directory, a comprehensive list of service and technical bulletins, the latest editions of owners manuals, our complete retail price list, a search engine, e-mail and more.

The most important contents of our internet site are the service and technical bulletins, technical articles, and the latest editions of owner's manuals. These are your best sources for safety and airworthiness advisories and information on Wills Wing products. Many of the documents are published in Adobe Acrobat format. A free viewer for Acrobat files is available at <http://www.adobe.com>. Note that it is best to have the most current available release of the viewer for Acrobat files, as newer files may not display properly in earlier versions.

If you are unable to obtain service information from the web site, you can contact us by email, by U.S. mail, or by telephone.

We wish you a safe and enjoyable flying career, and, once again, welcome aboard!

Rob Kells, Mike Meier, Linda Meier, and Steve Pearson
Wills Wing, Inc.

Disclaimer and Warning

Hang gliding is a form of aviation. Like any form of aviation, its safe practice demands the consistent exercise of pilot skill, knowledge of airmanship and weather, judgment and attention at a level that is appropriate to the demands of each individual situation. Pilots who do not possess or exercise the required knowledge, skills and judgment are frequently injured and killed. The statistical rate at which fatalities occur in hang gliding is approximately one per thousand participants per year.

The Federal Aviation Administration does not require a pilot's license to operate a hang glider. Hang gliders and hang gliding equipment are not designed, manufactured, tested or certified to any state or federal government airworthiness standards or requirements. Federal Aviation Regulation Part 103 states in part, "ultralight vehicles are not required meet the airworthiness certification standards specified for aircraft or to have certificates of airworthiness" and "operators of ultralight vehicles are not required to meet any aeronautical knowledge, age, or experience requirements to operate those vehicles or to have airman or medical certificates." Wills Wing hang gliding products are not covered by product liability insurance. As a hang glider pilot, you are entirely responsible for your own safety. You should never attempt to fly a hang glider without having received competent instruction. We strongly recommend that you not participate in hang gliding unless you recognize fully and wish to personally assume all of the associated risks.

Please fly safely.

Technical Information and Placarded Operating Limitations

The T2 144 and 154 have been tested and found to comply with the Hang Glider Manufacturers Association (HGMA) Airworthiness Standards. The T2 144 was granted a Certificate of Compliance by the HGMA on May 22, 2006, and the T2 154 was granted a Certificate of Compliance by the HGMA on October 6, 2006. Updated information on the current HGMA certification status of any hang glider can be found on the HGMA web site at www.hmga.net

The HGMA standards require:

1. A positive load test at root stall angle of attack at a speed equal to at least the greatest of:
 - a. 141% of the placarded maximum maneuvering speed
 - b. 141% of the placarded maximum rough air speed
 - c. 123% of the placarded speed never to exceed for at least three seconds without failure.

The required speed for the T2 for this test was 65 m.p.h.

2. A negative 30-degree angle of attack load test at a speed equal to at least the greatest of:
 - a. 100% of the placarded maximum maneuvering speed
 - b. 100% of the placarded maximum rough air speed
 - c. 87% of the placarded speed never to exceed for at least 3 seconds without failure.

The required speed for the T2 for this test was 46 m.p.h.

3. A negative 150 degree angle of attack load test at a speed equal to at least the greater of 30 m.p.h. or 50% of the required positive load test speed for at least 3 seconds without failure.

The required speed for the T2 for this test was 32 m.p.h.

4. For the T2 with a Vne of 53 m.p.h., pitch tests at speeds of 20 m.p.h., 37 m.p.h. and 53 m.p.h. which show the glider to be stable over a range of angles of attack from trim angle to 20 degrees below zero lift angle at 20 m.p.h., and from trim angle to 10 degrees below zero lift angle at 37 m.p.h., and from 10 degrees above zero lift angle to zero lift angle at 53 m.p.h.
5. Flight maneuvers which show the glider to be adequately stable and controllable throughout the normal range of operation.

Note: The T2 has been designed for foot launched soaring flight. It has not been designed to be motorized, tethered, or towed. It can be towed successfully using proper procedures. Pilots wishing to tow should be USHGA skill rated for towing, and should avail themselves of all available information on the most current proper and safe towing procedures. Suggested sources for towing information include the United States Hang Gliding Association and the manufacturer of the towing winch / or equipment being used. Wills Wing makes no warranty of the suitability of the glider for towing.

Because of the design of the nose catch for the bottom front wires on the T2 it is critically important that the nose line be attached properly during platform towing operations. In no case should the nose line be attached in such a way that there is any possibility that the nose line can pull forward on the nose wires, nose tang or nose tang handle, or, in any other way, contribute to disengagement of the nose wires. Please read the section on towing for more information.

Because of the lack of a kingpost and top rigging on the T2 design, tethering the glider by the nose, such as is commonly done during platform towing operations, creates the potential for overloading the keel tube of the glider which could result in a structural failure. To avoid overloading the keel, any tether line attached to the nose should pull as much as possible in line with the keel, and in no case in a direction more than 45 degrees below the line of the keel tube itself. Please read the section on towing for more information.

Flight operation of the T2 should be limited to non aerobatic maneuvers; those in which the pitch angle will not exceed 30 degrees nose up or nose down from the horizon, and the bank angle will not exceed 60 degrees. The T2 can be induced to spin at any VG setting. At VG settings of less than 50% (VG middle or looser) the T2 is moderately resistant to spinning, and has spin and spin recovery characteristics that are typical for other Wills Wing high performance flex wing gliders. At VG settings greater than 50% (VGM to VG full tight), the T2 becomes progressively and rapidly more susceptible to spinning, and the spin characteristics and spin recovery characteristics become markedly more extreme. In the most extreme case, a spin entry at VG full tight (VGT), initiated by a rapid pitch up to a significantly nose high attitude, the spin response will be a very sudden and abrupt spin with a very high rotation rate and a tendency towards a very nose down attitude. Any spin and / or the recovery from the spin involves a significant possibility of a total loss of control of the glider, including in flight inversion and possible structural failure. The probability of this result increases with the abruptness of the spin entry, the abruptness of the spin recovery, and the percentage of VG that is on when the spin is performed.

Recovery from a spin requires unstalling of the wing, and it is therefore critically important that in the event of a spin, no application of nose up pitch control be held. The T2 will tend to recover from a spin once control pressures are relaxed. To recover from a spin, move to the center of the control bar and gently pull in to position the basetube below your shoulders. Do not pull in rapidly and do not “stuff” the bar. As the nose lowers and the angle of attack is reduced, the stall will be broken and the spin will stop. In an aggravated spin, be prepared for the nose to pitch down significantly, and for the glider to accelerate to a high speed during the resulting dive. Ease the control bar out gently to recover to level flight. Recognize that such recovery will consume significant altitude, and will result in the glider assuming an unpredictable heading and attitude. Recovery from a spin at low altitude or in the vicinity of terrain or other aircraft may involve a flight trajectory, which intersects the terrain or another aircraft at a high rate of speed. In view of the unpredictable nature of spins and spin recovery, Wills Wing recommends that no attempt should ever be made to deliberately spin the glider. The T2 provides the pilot with a high degree of pitch authority, in combination with a very low twist sail. As a result, it is possible to produce a very aggravated and severe stall, the recovery from which may involve very severe pitch down rotation, the pilot going weightless, and the glider recovering via an unpredictable trajectory with a significant altitude loss. Therefore, aggravated stalls should not be induced except on landing flare. Due to the increased sharpness of the stall break and the reduced directional control available at tighter VG settings, flight within five mph of the minimum sustainable airspeed should be avoided at VG settings of tighter than VG middle, except in smooth air.

The maximum steady state speed for a prone pilot in the middle of the recommended weight range full forward on the control bar with the VG set full tight will range from approximately 53 m.p.h. to as high as 75 m.p.h. or more for the T2, depending on wing loading, harness design and adjustment, and glider tuning. The placarded speed never to exceed for the T2 is 53 m.p.h. The placarded maximum speed for maneuvering flight or flight in rough air is 46 m.p.h.. This speed will be achieved with the control bar basetube approximately at the waist. This speed should not be exceeded in anything other than smooth air.

No abrupt maneuvering or control inputs should be made at anything above this speed. An airspeed indicator is provided with the T2 and should be used by the pilot as an aid to comply with the placarded limitations.

The stability, controllability, and structural strength of a properly maintained T2 have been determined to be adequate for safe operation when the glider is operated within all of the manufacturer specified limitations. No warranty of adequate stability, controllability, or structural strength is made or implied for operation outside of these limitations.

The stall speed of the T2 at maximum recommended wing loading is 22 m.p.h. or less. The top (steady state) speed at minimum recommended wing loading for a prone pilot with a properly designed and adjusted harness is at least 40 m.p.h. All speeds given above are indicated airspeeds, for a properly calibrated airspeed indicator mounted in the vicinity of the pilot. Wills Wing provides such an airspeed indicator with the glider. It is strongly recommended that the pilot fly with such an airspeed indicator. Refer to the section on using the airspeed indicator for further information on speeds to fly.

The recommended hook in pilot weight range for the T2 is:

T2 154: 185 - 285 lbs.

T2 144: 160 - 235 lbs.

Be advised that pilots with hook in weights of less than 20 lbs above minimum will find the T2 more demanding of pilot skill to fly, and that pilots hooking in within 20 lbs of the maximum will experience some relative degradation of optimum sink rate performance due to their higher wing loading, as well as increased difficulty in foot-landing the glider in very light winds or at high density altitudes.

A minimum USHGA Advanced (IV) level of pilot proficiency is required to fly the T2 safely. Pilots are advised that the optimum proficiency level for the T2 is higher than the minimum recommended. Operation of the glider by unqualified or under qualified pilots may be dangerous.

Operating the T2 outside of the above limitations may result in injury and death. Flying the T2 in the presence of strong or gusty winds, or turbulence may result in loss of control of the glider that may lead to injury and death. Do not fly in such conditions unless you realize and wish to personally assume the associated risks. Wills Wing is well aware that pilots have, and continue to perform maneuvers and fly in conditions that are outside the recommended operating limitations stated herein. Please be aware that the fact that some pilots have exceeded these limitations in the past without dangerous incident does not imply or insure that the limitations may be exceeded without risk. We do know that gliders which meet all current industry standards for airworthiness can and do suffer in flight structural failures, both as a result of turbulence, and as a result of various maneuvers outside the placarded operating limitations, including, but not necessarily limited to aerobatics. We do not know, and cannot know, the full range of maneuvers or conditions that may cause the pilot's safety to be compromised, nor can we test the glider in all possible circumstances.

T2 Reassembly After Shipping and Breakdown for Shipping Procedures

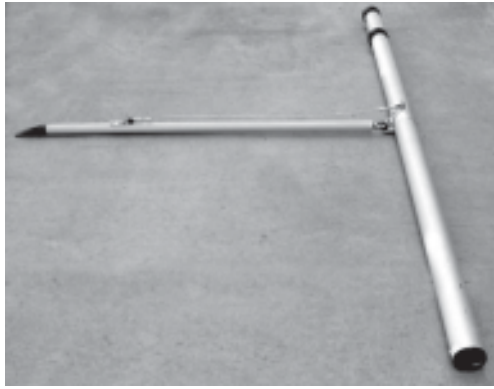
The front leading edge is 60mm (2.36") over sleeved with 62mm (2.44") at the crossbar junction. The rear leading edge is 50mm (1.97") over sleeved with 52mm (2.05") at the outer sprog attachment point.

Because of the different diameters of the front and rear leading edges, the front and rear leading edges are not concentric – that is they do not share the same axial centerline. Rather the rear and front leading edges are in contact along a line on the leading edge of the tube, just below the horizontal centerline, where the sail contacts the leading edge tube. Two “crescent reducers” are used to step down from the larger diameter of the front leading edge to the smaller diameter of the rear leading edge, and hold the rear leading edge in proper position inside the front leading edge. A screw holds the rear crescent in place in the front leading edge, and a clevis pin holds the front crescent in place in the front leading edge, and simultaneously passes through and secures the rear leading edge in place in the front leading edge. Note that this clevis pin passes through the center of the front leading edge, but is offset from the center of the rear leading edge, due to the eccentric location of the rear leading edge within the front.

The rear end of the rear leading edge contains a receptacle for the tip wand, secured in place by a clevis pin five inches from the rear end of the tube and a small screw 1/2" from the end of the tube. The clevis pin also passes through a tang on the rear sail mount webbing strap and secures this strap to the rear leading edge.

Reassembling the T2 after breakdown for shipping

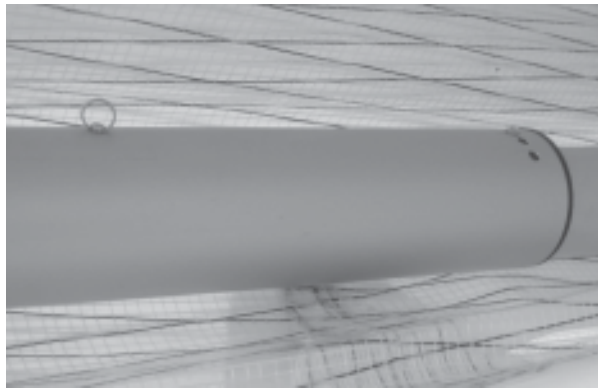
1. Lay the glider down on its back (bag zipper up) on a smooth, clean work surface. Unzip the glider bag, pull it off of the glider at the front and rear, and unfold the sail to its full length. Turn the glider right side up, as this is the easiest way to install the rear leading edges. Remove all Velcro sail-packing ties.
2. Identify the rear leading edges as to left and right in order to make sure you are mounting the correct rear leading edge into the correct front. Check the “right” / “left” label or marking on the rear leading edges. If the leading edges are not marked, identify left and right by consideration of the following: The sprogs are mounted to the back side of the leading edges, the sprog cables are attached to the top of the leading edges, and the wand receptacle is at the outboard end of the leading edge. The photo below shows the right rear leading edge, in a right side up orientation. Each rear leading edge should have one crescent on the front end of the tube, and another six inches aft of that. There should be a clevis pin and safety ring installed in the front crescent, and a small, hex socket button screw installed in the rear crescent. The spare parts kit included with the glider should have a small hex wrench that fits this hex socket button screw. Remove the clevis pin and safety, and the hex socket button screw from each rear leading edge. Take care to preserve the position and orientation of each crescent on the leading edge tube.



3. Working on one wing at a time, and working with the appropriate rear leading edge, fold the outer sprog, which is attached to the rear leading edge to the rear against the rear leading edge. Slide the outboard end of the leading edge tube into the sail through the inboard (front) sprog access zipper. As the end of the outer sprog reaches the outer sprog access zipper, bring the sprog outside of the sail through that opening as shown. (The photo below shows the right rear leading edge being inserted into the sail as described.)



Then slide the rear leading edge forward, allowing the sprog end to remain outside the sail, until the front end of the rear leading edge is at the aft end of the front leading edge. Carefully align the rear leading edge with the front leading edge, using the clevis pin hole in the front crescent and the corresponding hole in the front leading edge as an alignment guide, so that you can slide the rear leading edge into the front without twisting. Carefully slide the rear leading edge into the front leading edge until the clevis pin hole in the crescent appears through the corresponding hole in the front leading edge. (Just prior to this point, if the rear crescent has remained in position on the rear leading edge, you will need to insert the rear crescent into the front leading edge.) Install the clevis pin from the bottom of the front leading edge, and install the safety ring on top of the leading edge. (Make sure at this point that the clevis pin passes through all three parts; the front leading edge, the rear leading edge tube and the front crescent. If the clevis pin is properly installed in all three, you should not be able to pull the rear leading edge out of the front leading edge, and the rear leading edge should be secure and tight in the front leading edge – i.e. you should not be able to wiggle it up and down at the forward end.) At this point, if the rear crescent has not moved, the threaded insert in the rear crescent should be visible through, and centered in the forward most of the three holes in the front leading edge. Install the hex socket button screw to secure the crescent in place. (See the photo below showing the clevis pin, safety ring and button screw correctly installed in the right leading edge.) Repeat the process for the other leading edge.



5. Unzip the tip access zipper and pivot the cam lever outside of the sail. Reach into the sail from the cam lever access opening and grasp the rear end of the rear leading edge. Work the sail forward over the rear leading edge until the last six inches of the leading edge is outside the cam lever access zipper. Find the sail mount strap and stretch it towards the rear of the leading edge. If necessary, you can provide additional slack in the sail by disconnecting the sail mount at the nose of the glider by removing the screws that secure the nose mount webbing to the leading edge. Position the rear sail mount strap on the bottom of the leading edge tube and make sure the strap is not twisted or wrapped around the tube. Remove the safety ring from the clevis pin located five inches from end of the leading edge, remove the clevis pin, and pass it through the tang in the sail mount webbing. Re-install the clevis pin in the leading edge, from the bottom, and re-install the safety ring on the clevis pin on top of the leading edge. See the photos below.



6. Verify that the sail mount strap is on the bottom of the rear leading edge, is not twisted, and is not wrapped around the leading edge tube. Re-mount the sail at the nose. Pull the sail back over the end of the leading edge. (Note, if you are unable to remount the sail at the nose at this time, you can wait until you set up the glider and spread the wings. However, anytime you spread the wings without the sail mounted at the nose you must be careful to insure that the sail slides forward as you spread the wings, otherwise you could tear open the sail at the nose.)
7. Fold the outboard sprog to the front and against the leading edge. Place a Velcro around the sail at this point.

Rotate the tip wand cam lever inside the sail and close the Velcro closure or access zipper. Fold the tip of the sail over, roll it up and re-install the tip bags. Flip the glider onto its back, put the glider bag back on and zip it up.

To remove the rear leading edges for shipping follow these steps

This process will basically be the reverse of installing the rear leading edges after shipping. Before beginning, read through the section above on how to re-install the rear leading edges. While following the instructions below, refer to the photos in the section above for reference, if necessary.

1. Lay the glider on the ground or floor, unzip the bag and remove the Velcro ties. Remove the tip bags and lay the tips out flat. The sprog access zippers should be fully unzipped.
2. Unzip the access zipper at the wing tip and rotate the tip wand cam lever outside the bottom surface. Reach into the sail from the cam lever access opening and grasp the end of the leading edge tube. Work the sail up over the end of the leading edge to expose the clevis pin that secures the sail mount strap to the leading edge. Remove the safety ring from the sail mount clevis pin and remove the pin from the leading edge and from the tang on the sail mount strap. Immediately re-install the clevis pin in the leading edge tube and re-install the safety ring.
3. Check to see that the rear leading edges are labeled “Left” and “Right.” If they are not, mark them with an indelible marker.
4. Working through the inboard (front) sprog access zipper, remove the clevis pin and safety that secures the front crescent and front end of the rear leading edge in place. Also remove the hex socket button screw that secures the rear crescent reducer in place.



- Pull straight aft on the rear leading edge to disengage it from the front. The rear leading edge should come out of the front with both crescents still in position. Re-install the clevis pin and safety in the front end of the rear leading edge, securing the crescent to the tube, and reinstall the hex socket button screw in the rear crescent. Fold the outer sprog towards the rear, and remove the rear leading edge from the sail through the inboard (front) sprog access zipper.
5. Tape or pad the sprog ends, sprog / leading edge junctions, sprog wire junctions, the front end of the rear leading edge tubes, and the rear of the front leading edge tubes to prevent sail damage during transit.
 6. Pivot the tip wand cam lever into the opening in the sail and close the access zipper. Carefully fold the rear of the sail over against the front, and replace the bag on the glider.

T2 Set-Up Procedure

A number of set up operations are made easier by the use of the T2 Set-Up Tool - a six-inch length of 3/4" tubing included with your glider.

1. Lay the glider on the ground, with the bag zipper up, with the bag at right angles to the wind.
2. Undo the zipper, remove the battens, and remove the control bar bag.
3. Lift and deploy the control bar legs.
 - a. Remove the ball lock pins from the downtube end fittings.
 - b. Align the downtube bottom plugs properly in the basetube corner fittings.
 - c. Install ball lock pins, securing the brackets to the basetube.



Make sure that the small bushings that secure the side wire tangs in the downtube end fittings are in place, and that the side wire tangs are properly secured. Also make sure that the ball lock pins are fully and securely engaged in the basetube end brackets.

4. Flip the glider upright on the control bar. Try to set the basetube on level ground. Remove the glider bag and all the Velcro sail ties. Do not remove the leading edge tip protector bags at this time. Install the root battens onto the studs on top of the keel at this time.



Spread the wings almost all the way. As you spread the wings, and before you make any attempt to tension the crossbar, verify that the bottom side wires are not wrapped around or tangled in the inboard sprog.



6. Remove the battens from the batten bag, and check each batten for symmetry against the corresponding batten from the other wing. Align the battens at the nose, and at about the 60% chord point as shown. There should not be any deviation of more than 1/8" from one to the other along the full length of the battens.



Wills Wing convention is that black tipped battens go in the right wing and white tipped battens in the left. Battens are numbered from the tip inwards, and the shortest top surface cambered batten in a T2 is designated as the “#2” batten.

Working from the root out, install the three longest cambered top surface battens in the sail. Do not engage the tips in the trailing edge at this time.

Insert the battens carefully, so as to minimize stress and wear on the sail. Never insert or remove the inboard most top surface battens with the crossbar tensioned and never insert or remove battens with heavy wind pressure on the top of the sail or in any condition which causes the battens to slide with great resistance in the pockets.

If you choose not to check your battens for symmetry before each flight, you should, at a minimum check them every few flights.

7. Spread the wings all the way and check all cables for any twisted thimbles or tangled cables. At the rear of the keel, reach inside the keel pocket and find the sweep wire. Pull the sweep wire out the rear end of the keel pocket, and check that it is not wrapped around the keel. Insert the T2 Set-Up Tool in the string loop on the keyhole tang and tension the crossbar by pulling back on the sweep wire. Secure the sweep wire by installing the keyhole tang onto the keyhole collar on the rear wire bolt. Make sure the tang slides fully forward in the slot on the collar so that the narrow part of the keyhole slot is fully captive in the narrow part of the bolt collar.

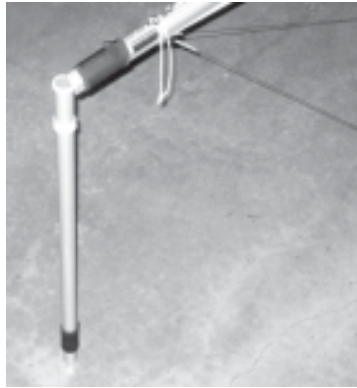


Make sure at this time that the button lock safety is in the full up, engaged position. On the T2, it is ABSOLUTELY NECESSARY that the sweep wire button lock safety be fully functioning and fully engaged whenever the sweep wire is attached – it is a NO FLY condition if the button lock becomes stuck in the down position such that it is does not properly prevent the sweep wire from becoming detached from the collar.

The reason that this is so critically important on the T2 is that if the VG is pulled on and then released on the ground, the crossbar will likely not fully return to its full forward position, leaving the sweep wire slack, and allowing the sweep wire tang to disengage from the keyhole collar if the safety is not engaged. In flight, there is enough load on the crossbar to maintain continuous tension on the sweep wire, but on the ground, cycling the VG can cause the sweep wire to become slack. Never install the keyhole tang onto the keyhole bolt without making absolutely sure that the tang is fully engaged on the narrow neck of the bolt, and pulled forward into the fully locked position with the safety button in the full up position. Due to the friction in the system, if this attachment were to become disengaged on the ground, it could be possible that the pilot would not notice it, and he could launch with the sweep wire disengaged. This would result in a complete loss of structural support of the glider and a total loss of control. Also, never attach the pull string to the collar, even temporarily. (Note, if the button should become stuck in the down position, it can usually be released and made to pop up by lifting on the keel tube just forward of the keyhole collar bolt, and taking the ground load off of the rear stinger. See the photos below.)



Note: T2s manufactured during or after September 2005 include a keel stand. After you have tensioned the sweep wire, if you are setting up on reasonably level ground, and if there is not too much wind, you can deploy the keel stand as shown below to raise the trailing edge of the glider. This will keep the tips off the ground and make installation of the remaining battens easier.

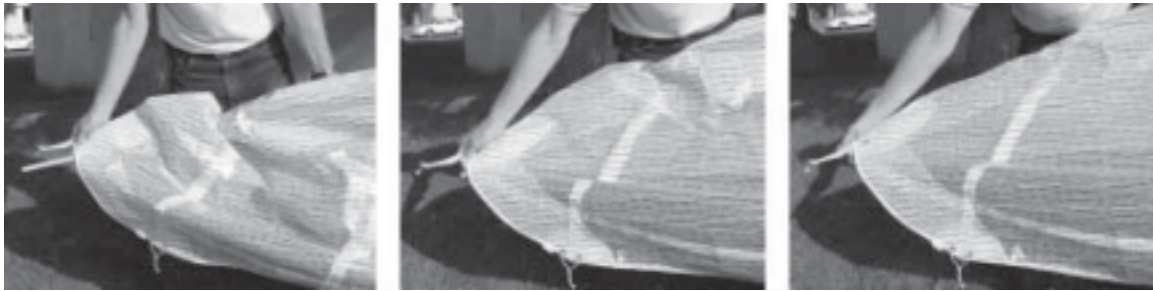


8. The next step is to install the tip wands. Remove the wingtip protector bag. Unfold the tip of the sail and open the zipper closure that provides access to the tip wand cam lever. Rotate the cam lever outside the sail. The tip wands are tapered; the larger end is installed in the receptacle in the end of the leading edge tube. Near the outboard end of the wand is a label that reads “BACK.” This indicates the side of the tip wand that should be positioned towards the rear of the glider after the wand is inserted in the leading edge, and before the cam lever and cup are installed. Reach into the opening with the tip wand in your hand and work your way up to the end of the leading edge. Install the tip wand into the receptacle, and push it all the way in until it bottoms out. Rotate the wand to align the “back” label to the rear – away from the front of the leading edge. (Note: The purpose of aligning the wand in this way is to extend the service life of the wand – see Wills Wing Technical Bulletin TB20040424 – available at www.willswing.com for more information.)



9. Working from the front side of the leading edge, facing the glider, hold the end of the leading edge tube from underneath in one hand and grasp the wand lever and cup in the other hand. Place the open end of the wand cup against the front side of the tip wand. While supporting the leading edge tube by pulling it towards you, push back against the wand with the wand cup, allowing the cup to slide outwards along the wand as the wand bows back. (Keep in mind here that you are not trying to “stretch” the sail lengthwise along the wand – that won’t work. You are bowing the wand back by pressing the cup against the front, which will naturally pull the sail outwards around the bow of the wand as you do so. Also keep in mind that the wand must be allowed to bow in order

for this to work; you cannot be holding onto the wand with your other hand during this operation.) As the wand cup reaches the end of the wand, it will rotate and pop into place over the end of the wand.



Note: There are two other methods that can be used to install the wand cup onto the wand if you're having difficulty with this method. One is to use the same procedure as described above, but to follow the procedure before tensioning the crossbar. The other is to install the wands and wand cups before installing any battens or tensioning the crossbar. To do this, install the wand into the wand receptacle as described above. Then, grasp the wand in one hand and the cam lever in the other hand.

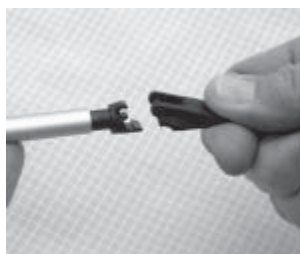


Pull straight back on the cam lever until the cup is beyond the end of the wand, and then install the cup onto the wand. Either of these methods is an acceptable alternative to the primary method described above, and you may find either or both to be easier. The disadvantage of either is that because the crossbar is not tensioned, the wing tips are not being held up off the ground, so the tip area of the sail is more exposed to dirt and wear.

10. The next step is to cam over the tip wand cam lever, tensioning the sail at the tip. Tension the crossbar haulback cable if you have not done so already. Hook your thumb into the loop of string on the cam lever and grasp the opening of the sail in the bottom surface with your other hand.



11. Pull the string around in a circular motion, first towards the trailing edge and then inboards towards the keel, to cam the wand lever over and tension the wand. Before you zip up the access zipper, look into the sail from the tip and verify that the most outboard internal rib is fully zipped up, and that the “back” label on the wand is properly aligned – it should now be aligned with the portion of the cam lever that is resting against the wand. Then close the access opening.
12. Install the remaining outboard top surface battens. Secure the shortest cambered battens with a double purchase loop of the 205 leech line. At this time you can install the batten tips for the cambered battens into the hem of the trailing edge using the following procedures. The lever tip incorporates a hinge and a snap locking mechanism, as well as a threaded shank that allows for adjustment of the overall batten length, and hence the chordwise tension that the batten puts on the sail. The locking mechanism can be broken if it is not released properly before the lever portion of the tip is rotated upwards. If it does break, it will usually break at the locking hook on the lever (rear) portion of the tip. Also the hinge portion can pop apart relatively easily. (This is not a failure of the tip, and you can easily pop the hinge back together again.)



If you do have a failure of the locking hook on the lever portion, simply pop the hinge apart and pop on a new lever part. It is also possible, though less likely, to break the forward portion of the tip. If that happens, unthread the tip from the batten and thread in a new piece.

Once the batten is installed, in order to fit the batten tip into the trailing edge hem, you will need to unlock the lever part of the tip and pivot it upwards. To unlock the tip, place a slight downward pressure on the top of the lever portion of the tip, and squeeze upwards on the bottom of the lever portion just behind the locking clasp. Then pivot the lever tip upwards. You should not feel any resistance to the lever rotating upwards - if you do you haven't properly released the locking portion. If you hear a click when pivoting the lever upwards, it is likely that you have broken, or partly failed the locking tab on the lever.



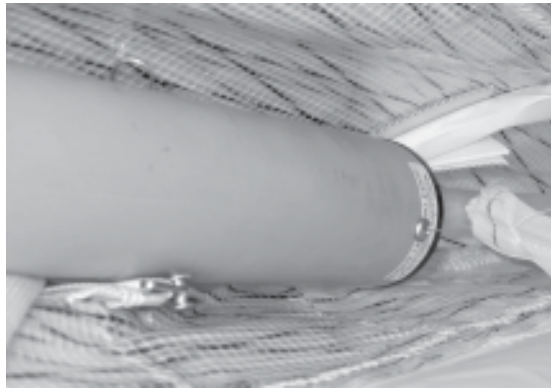
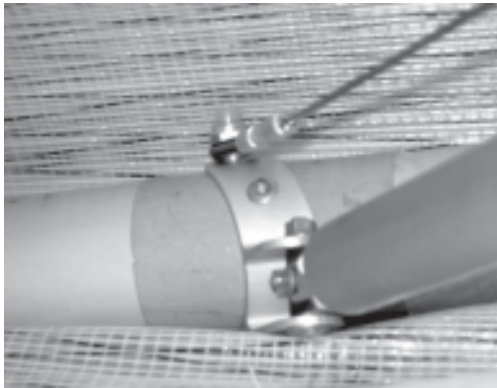
After the rear of the tip has been rotated upwards, fit it into the gap in the hem of the trailing edge and then rotate the tip downwards until it locks into place. You should hear a click at this point, and the tip should be securely held in the locked position. (Note: A tip with a failed catch will still

“click” when you rotate the lever downwards into position, but depending on the degree of failure of the catch, it may not support an upward load on the trailing edge sufficient to keep the tip locked in position.) NOTE: The root battens (the ones you installed onto the keel studs at the beginning of the set-up process) on the T2 extend all the way to the trailing edge, and are also fitted with lever tips. Don’t forget to engage these into the trailing edge hem at this time.

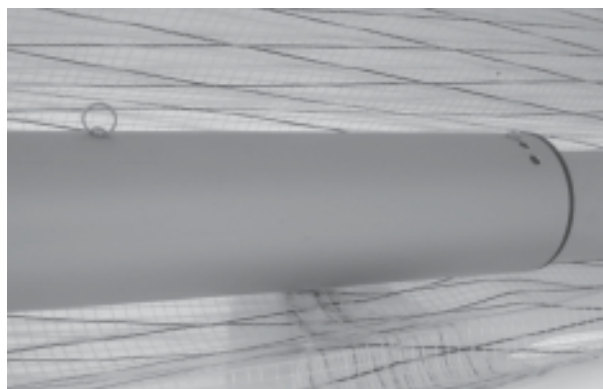


13. The next step is to deploy the sprogs and secure them in position. Before doing so, working through the sprog access zippers, preflight the following items:

- a. The remaining internal ribs to confirm that they are fully zipped up.
- b. The sprog hardware, including the leading edge sprog brackets, the attachment of the sprogs to these brackets, and the sprog cable attachments at both ends of each sprog cable.
- c. The rear leading edge sail attachment / tip wand installation.



- d. The leading edge crossbar junction hardware, including the bolt and nut that secures the bottom side wire and inboard sprog wire to the crossbar, and the bolts and nuts that attach the inboard sprog and crossbar to the leading edge. Also preflight the rear leading edge / front leading edge junction at this time



To deploy and secure each sprog, swing the sprog away from the leading edge and align it in the center of the rear end of the sprog access zipper, such that the rear end sprog paddle lies below both the transverse batten and the short piece of webbing in the sail. Fully close the sprog access zipper and this will secure the sprog in the proper position underneath the transverse batten and capture it in position with the webbing.

14. Attach the bottom front wires to the bottom of the noseplate. Install the keyhole tang over the collared bolt by pulling down on the nose of the glider while pressing the tang upwards over the collared bolt. Remember, it is the pulling down of the glider's nose rather than the upward pressure on the tang that allows you to install the tang over the bolt.



After installing the keyhole tang, verify that it has been secured in position by the button lock - make sure that the button pops up in front of the tang to lock the tang in position after the tang is fully seated on the collar.

Note that on the T2, there is not as much tension in the bottom wires to keep the keyhole tang engaged as there would be on a glider with top rigging. Because of the lack of a kingpost and top rigging on the T2 design, tethering the glider by the nose, such as is sometimes done after setup and while waiting to fly, creates the potential for overloading the keel tube of the glider which could result in a structural failure. A similar problem could arise during a hang check. To avoid overloading the keel, any tether line attached to the nose, or any restraint used during a hang check should pull as much as possible in line with the keel, and in no case in a direction more than 45 degrees below the line of the keel tube itself. See the diagram in the section on towing. Alternately, for performing a hang check, the glider can be supported by pushing up from underneath the rear keel instead of pulling down and forward at the nose.

16. Unzip the center zipper. On later model T2's, rotate the hang system base pillar to align the hang lever at right angles to the keel tube. (See photo)



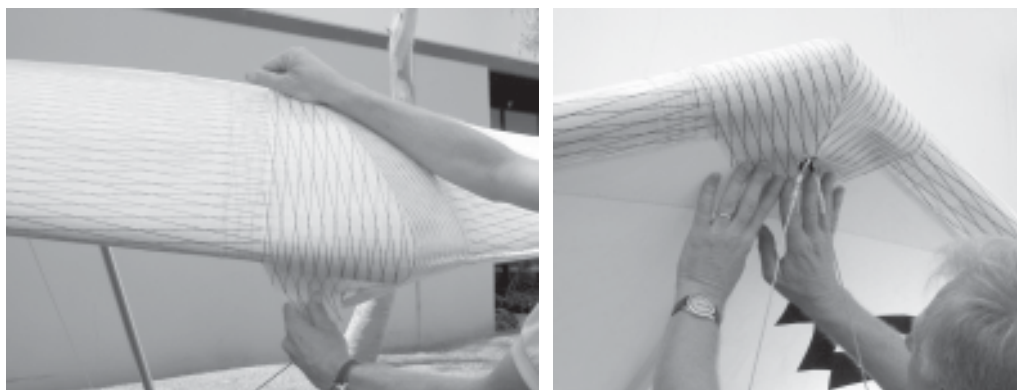
17. With the center zipper open, look inside the sail to preflight the following items, including all nuts, bolts, pins and safeties:
- The spar center section, including the front spar hold down strap, and the rear spar anchor.
 - The routing of the VG line.
 - Each spar along its entire length.
 - The top to bottom surface sail velcro attachments.
 - The hang lever and main and backup hang loops.



18. Check the operation of the VG throughout the range, and leave the VG set full tight. Zip up the center sail zipper

19. Install the nosecone as follows - fit the nose cone to the nose of the sail and stretch the top rear end of the nose cone back along the centerline of the glider. Press down to attach the velcro. Then pull the bottom front end of the nose cone tight around the bottom of the nose and attach the velcro. Finally, re-adjust the top rear attachment as necessary to remove any gaps between the nosecone and the sail along the sides of the nosecone.

Note: T2's made after June of 2006 feature a nosecone that is attached to the sail at the top rear end. To install, simply pull the bottom of the nosecone tightly around the nose of the glider and mate the velcro surfaces at the bottom such that the nosecone lies flat and smooth.



It is important to fit the nosecone carefully so that there are minimal discontinuities in the sail in the nose area. Any discontinuity in the sail in the nose area, or along the leading edge will tend to promote premature separation of the airflow, leading to an increased stall speed and reduced performance.

Never fly without the nosecone, or with any replacement that was not designed for your sail.

20. Return the VG to the full loose position. Open the bottom surface zipper and pull forward on the crossbar center to assist the crossbar in returning to the full forward position. Then re-close the center zipper.
21. Install the bottom surface battens. The bottom surface battens are retained by a narrowing at the front of the bottom surface batten pockets. You will feel increased resistance as you push the battens into this area.
22. Conduct a complete preflight of the glider, checking all assemblies, which have not already been checked.

Preflight Procedure

Along the left leading edge

Carefully check the entire length of the leading edge pocket to insure that the Mylar insert is laying flat in the pocket. If any section of the Mylar is folded under, de-tension the crossbar, remove the batten closest to the area of distortion, and unfold the Mylar.



Failure to correct folded under or severely creased Mylar will cause a severe alteration of the flight characteristics of the glider, which may lead to a dangerous loss of control.

Open the inboard sprog access zipper and look inside, making sure that the bottom side wire is properly secured to the crossbar, that the thimble is not cocked on the tang, and that the nuts securing the side wires and the sprog wire are tightened and secure. Remember to close the access zipper.



While pushing up on the leading edge between the nose and the crossbar junction, step on the bottom side wire with about 50 lbs. of force. This is a rough field test of the structural security of the side wire loop, the control bar and the crossbar, and may reveal a major structural defect that could cause an in-flight structural failure or loss of control.

At the left wingtip

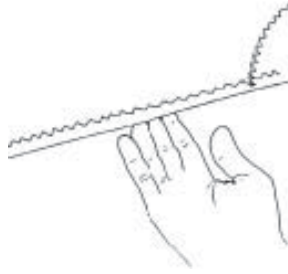
Check that the tip wand lever access zipper is closed.

Along the trailing edge, left wing

Check that there are no tears in the sail material along the trailing edge.

Check that all battens are properly secured.

Check that the sprogs are properly secured in position supporting the transverse battens, and that the sprog access zippers are properly closed.



From the rear keel

Check again that the keyhole tang is fully engaged and that the button lock is fully up and engaged.

Look inside the keel pocket and verify that the VG activation rope is not twisted.

Also check that the sweep wires are tight and actively tensioning the tang on the bolt.

Along the trailing edge, right wing

Same as for left wing.

At the right tip

Same as for left tip.

Along the right leading edge

Same as for left leading edge.

Under the glider at the control bar

Sight down the downtubes, making sure that they are straight.

Unzip the center zipper.

Check the sweep wire for wear where it passes the hang system pillar.

Check that the routing of all VG ropes and pulleys is clear and straight.

Check the crossbar center plate and wedge assembly including the following: The four nuts and bolts that attach the crossbar plates to the wedge. The attachment of the sweep wire at the rear of the crossbar center wedge.

Also, visually inspect the crossbars by sighting along the length of the crossbars looking for any evidence of damage. Zip up the center zipper.

Pull down the neoprene protectors and check the control bar apex bracket hardware, including the clevis pin safeties, the control bar top plug bolts and nuts, and the elbow to apex bracket bolt and nut.



Check the cables at the control bar corners, making sure there are no kinks or twisted thimbles. Check for proper installation of all nuts and safety rings at the control bar corners. Check for full engagement of the ball lock pins.



Launching and Flying the T2

Before launching, hook in to the glider and do a careful hang check. We recommend that you hang as close to the basetube as possible - this will give you lighter control pressures and better control in both roll and pitch.

1. We recommend that you launch with the VG set between full loose and 1/3 on. Having the VG set at 1/4 when launching will enhance the glider's lifting capability and increase the trim speed slightly, enhancing control of the glider during departure,

If you launch with the VG set partly on, you must make sure that there is no way that the excess VG rope can catch on anything on the ground or that you can step on it. One way to do this is to fold the rope into a flat loop about eight inches long, and tuck it around the outside of the right downtube above the bottom front, rear, and side wires.

If the wind is more than 10 m.p.h. or gusty you should have an assistant on your nose wires on launch, and, if necessary, an assistant on one or both side wires. Make sure all signals are clearly understood. The angle at which you hold the glider should depend on the wind speed and slope of the terrain at launch; you want to achieve a slight positive angle of attack at the start of your run.

2. Run aggressively on launch and ease the bar out for lift off.
3. The flying characteristics of the T2 are typical of a high performance flex wing. Make your first flights from a familiar site in mellow conditions to give you time to become accustomed to the glider.

Minimum controllable airspeed and minimum sink airspeed

There are two important airspeeds with which all hang glider pilots should be intimately familiar; minimum sink airspeed (hereinafter referred to as MSA) and minimum controllable airspeed (MCA). Minimum sink airspeed is that speed at which your descent rate is the slowest possible. It is the speed to fly when you want to maximize your climb rate in lift, or slow your rate of descent to a minimum in non-lifting air. (You would normally not fly at MSA in sinking air; the strategy there is normally to speed up and fly quickly out of the sink. By minimizing your time spent in the sinking air you minimize altitude lost, even though you have momentarily increased your sink rate by speeding up.)

Minimum controllable airspeed is that speed below which you begin to rapidly lose effective lateral control of the glider. Recognition of this speed and its implications is a subtler problem than many pilots realize. We have seen several instances of pilots who were having a lot of trouble flying their gliders simply because they were unknowingly trying to fly them too slowly; below the speed at which the glider responded effectively to lateral control inputs. It is our opinion that a great percentage of hang gliding accidents are caused by inadvertent flight below MCA, and subsequent loss of control of the glider with impact preceding recovery. Such incidents are usually attributed to "stalls," but it is not the stall per se that causes the problem, indeed the glider need not even be "stalled" in the traditional sense.

On most hang gliders, MCA and MSA have evolved towards a common value during the design and development of the glider. This is so because if the wing is tuned so tight that minimum controllable

airspeed is at a higher speed than minimum sink speed, then effective sink rate performance can be improved by loosening the wing so as to lower the minimum controllable airspeed. Conversely, if minimum controllable airspeed is reached at a speed below that of minimum sink, the wing can usually be tightened so as to improve glide performance without significant sacrifice in other areas. One important thing to note is that as the VG is tightened, minimum sink airspeed normally goes down, while minimum controllable airspeed goes up. Therefore as you tighten the VG, you will find that at some point you can no longer adequately control the glider at minimum sink airspeed. The exact VG setting at which this happens depends on how active the air is, and how advanced your skills are.

Using wing tufts to find the minimum sink speed of your glider

Your Wills Wing glider has been equipped from the factory with short yarn tufts on the top surface of each wing. The shadow of these tufts will be visible through the sail. The tufts are useful for indicating the local reversal of the airflow, which is associated with the onset of the stall in that portion of the wing. You can use these tufts, as described below, to help determine when you are flying at minimum sink airspeed.

On a flex wing hang glider with moderate twist, the wing experiences a progressive stall, and different spanwise stations of the wing stall at different angles of attack. The tufts have been placed on your wing at the approximate location of the first onset of stall. As the angle of attack is raised further, the stall propagates both outward towards the tips and inward towards the root. If you wish to observe the stall propagation across the whole wing on your glider, you can cut some more tufts from knitting yarn, about 3-4" long, and tape these to the top surface of your sail across the rest of the span. (Note: On a T2, with the VG set full tight, the twist is reduced to a minimal amount, and the wing stalls much more abruptly, with the stall progressing across the entire span much more quickly).

During normal flight the flow will be chordwise along the wing, and the tufts will point towards the trailing edge. When the wing stalls, the tufts will reverse direction, indicating the local flow towards the leading edge.

At the first onset of stall, the tufts will indicate the impending separation by first wiggling, and then deflecting spanwise, before they fully reverse and point forward. The first onset of stall occurs well before the familiar "stall break" in which the glider pitches uncontrollably nose down to recover from the stall. By the time the stall break occurs, all tufts but those farthest outboard will have indicated reversed flow.

On the T2, minimum sink rate is achieved with the tufts deflected spanwise between 30 and 60 degrees. Significant control authority is normally retained even with the tufts indicating 90-degree spanwise flow - however, you will usually achieve better performance at a slightly higher speed.

To find the glider's minimum sink speed, fly the glider in smooth air, early in the morning or late in the afternoon. When you are well away from the terrain, and well clear of other aircraft, look up at the wing tufts while you very gradually reduce the speed of the glider. Note the speed at which the tufts indicate a partial spanwise flow - between 30 and 60 degrees of deflection. This is your speed for minimum sink rate. Familiarize yourself with the position of the control bar relative to your body at this speed, with the sound and feel of the wind, with the reading on your airspeed indicator, and with the feel of the glider in terms of pitch and roll pressures. Most of the time when you are flying it will not be practical to look up for extended periods of time at your tufts. Also, in active air, the tuft

behavior will be affected by transient changes in angle of attack due to gusts. That is why familiarization with these other, more accessible indicators is important.

After finding your minimum sink speed, experiment with roll control response at speeds just above and just below this speed to find the value of MCA and the corresponding bar position and other indicators for this speed. Realize that your effective MCA is going to be higher and higher as the air becomes more and more turbulent; control response that is perfectly adequate in smooth air will not be good enough in rougher air. At VG 1/4 or looser, you can try flying the glider with the tufts indicating spanwise flow or partially reversed. You will probably find that the glider is controllable, but only with more than normal physical effort. Note that both MCA and MSA come well before the glider actually “stalls” in the traditional sense, i.e. pitches uncontrollably nose down. You may also be able to sense, or your vario may tell you that although the glider has not “stalled” (pitched nose down) your sink rate has increased significantly. In this mode the glider is “mushing.”

The VG rope is marked in 25% increments - one mark indicates VG 1/4, two marks VG 1/2 or VGM, three marks VG 3/4 and one long mark at the full pull of the rope indicates VG tight (VGT). The stall and spin characteristics of the T2 are relatively benign at VG settings of VGM (50% or two marks) and looser. At tighter VG settings, the stall rapidly becomes markedly more abrupt, and the T2 becomes much easier to spin and spins much more rapidly with a more severe recovery. We therefore recommend that flight at speeds less than five mph above minimum sink airspeed be avoided at VG settings of tighter than 50%, except in smooth air. We recommend against deliberate spins, or aggressive full breaking stalls, (with the exception of the landing flare).

Once you have familiarized yourself with the glider’s characteristics in the range of speeds near minimum sink, you will not need to look at the tufts very often. You will know from bar position and bar pressure, and from the sound and feel of the relative wind when you are at your minimum sink / minimum controllable airspeed. In general, you should not fly your glider below this speed. Be aware, however, that when you are flying at minimum sink in thermal gusts and turbulence, you will experience gust-induced separation of the airflow, which will periodically cause the tufts on your sail to reverse.

Of course in a turn, your minimum sink *speed* goes up because you are banked, and the bank effectively increases your wing loading that increases your flying *speed* for any angle of attack. But note this: *The tufts indicate angle of attack, without regard to airspeed!* Therefore, if you practice flying various bank angles in smooth air (while well away from any terrain or other gliders) and watch your tufts (on the inside wing, which will be at the highest angle of attack) you will get a feel for the way your minimum sink speed varies at varying bank angles.

Also be aware that in some thermalling situations, such as when trying to maximize climb rate in a thermal with a very strong and very small core, there may be an advantage in overall effective climb performance to flying so slowly that some portion of the inside wing is partially stalled most of the time. This is, however, an advanced and potentially dangerous technique - it is the beginning of a spin entry, and if pushed just a little too far can result in a sudden and extreme loss of control and / or altitude. In general, if the tufts are indicating flow reversal associated with the stall, you will improve both performance and controllability by pulling in and speeding up a little.

One final caution: from time to time a tuft may stick completely to the sail, and fail to properly indicate the direction of local flow. This may result from static buildup, or from the fine threads of the yarn becoming caught on a seam or some dirt or imperfection in the sail. The tuft may stick while indicating normal flow, but most often it will stick after having reversed, such that the tuft will indicate a stalled condition that does not exist. One clue in this situation is to note whether or not the tuft is wiggling. Since flow reversal occurs during a turbulent separated flow, a reversed tuft should be wiggling rapidly. If it is not, it is probably stuck. A tuft indicating normal flow will not usually wiggle. An occasional application of silicone spray to the tufts, and making sure that they are positioned so that they cannot catch on any seam will minimize the problem of sticking.

Towing

Special care must be taken in any form of towing. In particular, in platform towing, it is critically important that the nose line be attached so that there is no possibility of inducing a spontaneous disengagement of the bottom front wires. In particular, there must be no way that the nose line can pull forward on the nose wires, the nose tang, or anything attached to either. See the photos below for the correct and incorrect methods of nose line attachment.



The photo above shows a CORRECT method for attaching a nose line for platform towing. Note that the line is cinched over the top of the tang, in front of the tang handle and in front of the wires.



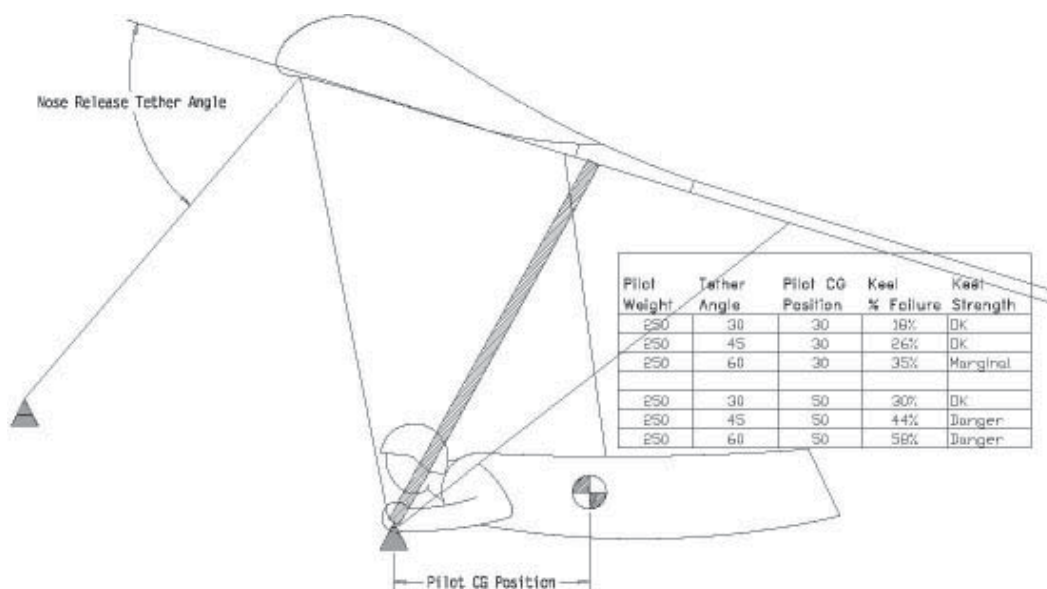
The photo above shows an INCORRECT method for attaching a nose line.

In the photo the nose line is routed between the wires, making it likely that the nose line could push forward on the nose tang, causing it become disconnected. It is also possible for the nose line to pull forward if routed outside the V of the wires, but behind the tang handle. In any platform-towing launch, a final check of the routing of the nose line and the security of the nose tang should be made prior to launching.

Because of the lack of a kingpost and top rigging on the T2 design, tethering the glider by the nose, such as is commonly done during platform towing operations, creates the potential for overloading the keel tube of the glider which could result in a structural failure. To avoid overloading the keel, any tether line attached to the nose should pull as much as possible in line with the keel, and in no case in a direction more than 45 degrees below the line of the keel tube itself.

As the following table indicates, the load on the keel is also very sensitive to pilot weight and CG position. With a nose release tether angle of 45 degrees, the load on the keel is marginally acceptable at a pilot position corresponding to free flight airspeed of approximately 30mph. With an arms extended pilot position, the keel will be overstressed and the front wires will be quite slack.

A keel angle of 7 degrees has been used for platform tow operations, which allowed the glider to start lifting off the chocks at approximately 30 m.p.h.



Aerotowing

The T2 aerotows fairly easily compared to other gliders in its performance class. We recommend that the VG be set to 50% prior to launch. This reduces pitch pressures, slows the roll response of the glider, and provides the best qualitative flight characteristics for flying in formation with the tug at normal aerotow speeds.

The control bar on the T2 is taller than on most other gliders. Ground launch carts designed for the average glider will, when used with the T2, usually put the glider at a higher angle of attack on the cart than is optimum. If possible, it is best to adjust the keel cradle on the cart to re-set the glider to the proper angle of attack. If it is not possible to re-adjust the cart, recognize the launch will be more demanding, and more dangerous, as the glider will have an increased tendency to leave the cart at a

lower speed, where lateral control is reduced, and the tendency to come off the cart with one wing low is increased. To some degree, this can be compensated for by pulling forward through the control bar to position the basetube below your shoulders, and holding tight to the hold down rope. This will cause the glider to raise the keel as it begins to develop enough lift to lift out of the cart. At that point, and not before that point, you can release the rope and ease your weight aft to fly the glider off of the cart. Be prepared to pull in once clear of the cart if necessary so as not to climb more quickly than the tug.

Once clear of the cart and in position behind the tug, use firm lateral movements of short duration for roll and directional control in order to stay in position behind the tug. Do not move to one side of the bar and wait for the glider to respond - this will lead to over control and being out of position, and may lead to roll / yaw oscillations. It is better to “bump” the glider firmly in the direction of the desired correction and then return to center. If you need more correction, bump again. In pitch, stay on top of the situation and be as aggressive as necessary to keep the tug on the horizon.

Trimming Your Glider in Pitch

You will find that the pitch trim of the T2, as well as the basetube position at trim, changes with VG setting. At VG loose, the T2 will normally be trimmed very close to stall, and may even be trimmed below the minimum sink or minimum “sustainable” speed (trimmed partly in a mush). The bar position at trim at VG loose will be relatively far out. As you set the VG tighter, the trim speed will normally increase and the trim bar position will move back. On a competition tuned T2 with a Mylar sail, the trim speed at VG full tight may be as high as 30 mph or more.

At tighter VG settings, the amount of pitch pressure felt as you move away from trim also decreases. At VG loose, the pitch well is very defined, and the pitch force increases quickly as you pull in from trim speed. At tighter VG settings, the “pitch well” becomes more “shallow,” and the pitch force increases much less as you pull in from trim speed. At VG full tight, the pitch pressures when pulled all the way forward may be as light as 2 lbs per hand.

Overall pitch trim is affected by several factors. Among the most significant is the location along the keel of your hang point (commonly, if mistakenly, referred to as your “CG location”). The farther forward your hang point is, the faster the glider will trim, the less effort will be required to fly fast, and the more effort will be required to fly slow. If the glider’s trim is too slow, it will make the glider more difficult to control in roll, especially in turbulent air and when the nose pitches up on entering a strong thermal. For this reason, you may well find that it is easier to thermal with the VG set between 1/4 and 1/2, as this will speed up the trim and make the glider less subject to pitching up in thermal gusts.

On the T2, hang loop fore and aft position is adjusted by repositioning the elevated hang bracket on the keel. The bracket is secured by a bolt a through the keel. On early model T2’s, there are three holes in the keel and two holes in the bracket to allow six positions in increments of 1/2" over a range of 2 1/2" of adjustment. On later models, there is one hole in the bracket and three holes in the keel at intervals of 3/4" to allow for three positions in increments of 3/4" over a range of 1 1/2" of adjustment.

Note that the bracket on early models, and the base saddle on later models, are front to rear asymmetric – providing more support to the rear. Do not mount either the old style bracket or the new style saddle in the reversed position.

We recommend that you not stow your glider bag, or any other cargo on the glider. The practice of putting your glider bag inside the sail, for example, can drastically alter the pitch trim and static balance of your glider, and adversely affect its flying and landing characteristics. The best place to carry your glider bag or other cargo is in your harness.

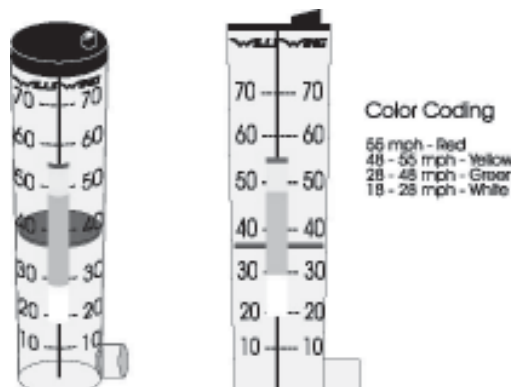
Another factor that can affect pitch trim is the adjustment of the keel pocket rear support strap. If this strap is too tight, it can significantly slow the trim speed, to the point where the glider is difficult to fly. With the glider fully set up on the ground, and the VG set full loose, there should be some slack in this strap.

Finally, the adjustment of the sprogs will affect pitch trim at tighter VG settings, although not at VG settings looser than about 2/3. If there is excessive “transient trim” (increase in trim speed at tighter VG settings), it is an indication that the sprogs are set too low. If there is a marked reduction in trim speed between VG 2/3 and VG tight, it indicates that the sprogs are set too high. When the sprogs are set properly, the trim speed will normally increase at least up to VG 3/4, and will not be significantly higher or lower at VGT than at VG 3/4.

In the absence of the use of tufts, it has become common for pilots to talk about bar position, or about indicated airspeed, when trying to communicate how to trim a glider properly or how to fly a glider at the proper speed for a given situation. The problem is that these methods are unreliable and inconsistent from one pilot to another even on the same glider. The angle at which your harness suspends your body in your glider has a great deal to do with your perception of the bar “position” relative to your body. Airspeed indicators vary in their indicated airspeed depending on the make of the instrument, its calibration, any installation error, etc. The use of tufts gives you an absolute first hand indication of the actual aerodynamic event associated with two critically important airspeeds on your glider. It is a potentially useful tool that may improve your flying.

Speeds to Fly and Using Your Airspeed Indicator

The Wills Wing Hall Airspeed Indicator has been specially designed to help you fly your T2 at the proper speeds for optimum safety and performance, and is provided with your glider.



There are four color-coded bands on the ASI:

White: This is the range from 18 m.p.h. to 28 m.p.h. This is the normal thermalling speed range for light to moderate thermalling conditions. Try to keep your speed within this range when thermalling in light to moderate conditions. Very strong or turbulent conditions will warrant a faster flying speed.

Green: The top of the green region represents the placarded maximum rough air and maximum maneuvering speeds. This speed of 46 m.p.h. should not be exceeded except in smooth air, and no abrupt large control inputs should be used above this speed. In significant turbulence it is recommended that you keep the airspeed “in the green” for best control and stability and best structural margin at all times.

Yellow: This region represents the upper speed range between maximum rough air / maximum maneuvering speed and the speed never to exceed. You should fly in this range only in smooth air as described above.

Red Line: This is your never to exceed speed. At no time should you fly faster than this speed.

The design of the Hall type airspeed indicator involves using a ram air versus static pressure differential to raise a disc in a tapered tube against the force of the weight of the disc. Because of this the ASI has certain operating limitations:

- a. It is only accurate in one G flight. If you are turning at a bank angle of more than 30 degrees, the ASI will read artificially low as a result of the G loading of the turn. Reliance on the ASI for limiting airspeeds in high banked sustained spiral maneuvers will likely cause you to exceed the placarded speed limitations of the glider and will compromise your safety.
- b. It is only accurate when within 15-20 degrees of the vertical orientation.

Using the VG System

The T2 uses a “conventional” VG system whereby a reduction system of pulleys and cords is used to vary the longitudinal position of the crossbar center along the keel, and thus increase and decrease the nose angle of the airframe, changing the tension and twist in the sail. Tightening the VG increases the spanwise tension which the airframe places on the sail, reducing the spanwise twist and the sail elasticity. The result is an increase in L/D performance and a reduction in roll control authority and roll control response.

The VG is activated by pulling laterally on the VG rope and then moving the rope to set the rope in the V-cut knife cleat. The recommended procedure for increasing VG tension is to grasp the rope firmly at the cleat, and pull straight across the basetube.

VG full loose is for maximizing roll control authority and roll rate. Due to the slower trim and increased pitch pressures at VG full loose, you may find that total effective control is actually improved in some conditions at slightly tighter settings up to VG 1/4. VG settings between VG loose and VG 1/3 are recommended for working lift when any significant degree of turbulence is present, or when you are in proximity to terrain or other gliders.

Between VG full loose and VG one half, the glider retains good lateral control authority and response. Tighter than VG one half, the glider’s roll pressures increase significantly and the roll rate becomes significantly slower. Tighter VG settings are recommended for straight-line gliding, or for flying in smoother conditions when well clear of both the terrain and of other gliders. The stall characteristics

of the T2 at tighter VG settings are more abrupt and less forgiving and the glider is more susceptible to spinning. Full breaking stalls and accelerated stalls at tighter VG settings are not recommended.

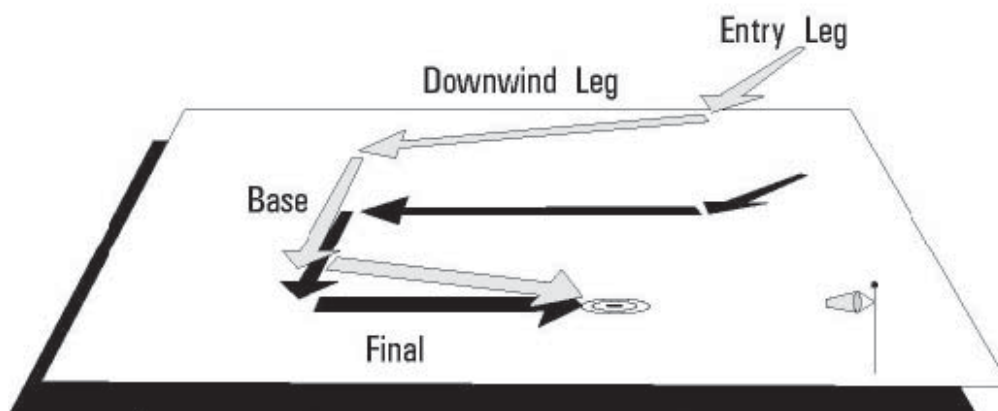
The T2 may be equipped with either Litestream or Slipstream 2 type downtubes. Unlike the Talon, the VG system is rigged the same whether the glider has Litestream or Slipstream 2 downtubes – in each case the VG rope is routed down the front side of the downtube. As a result, Slipstream downtubes, as used on the Talon, cannot be used on the T2 on the right (VG) side of the control bar, although they can be used on the left side. Similarly, Slipstream 2 downtubes cannot be used on a Talon on the right side, though they can be used on the left side.

Landing the T2

The following discussion assumes that you are executing the landing without the aid of a drag device such as a drogue chute. At the end of this section, we will discuss the use of drag inducing devices.

We recommend using an aircraft landing approach (45° entry leg, downwind leg, base leg, and final leg) whenever possible, and we suggest that you practice making your approaches with as much precision as possible. Under ideal conditions, landing approaches are best done so as to include a long straight final into the wind at a speed above best L/D speed. In a very limited field, or a field which slopes slightly downhill, when landing in light wind, you may need to make your final approach at a slower speed, perhaps as slow as minimum sink, in order to be able to land within the field. In winds of less than 5 mph, if the landing area slopes down hill at more than 12:1, you should seriously consider landing downwind and uphill; or crosswind, across the slope. Landing attempts, which require slow speed approaches, maneuvering around obstacles or into a restricted area, or downwind or crosswind landings are not recommended for pilots below an advanced skill level.

Standard Aircraft Approach Pattern



We recommend that you make your approach with the VG set between full loose and 1/3 on. A full loose VG setting will reduce glide performance, making it easier to land on a target or within a small field. It will also ensure maximum control authority during the approach, and especially when flying very slowly on final. At VG full loose, however, there is some loss of aerodynamic efficiency and flare authority. For this reason, in very light winds, at higher wing loadings or at higher density altitudes, it is recommended that a setting of VG 1/4 be used. A full loose VG setting will also increase the glider's roll sensitivity, and some pilots have had difficulty with roll / yaw oscillations on final. The best way to avoid this is to fly your entire approach at a constant airspeed, and to control your touchdown point by making adjustments to the shape of your pattern. You should choose your approach speed based on the amount of wind and turbulence present - in stronger wind and more turbulent air, fly faster. In strong wind when the air is stable, and you expect a strong gradient, or if obstacles indicate the likelihood of a wind shadow near the ground, fly faster. In any case, however, try to fly a constant airspeed throughout the approach. In particular, we recommend against the technique of make a diving turn onto final. This maneuver, sometimes called a "slipping turn" is often taught to student hang glider pilots as a way to lose altitude during the approach. While it will work reasonably well with low or medium performance low aspect ratio gliders which have high levels of yaw stability and damping, and which are able to lose energy by diving because of the large increase

in drag at higher speeds, on a high performance glider this technique serves only to convert the energy of altitude to energy of speed, while at the same time suddenly increasing the glider's sensitivity to control inputs. The result is a high probability of overshooting the intended landing point and the prospect of roll / yaw oscillations, which may interfere with a proper landing.

Once established on a straight final approach, with wings level and flying directly into the wind, you should fly the glider down to where the basetube is between three and six feet off the ground. At this altitude, let the control bar out just enough to "round out" so that your descent is arrested and your flight path parallels the ground. The remainder of your approach will consist of bleeding off excess speed while paralleling the ground and keeping the wings level and the nose pointed in your direction of flight until it is time to "flare" for landing.

Prior to the landing flare your body position should be generally upright, but slightly inclined forward, with your head and shoulders forward of your hips and your legs and feet trailing slightly behind. Many pilots make the mistake of trying to get too upright at this stage of the landing, which actually reduces your flare authority and makes it harder to land on your feet. Your hands should be at shoulder width and shoulder height on the uprights. You should be relaxed, with a light grip on the bar, and your weight should be fully supported in your harness and not at all by your arms. (If your harness does not allow you to hang in the proper semi-upright landing position "hands off," without supporting your weight on the control bar, you will have a lot more difficulty making good landings. Talk to your harness manufacturer or your dealer about getting your harness adjusted to allow you to hang properly in the landing position.)

There are several options for when to make the transition from prone to this semi upright position. Some pilots favor going upright and moving both hands to the downtubes while still at altitude prior to the start of the approach. Others transition at the start of the approach to a semi upright position with one hand on a downtube and one hand on the basetube, and complete the transition by moving the other hand to the downtube just a few seconds prior to flare. Still others fly with both hands on the basetube until established on final glide, and then transition one hand at a time to the downtubes prior to flare.

Whichever method you use, there are a few important principles to observe. The first is that you should not make any change in hand position unless you are flying at or very near trim speed. At speeds faster than trim, you will be holding the bar in pitch against substantial force, and if you let go to move your hand the glider will pitch up and roll towards your remaining hand. The second is that while moving either hand, you have no control over the glider. You should move only one hand at a time. Even so, if you can't make the transition in the position of each hand quickly and reliably, you should transition both hands while at altitude, before you start your approach. Otherwise, if you fail to make a quick transition, you could be out of control close to the ground, and suffer a turbulence-induced change in heading or attitude without sufficient time to recover. Many pilots make the mistake of trying to change position while flying fast and close to the ground, and experience a dangerous loss of control as a result. A third principle to observe is that if you are using a "pod" type harness, you should unzip and confirm that your legs are free to exit the harness at least 500 feet above the ground and before you start your approach. If there is any problem finding the zipper pull, or dealing with a stuck zipper, you don't want to have to try to fix that problem while also flying the approach.

Once established on a wings level short final, into the wind, body semi upright and with both hands on the downtubes, your final concern is the timing and execution of the landing flare. The goal is to arrive on the ground, on your feet, under control with the glider settling on your shoulders. If the wind is 15 mph or more, you will not really execute a flare at all; you will simply slow to minimum flying speed, put a foot down, and step onto the ground. In lighter winds, you will want to use some combination of a final nose up flare, and running out your landing, in order to finish the flight on your feet with the glider settling on your shoulders. The lighter the wind, the stronger should be both your flare and your run.

The traditional method of landing in light or no wind calls for a sharp, aggressive flare at precisely the correct moment. This technique works fine when done correctly, but it's not easy to get the timing just right. Flare too early and you will climb, and then fall with the nose pitching down. Flare too late and you won't get the nose up enough to stop your forward motion, and the glider may nose into the ground as you run into it from behind.

The flare timing process is made much easier by using a combination of a "crescendo flare" and a run out of the landing. As you bleed off speed on final, flying just above the ground, you are at first letting the control bar out towards its trim position. As the glider reaches trim speed, which will normally be one to three mph above stall speed, you begin to gently push the bar out to keep the glider from settling. At this point it is almost time to flare. As the glider enters the "mushing" range of angles of attack, it will begin to settle in spite of your continuing to ease the bar out. This should be happening well before your arms are significantly extended. At this point begin your flare by smoothly accelerating the rate at which you push out on the bar. At the same time, draw one leg forward, put a foot down, and start to run as hard as you can. This run should be very much like an aggressive take off run – your body should be leaning forward into the run and you should be driving with your legs. The difference here is that while you are leaning into your run and driving forward with your legs, your arms are extending fully from your shoulders, pushing out, and what feels like upwards, on the control bar in an accelerating, "crescendo" flare.

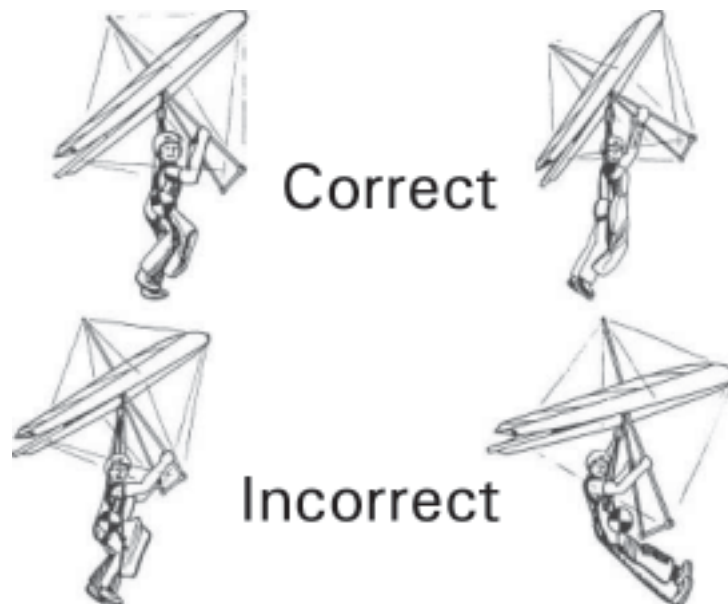
Done correctly, this type of flare / run combination will bring the glider quickly to a very nose high attitude, producing a great deal of drag and quickly arresting all of your forward motion. You will feel the glider pulling you from behind, resisting your attempt to run, and as you slow down the glider will settle gently on your shoulders. Even in no wind, you should not have to take more than a few steps. If your timing is a little early, and you feel the glider start to climb, simply stop pushing out and resume the flare when the glider again begins to settle. If your timing is a little late, your feet will touch down a little sooner, but as long as you're running and flaring at the same time, the glider will stay over your head or behind you.

Note: Pilots who have trouble with the flare, and with the glider nosing over during landing, usually do so because of one of the following problems:

- a. Harness leg straps too long / hanging too low below the glider, and / or hands too low on the control bar. This reduces pitch authority and prevents an adequate flare.
- b. Improper body position - pilot leaning back, (away from the anticipated hard landing), with feet extended in front. This moves the pilot's center of mass forward ahead of his shoulders, effectively shortening the pilot's arms and reducing flare authority. The proper position is with the pilot's body inclined forward, with the shoulders out ahead of the pilot's center of mass. Thinking

about pushing “up” instead of “out” when flaring may help you to maintain the proper forward inclined body position.

- c. Slowing too much prior to flare, so that your arms are too extended to allow enough flare amplitude.



Using drag devices during landing

It is becoming more popular on high performance gliders for pilots to utilize a small parachute or “drogue chute” during landing approach. The proper function of such a device is to increase drag on the glider, and as a result reduce the glide ratio. Please note that a drogue chute, because it produces only drag and not lift, does not “slow the glider down” or allow it fly at a slower speed, or reduce the landing speed. What it does do is to allow the pilot to fly a steeper approach at a higher speed, have much less “float” after round out, and thus make it much easier for the pilot to plan his approach, to time the flare, and to accurately “hit the spot” and land close to the intended landing point. It restores the ability, which used to be present on lower performing gliders, to use adjustments in speed to control the steepness of the descent.

Drogue chutes have been used which attach to the glider, and others have been used which attach directly to the pilot’s harness. There are several significant dangers in using a drogue chute. One pilot died when he deployed a drogue chute over the bottom side wire, and the glider was pulled into a fatal spiral dive. A drogue chute attached to the pilot’s harness can, if it becomes caught on the keel or on a batten at the trailing edge, interfere in a dangerous way with the pilot’s control of the glider. A drogue chute that is unstable, or does not remain inflated, can create distractions for the pilot that interfere with his safe operation of the glider.

Wills Wing manufactures a drogue chute that attaches to the pilot’s harness on one side, and deploys and flies off to one side behind the pilot attached to a very short bridle that keeps it inside the keel and the trailing edge of the sail. This configuration minimizes the prospect of entanglement of the chute with the glider.

When using a drogue chute, we recommend that you deploy it early, before you begin your approach. Deploying the drogue will effectively change the performance polar of your glider - the glide ratio will be reduced at all speeds, and it will be reduced more and more as you fly faster and faster. As a

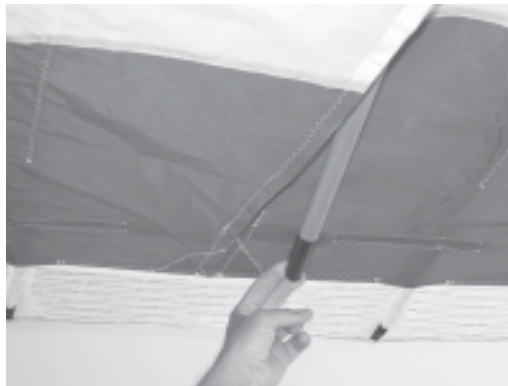
result, proper approach technique will include setting up a normal approach, but at a significantly steeper approach angle in all phases of the approach. In other words, you will be higher, and on a steeper angle of descent, at every point during the approach. You should also err on the high side when in doubt, because with the drogue chute you have limited ability to extend (flatten) your glide, but very good ability to reduce (steepen) it. For example, in the normal glider configuration, if you were approaching at best L/D speed into a head wind, and were coming up short, you would speed up. With the drogue, speeding up will primarily degrade your glide and will not get you significantly more distance. When using the drogue, set up higher, and approach with more speed. Then, if you are too high, you can still speed up more and cut your glide, while if you are too low, you can slow down and extend your glide. When you round out on short final and begin slowing down, the drogue will shorten the time period between round out and flare. This reduces the opportunity that turbulence would otherwise have to lift a wing or yaw the nose away from your flight direction. As a result, timing the flare becomes easier, and the chances of making a wings level flare with the glider pointed in the direction of flight are increased. Overall, the effect is very much that of making the glider take on the landing characteristics of a lower performance, easier to land glider.

The first time you use a drogue chute you should fly over the LZ at more than 1000' AGL, and deploy it long before you start the landing approach. This will allow you to take the time to learn how the glider flies with the drogue. A properly designed and mounted drogue chute should not have any major effect on the glider's flight characteristics, other than to reduce the glide ratio, but you should get a feel for these effects at altitude. Also keep in mind that if there are gliders in the pattern below you, you may descend through them prior to landing due to your higher sink rate. If possible, wait to deploy your drogue until you are the lowest glider in the pattern.

T2 Breakdown

Breakdown of the glider is the reverse of assembly.

1. Start with the VG set full loose. Unzip all four sprog access zippers all the way to the leading edge and disengage the sprogs from the sail and pivot them towards the keel. Do this before any other step in the breakdown of the glider. (If you unzip the sprog zippers but leave the sprogs in position in the sail, they can become caught on the sail and damage it during breakdown.)



2. Remove the nosecone and put it aside. Remove any instruments. Detach the bottom front wires at the noseplate.



3. Unzip the center zipper. On early model T2's verify that the bungee attached to the hang lever is pulling the lever down on one side. On later model T2's, rotate the hang pillar 90 degrees to align the lever with the keel tube. (See photo)



4. Remove the number two through number six battens (five shortest cambered battens).

5. Unzip the zipper at the wing tip, and pull on the string attached to the end of the tip wand cam lever lever to “un-cam” the lever and straighten the tip wand. Install the tip bag over the wand and tip of the sail at this time.
6. De-tension the crossbar sweep wire and let the wings fold in slightly. Re-install the neoprene protective socks over the rear wire junction bolt and the rear end of the keel. Remove the remaining top surface battens and the bottom surface battens at this time. Disengage the rear lever tips on the two root (nose) battens from the trailing edge hem, but leave the battens in the sail
7. Swing each wing in about 1/3 of the way. At each wingtip, remove the tip cover bag. Holding the tip wand in one hand, pull straight aft on the cam lever and disengage the cup from the end of the wand. Remove the tip wand by pulling straight aft from the end of the leading edge. Rotate the lever inside the sail and close the access opening.
8. Fold the wings all the way in to the keel pulling the sail over the top of the leading edges, and folding all of the sprogs forward. At this time you should dismount the front ends of the root battens from the studs on the keel and pull them out several inches.
9. Make sure the sprog zippers are fully open. The sprogs remain outside the sail when the glider is packed up.
10. Pull the sail out away from the keel until it is even on top and bottom. Place the bottom surface battens and tip wands on the sail and roll the sail gently and carefully, parallel to the trailing edge of the outboard portion of the sail.



Install a Velcro sail tie on each wing far enough behind the trailing edge to capture the end of the inboard sprog.

Try to roll the sail in such a way that the leading edge portion remains as smooth as possible. Do not attempt to stuff the sail between the Mylar pocket and the leading edge tube at any point where you feel resistance, and do not attach the velcro ties so tight so as to induce creases in the Mylar or leading edge sail material. Note that the leading edge panel of the sail extends behind the end of the Mylar insert - roll the sail in this area so as to avoid creasing the leading edge panel at the rear of the Mylar insert.

11. At the wingtips, lay the sail at the tip out flat, and fold the wingtip forward over onto the bottom surface of the sail.



Working from the trailing edge, roll the sail tightly to the leading edge, and install the tip cover bag. Note: If you're breaking down in a dirty, rocky and/or abrasive area, you can combine this step with step 7 above, by pivoting the wing inwards enough to allow you to flip the sail at the tip over the top of the leading edge, fold forward and roll up the wing tip and put it in the tip cover bag.

12. Finish rolling the sail in the area of the outboard sprogs, and install the other sail Velcro ties at this point.
13. Install the long, wide sail Velcro around the sail forward of the control bar apex, and stow the nosecone under this Velcro.
14. Install the glider bag. Flip the glider over onto the ground. Put the battens in the batten bag.
15. Remove both ball lock pins and remove the basetube entirely from the control bar. Stow the ball lock pins in the downtube bottom end plugs. Bring the legs of the control bar together and lay them down against the keel and install the control bar bag.
16. Stow the basetube in the tail end of the glider bag, between the leading edges. Lay the batten bag along the side of the control bar, with the open end to the rear, and slide the forward end of the basetube into the open end of the batten bag to isolate it from the sail.
17. Zip up the glider bag.

T2 Stability Systems

Several design features of the T2 determine the glider's degree of stability in pitch:

- a. The combination of wing sweep and spanwise twist.
- b. Reflex in the root section, the degree of which is determined by the lengths and hole locations of the keel, the control bar and front to rear bottom wires, and by the shape of the root battens.
- c. The alignment of the sprogs, and the height at which they and the transverse battens support the trailing edge.
- d. The shape of the preformed battens and the internal fabric ribs, and adjustment of the internal Velcro attachments, which define the airfoil.
- e. The setting of the tip wands.

Correct attachment and proper adjustment of the sprogs are critical to providing adequate stability at low angles of attack, particularly those below the normal operating range.

T2 Sprog Adjustment and Flight Testing

The T2 uses two internal sprogs per side in combination with one transverse batten on each sprog. Each transverse batten spans two top surface battens, so a total of eight top surface battens are supported. The sprog system is the primary component of the system, which provides pitch stability. The function of the system is to support the trailing edge of the sail at low angles of attack, and thus provide a nose up pitching moment. The sprogs are adjusted at the factory to their proper settings. You can check this adjustment as follows:

Sprog measurement

1. Fully set up glider on a reasonably level surface and set the VG to full tight.
2. Place two equal supports, about 30" tall, under the rear end of each leading edge tube, so as to lift the keel off the ground and take up any slack in the bottom side wires. Make sure that the support touches only the leading edge tube, and does not in any way contact or influence the tip wand.
3. Tie a lightweight thread tightly across wing from the outer of the two supported battens on each sprog to the corresponding batten on the other wing. (These are the #3 and #5 battens, counting the shortest cambered tip batten as the #2 batten).
4. Press firmly on end of each sprog supported batten and then release. Measure the height of each thread relative to the top of the keel tube. The results should be as follows:

	<u>Outer Sprog Thread</u>	<u>Inner Sprog Thread</u>
T2 154 3/8"	(10mm) below top of keel	1 3/16" (30mm) below top of keel*
T2 144 3/4"	(20mm) below top of keel	1" (25mm) below top of keel*

* Thread, when straight, will be below top of keel tube. The measurement can be obtained by removing the rear keel section, laying a straight edge along the top of the keel tube and measuring down from the bottom of the straight edge to the thread.

Note that this method will not disclose sprogs that are asymmetric. If, after achieving the proper measurement, you have a turn in the glider, which is only present at tighter VG settings, lower the sprog on the side the glider is turning towards, and raise the other sprog by the same amount.

Method of adjustment

1. To adjust the sprog height, fully unzip the access zipper to gain access to the front of the sprog where it is mounted to the sprog bracket. (Note: The procedure described herein is most easily done with the battens removed and the wings folded.)
2. Remove the horizontal bolt and nut that secures the sprog clevis fork to the pillar block, taking care to maintain the rotational alignment of the clevis fork in the sprog at its original setting. Disengage the fork from the pillar block.



3. To raise the sprog, turn the clevis fork so as to “loosen” or unscrew the fork in the end of the sprog, thereby lengthening the sprog. To lower the sprog, turn the clevis fork in the opposite direction. One full turn raises or lowers the sprog outboard sprog about 1/2 inch, and the inboard sprog about 1/4 inch. The adjuster may be locked in place with a thin jam nut, in which case you will need to loosen this jam nut before you can turn the clevis fork.

If your sprogs are configured with jam nuts, you can usually loosen them by rotating the sprog counter clockwise before dismounting it, and then spin the nut out of the way until you have re-adjusted the clevis fork as desired. When you have achieved the desired adjustment, run the nut against the end of the sprog, loosen the clevis fork a quarter turn, and snug the nut finger tight against the sprog. After you re-attach the clevis fork to the pillar block, while holding the nut, rotate the sprog 1/4 turn in the correct direction so as to tighten the nut. Note that the jam nut is primarily to preserve the sprog adjustment if the sprog or sprog cable is detached. With the sprog and cable fully installed and attached, the adjustment cannot change.

4. Re-attach the sprog clevis fork to the pillar block.

DO NOT overtighten the bolt which secures the clevis fork to the sprog pillar. Also, do not reverse the direction of the bolt through the fork and pillar, or the sprog may not fold in properly against the leading edge during breakdown.

The fork should not be compressed against the pillar, and must be completely free to pivot on the pillar. With the glider fully set-up, press down firmly on the rear end of the sprog to seat the cable before checking the measurement again.

Note that the outboard sprogs should always be adjusted slightly higher than the inboard sprogs

Test flight

Setting the sprogs to the prescribed measurements is only the first step in ensuring that the glider has an appropriate level of pitch stability. There are two components to the HGMA pitch stability requirements – the required vehicle test results and the required flight test results. The primary purpose of the vehicle pitch tests is to measure static pitch stability outside of the normal flight envelope, and it is important that the sprogs be adjusted correctly to at least the minimum listed settings in order for the glider to meet the vehicle pitch test stability requirements. However, adequate stability for safe operation also requires that the glider conform to the required levels of pitch stability within the flight envelope, and such conformance can only be verified by actual flight testing, and this may require a higher sprog setting, and/or other adjustments.

Specifically, at all VG settings, when flown in smooth air, the glider should have a trim point in pitch that corresponds to a constant, steady state speed at which the glider seeks to fly. Speeds below this trim point should require a continuous outward pressure or “push” on the control bar, and speeds above this trim point should require a continuous inward pressure or “pull” on the control bar. As this pressure is relaxed, the glider should return to the trim bar position and the associated trim speed.

(Note that it is common for this trim speed to increase with increasing VG settings, and that it is considered permissible, as a matter of individual pilot choice, to set the trim speed at the looser VG settings to be at, or even slightly below the glider’s stall speed, thus requiring a constant pull in to maintain flight above stall speed at the loosest VG settings. It should be possible, however, to set a position for the pilot hang loop that will provide a trim point within the normal operating speed range at any VG setting.)

It is typical on a T2 for the trim at VG full loose to be near the minimum sink speed – perhaps 21 mph (34 kph) indicated. As the VG setting is increased, it is typically for the trim speed to rise to a maximum of perhaps 25 - 29 mph (40-47 kph) at VG $\frac{3}{4}$. Between VG $\frac{3}{4}$ and VG full tight, the trim speed will normally decrease slightly as the sprogs begin to become engaged.

If the trim speed continues to increase between VG $\frac{3}{4}$ and VG full tight, it is an indication that the sprogs are set too low, irrespective of the sprog measurement. Sprogs set too low can cause inadequate stability both inside and outside the normal flight envelope, and can increase your chances of experiencing a turbulence induced tumble or delayed recovery from a dive.

By contrast, if the trim speed is lower at VG $\frac{3}{4}$ than it is at VG $\frac{1}{2}$, it may be an indication that the sprogs are set too high. Sprogs set too high can result in excessive pitch bar pressure at high speeds, excessive roll control pressures, lag in roll response and increased adverse yaw.

(Note: If, after adjusting your sprogs, you experience a significant degradation in roll control response, be sure to check to see that you have not overtightened the nut that secures the sprog adjustment clevis fork to the sprog pillar. Modest adjustments to sprog height will not have a significant effect on the glider’s handling response, so if you experience a dramatic change it is likely that something else is wrong.)

Pitch pressure at the highest speeds will be lightest when the VG is set to full tight. At VG full tight, in smooth air, if you slowly pull in to a pilot full forward position (normal prone position, not hunched over or balled up), the glider should reach a steady state top speed, and you should have at least 1-2 lbs (.5 to 1 kg) of positive pitch pressure per hand on the control bar. If the pitch pressure is less than this, or goes negative, or if the glider does not stabilize at some maximum steady state speed, then the glider does not exhibit the static pitch stability that is required by the HGMA standards, and this situation should be corrected.

Note: The top speed reached in the above test will likely be between 58 and 72 mph. In order to perform this test it is therefore necessary to exceed the placarded 53 mph VNE for the glider. This test is best performed by a qualified test pilot, and in any case should be performed only in smooth air and with caution.

Raising the sprogs is one way to increase this pitch pressure. If your sprogs are already set at or above the recommended measurements, there are a few other things that you can do to increase pitch pressure:

1. Check the adjustment of the keel pocket rear strap. It should be no more than just slack on the ground at VG loose, and slightly snug at VGT.

2. Increase the overlap in the inboard most, and next outboard internal sail velcros that connect the bottom and top surface at the bottom surface battens. You can tighten these velcros by $\frac{1}{4}$ " at a time until you just begin to notice the tension on the bottom surface from the velcros in flight, with the VG set to full loose.
3. Increase the amount of reflex (upward deflection at the tail) in the three most inboard battens on each wing. You can increase the reflex by up to an inch over what is shown on the batten pattern – the result will be an increase in pitch pressure, a slight improvement in high speed glide, and a slight degradation in minimum sink rate performance.
4. Rotate each tip wand up one notch by rotating the right tip wand endcap counter-clockwise and the left tip wand endcap clockwise.

Parts Ordering and Parts Replacement

Wills Wing policy requires, for safety reasons, that replacement parts be ordered through an authorized Wills Wing dealer. The purpose of this policy is to insure that the parts will be delivered to someone who has the required expertise to install the parts properly. We have seen multiple examples of incidents in which a pilot's life was endangered as a result of the incorrect installation of replacement parts, or incorrect assembly of a glider.

The serial number of the glider is required when ordering any fabricated replacement part. The serial number is a five digit number which can be found in several places on the glider; on an embossed label on the bottom of the front of the keel tube, on the operating limitations placard on the bottom of the rear of the keel, and written inside the nose area of the sail. In addition to the serial number, you should provide any relevant information regarding configuration options for the glider in question.

When replacing a part on the glider, always compare the old part with the new part to make sure that the new part appears to be the correct item. If you have any question, contact Wills Wing. Also, be sure to do a thorough inspection of the glider after the installation of the part, to insure that the part has been installed correctly, and appears to be functioning correctly, and that the rest of the glider is properly assembled. Note that the T2, when equipped with Slipstream downtubes, uses a new type of downtube, designated as "Slipstream2." Slipstream and Slipstream 2 downtubes can be used interchangeably on T2's or Talons on the left side only, but cannot be interchanged on the right due to the VG routing.

Applies To

All Models T2

Introduction

There have been two types of hang loop spreader bar configurations used on the T2, and three different configurations of the hang loop – spreader bar and support pillar combination. When ordering a replacement hang loop or a replacement spreader bar, you must specify the glider serial number and the hang loop type and spreader bar type, and take note of the proper installation procedures, as detailed below.

The first 50 or so T2's – those assembled through mid-July of 2005 – were made with the original T2 type hang loop and hang loop spreader bar and the non-swiveling support pillar, as shown below, left. T2's assembled between mid July 2005 and mid May 2006 were upgraded to the current type support pillar, which provides for the spreader bar to be rotated 90 degrees during glider breakdown, and reduces interference with and wear on the spars when the glider is folded up. This configuration is shown below on the right. The spreader bar and hang loop for both these configurations are the same – the spreader bar incorporates removable end caps which secure the hang loop to the spreader bar, and which are held on by self-locking Allen screws.



After mid May 2006, T2's were made with the same, 2nd configuration support pillar, but with a new, one piece spreader bar with integral end caps, and a new type of hang loop which fits tightly over the integral end caps and is then secured with plastic zip ties that pass through small webbing loops (picture on the following page shows the older T2 type spreader bar and hang loop on the left and the most recent, one piece spreader bar – hang loop assembly on the right).

While both T2 type spreader bars are compatible with either support pillar, each requires the specific compatible hang loop designed for that spreader bar.



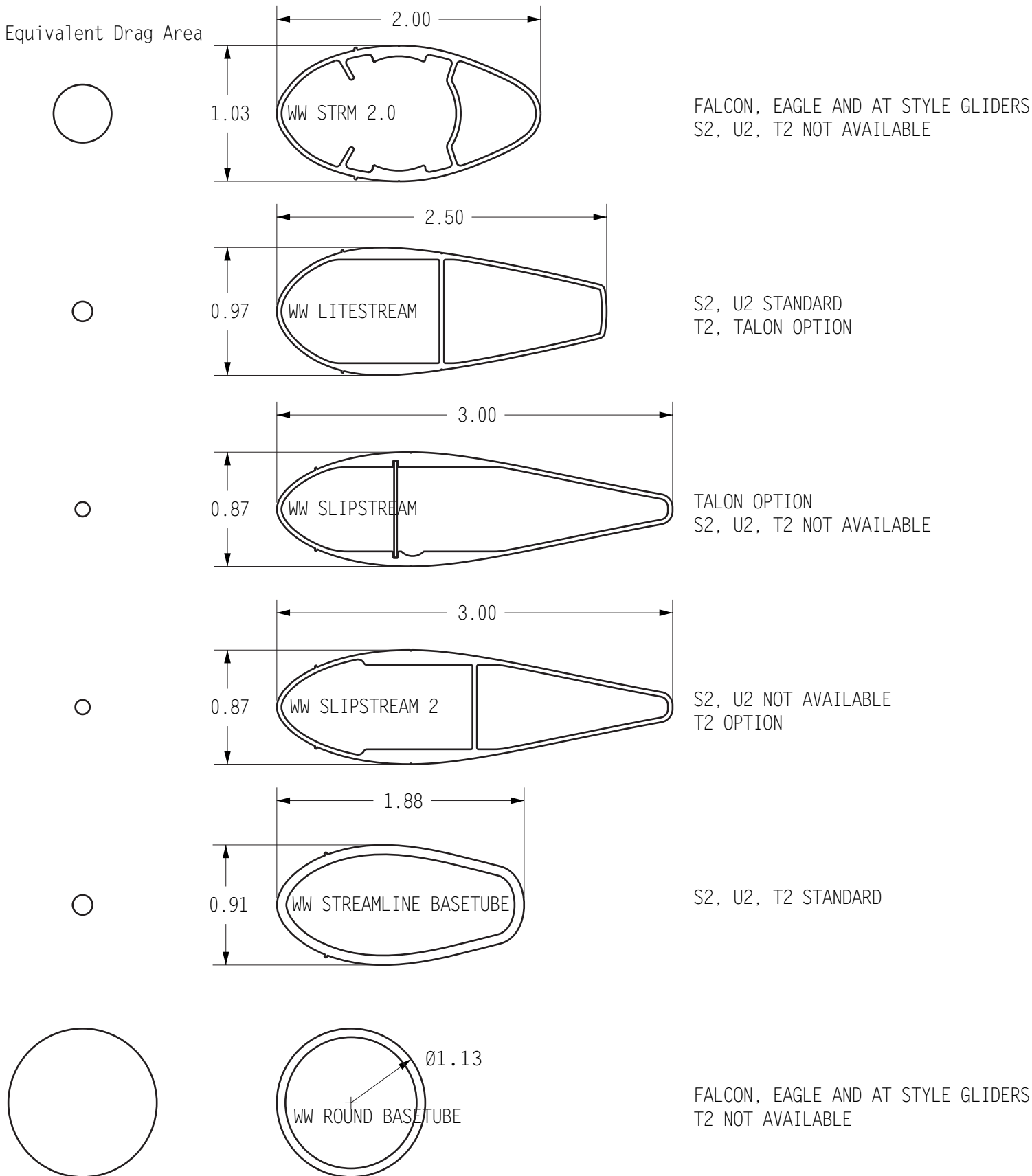
Procedures – Inspection, Replacement, Adjustment

On the original T2 type spreader bar, with the removable end caps, it is important not to over tighten the securing Allen screws, as they can be broken during installation or removal if over tightened. These screws are manufactured with a small patch of locking material to insure that they will not back out after installation, so if you have removed them to replace the hang loop, you should use a small amount of non-permanent Loc-Tite when you re-install them.

As shown in the second photo on the first page, the back up portion of the original T2 type hang loop is secured to the glider by larks heading the loop around the keel, underneath the sweep wire and VG ropes. On the most recent T2 type hang loop the back up portion is secured around the keel, and over the top of the sweep wire and VG ropes with a quick link. After installation, the quick like should be finger tightened, and then tightened not more than one quarter additional turn with a wrench. (The purpose of routing the backup loop over the top of the sweep wire and VG ropes is that this will provide an additional means of connection between the pilot and glider in the event of a failure in flight of the keel tube.)

There is no requirement to upgrade from an older configuration to one of the newer configurations. There are some possible reasons to upgrade:

- 1) The swiveling type of support pillar allows the spreader bar to be rotated more effectively out of the way of the spars during breakdown, and may thus reduce wear on or damage to the spars during transport.
- 2) The one piece spreader bar avoids the possibility of a screw breaking off during installation of a new hang loop.
- 3) The most recent hang loop design, on which the back up is installed over the top of the sweep wire and VG ropes, may provide a more secure attachment of the pilot to the glider in the event of an in-flight failure of the keel.



Maintenance

This section contains a recommended schedule of periodic maintenance. None of the items in this section are a substitute for the continual and consistent practice of proper pre-flight inspections and immediate maintenance of any items on the glider, which require it. Safety requires that your glider be fully airworthy for every flight. Nuts and bolts must always be secure, safeties must always be in place, and damage to any part, which could compromise the airworthiness of the glider, cannot be tolerated. If you have a question about the need to repair or replace some part of your glider, feel free to contact your dealer or Wills Wing directly. It is not always obvious which items require attention and which may not. Minor dents or dings in a non-critical location on an airframe tube may not require any repair or maintenance. On the other hand, a wire that has been kinked one time can fail very quickly after that, and should be replaced immediately. A control bar corner fitting that has had a significant landing impact may have a crack that is almost undetectable, but which could cause the part to fail catastrophically at a later time.

We recommend that you have all maintenance work done by your Wills Wing dealer.

Every Six Months

1. Check the adjustment of your sprogs, as described in the last section.
2. Check your battens on a flat level floor against the batten diagram provided, and correct any that deviate from the pattern by more than 1/4".
3. If you fly in a dusty or sandy environment, it will help to prolong the life of your batten pockets if you wipe each batten with a rag before you install it in the sail.
4. Have a complete inspection performed on the glider and replace any suspension system component that shows any wear, and any cable that shows any kinks, wear, damage, corrosion, etc. Replace any structural cables that are less than 3/32 diameter.
5. Inspect all bolts for tightness, all safeties for proper installation and possible damage. Inspect plates and fittings for damage, holes in tubes for elongation.
6. Inspect the sail for wear, tears, UV damage, loose stitching, etc.
7. Disassemble basetube pulley assembly, clean, lubricate with white grease, and re-assemble.
8. Lightly spray all zippers on the glider with silicone spray lubricant. Also spray your battens before you install them in the glider to lubricate the insides of the batten pockets. Do not use any other type of lubricant. Wipe off any excess silicone so that it does not attract dirt.
9. Inspect the sprogs, sprog hardware and sprog cables. If the sprogs have been loaded heavily, it is possible that the sprog tubes may have been bent, and the cables may have been stretched. If it is not possible to achieve proper adjustment of the sprogs, the sprog cables may need to be replaced. On late model T2s the cables are part of an integral assembly with the sprogs, and cannot be replaced separately from the sprogs themselves.

There are three hinge mechanisms in each sprog assembly that must be free to swivel. One is the cable attachment to the leading edge. Make sure the cable can swivel in the horizontal plane at this attachment. Also make sure that the locknut is fully engaged and secure on the bolt. Second is the junction of the sprog fork and sprog pillar. This junction should be disassembled, cleaned and lightly lubricated with white grease. When reassembling, take care not to over tighten the nut, as there should be no

clamping effect of the sprog fork on the pillar. Third is the junction of the pillar and the sprog bracket attached to the leading edge. Service this junction in the same manner, and again, do not over tighten the nut.

Every Year

In addition to the normal six month service items, also perform the following:

1. Have the sail completely removed from the frame, and disassemble all frame components. Inspect every part of the glider for any damage or wear. Inspect the tubes for straightness and for signs of corrosion.
2. Anytime you have the sail off the frame, turn the sail inside out through the bottom surface center zipper and inspect all of the batten pockets and batten pocket terminations.
3. Replace bottom side wires and hang loops. Note: The bottom side wires are retained by a lightly press fit bushing. This bushing is best removed with a special stepped drift, by pushing it out of the fitting from the rear. Take care not to damage the fitting.
4. Replace the VG ropes.
5. Inspect the composite crossbar and all associated fittings. Remove the hollow steel pins at the spar root (circlip pliers required), clean the pins and the area where the pins bear in the spar and spar root plates, and lubricate the bearing surfaces with white grease. Look for any visual evidence of damage to the spar. If any damage is suspected, remove the spar completely from the glider for a more thorough inspection, and contact Wills Wing.
6. Remove the transverse battens from the sail and inspect for damage.

Special circumstances

1. Any time you suffer a crash or extremely hard landing you should have an “annual” inspection done on your glider to insure that you find all damaged parts. Following any hard landing, be sure to inspect the apex hardware, the control bar legs and basetube, and all control bar fittings for damage. Any time you replace a control bar leg or basetube, you must carefully inspect all related fittings and replace any that are bent or damaged.

Hard landings may also impose very high loads on the sprog assemblies and transverse battens. Inspect accordingly.

2. If your glider is ever exposed to salt water you will need to have the glider completely disassembled in accordance with the recommended annual inspection procedure. All frame parts will need to be disassembled, including the removal of all sleeves and bushings, flushed liberally with fresh water, dried completely, and treated for corrosion inhibition with LPS-3 or other suitable agent.
3. Cleaning Your Sail - Keeping your sail clean will extend the life of the cloth. When cleaning the entire sail you should generally use only water and a soft brush. You may clean small spots or stains with any commercial spot remover that is labeled for use on polyester. Such cleaning agents are available at the supermarket or drug store, or you may order a cleaning solution from Wills Wing through your dealer.

A note about cables and cable maintenance

The cables which support the glider's airframe are critical components of the glider's structure, and must be maintained in an airworthy condition. It is a general practice in the design of aircraft structures to design to an ultimate strength of 1.5 times the highest expected load in normal service. Hang glider cables, like other structural components on the glider, are typically designed with a structural safety factor of only about 50% above the expected maximum load. No significant loss in cable strength can be tolerated.

A cable with even a single broken strand must be replaced before the glider is flown again. A cable which has been bent sharply enough to have taken a permanent set (will not lie flat in a straight line when all tension is removed) must also be replaced immediately. If it is not, subsequent tensioning and de-tensioning of the cable will induce fatigue, and the cable will fail. In tests we have conducted, a cable bent one time to 90 degrees, and then loaded to the equivalent of a normal flight load 100 times (corresponding to 100 or fewer flights), failed at only 56% of its original strength.

Some degree of fatigue due to repeated bending of cables is almost unavoidable in an aircraft that is assembled and disassembled with every flight. Bottom side wires are subject to the highest loads in flight, and are therefore the most critical. This is why we recommend that these wires be replaced annually, even if there is no known damage. The requirement for immediate replacement of a cable known to have been bent or otherwise damaged supersedes this annual replacement requirement.

Replacement cables should always be obtained from the factory, or, if not from the factory, from a reliable source known to use proper fabrication procedures. An improperly made cable may appear perfectly OK on visual inspection, but could fail in flight at a load much below the intended design strength of the cable.

Removing the Sail from the Airframe and Re-Installing

Many maintenance and repair procedures will require the removal of the sail from the frame. Please follow these instructions when removing and reinstalling the sail. Please read all the instructions for each operation before beginning.

Sail removal

You will need an unobstructed area six feet by thirty feet. Make sure the surface is clean. If it is abrasive, like rough concrete, you should either put down a protective tarp or be extremely careful not to scrape your sail.

1. Lay the glider on its back, unzip and remove the glider bag and put the battens and basetube aside. Remove the control bar bag.
2. Remove the screws that secure the sail at the front of the leading edges. Remove the zip-tie at the bottom nose area. Completely unzip and separate the bottom surface zipper.
3. Spread the wings slightly. Dismount the sail from the rear leading edges by removing the clevis pin located five inches forward of the rear of the leading edge tube. Remove the pin from the sail anchor strap and re-install it in the leading edge.
4. Remove the rear leading edges, and the inboard sprogs from the glider. (See the section on "To Remove The Rear Leading Edges for Shipping" at the beginning of this manual).
5. Unbolt the bottom side wires from the crossbar and feed them through the hole and out of the sail.

7. Unbolt the bottom rear flying wires from the rear keel. Reassemble the hardware removed onto the bolt in the original order so that it doesn't get lost. All disassembled assemblies on the glider must be reassembled in the proper order and orientation. Use the exploded parts diagrams in this manual to help you.
8. Slide the frame out through the open center zipper. If you encounter resistance, stop and find out what is hanging up.
9. If you need to send the sail in to the factory for repair, remove the Mylar and the transverse battens. The Mylar is removed from the front end of the Mylar pocket. It helps to secure the opposite end of the sail to something solid, so that you can lay the leading edge out straight and pull the Mylar straight out of the pocket. If you have trouble getting it to slide out freely, it is probably because the edge of the Mylar has worked its way into the seam and gotten stuck on the adhesive seam stick tape. Work your way up and down the leading edge pocket rolling the Mylar away from the seam until it is free along its entire length.
10. Fold and package the sail carefully if you plan to ship it in for repair. Be sure to include written instructions of what you want done, your name, address, email address and a phone number where you can be reached during the day.

Re-installing the sail on the frame

1. Install the Mylar in the sail. Make sure you install it right side up; the slit edge is at the front and on the bottom. The easiest way to install the Mylar is to push it into the pocket using a long lofting batten attached to the end of the Mylar insert, which is first inserted in the pocket. A small diameter pin on the end of the lofting batten placed through a small hole in the end of the Mylar insert allows you to push the Mylar into the sail and remove the batten while leaving the Mylar in place.

You will have to stop from time to time to make sure the Mylar is properly lying flat in the pocket. Do not push the Mylar too far into the pocket. Make sure there are no folds in the Mylar, especially at the tips. Make sure the Mylar wraps in the proper direction to follow the sail around the leading edge as it enters the pocket.

2. Install the transverse battens in the sail. Feed the cord sewn to the end of the transverse batten pocket through the hole in the transverse batten and tie a knot to retain the batten in the pocket.
3. Position the sail on the floor with the keel pocket up and the wings folded over so that the leading edges lie along the length of the root line, with the Mylar pockets lying on top.
4. The frame is most easily inserted without the rear leading edges installed, and without the inboard sprogs attached.
5. Position the frame with the bottom of the noseplate facing up and with the rear end of the leading edges at the nose of the sail. Slide the frame into the sail through the open bottom surface zipper, making sure that the leading edges of the frame pass properly into the leading edge pockets of the sail and don't get caught at the rear of the bottom surface near the root. As you feed the frame slowly into the sail, check periodically to see that none of the hardware is snagging on the sail or internal sail ribs. Be sure to guide the keel through the keel pocket as you insert the frame into the sail.

6. Reconnect the bottom surface center zipper at the nose, zip part way up, and install a new securing zip tie at the nose.
7. Install the rear leading edges and inboard sprogs (see the section on re-installing the rear leading edges after shipping at the beginning of this manual.)
8. Mount the sail at the front of the leading edges, if you are able to.
9. Mount the sail at the rear of the leading edge. (see the section on re-installing the rear leading edges after shipping at the beginning of this manual.)
10. Working through the inboard sprog access zippers, insert the bottom side wires into the sail through the side wire hole in the bottom surface, and attach to the crossbar, making sure that no cable is wrapped around a leading edge or crossbar, and that no thimbles are cocked or twisted.
11. Bolt the bottom rear wires and keel pocket webbing strap to the rear of the keel.
12. Flip the glider up onto the control bar.
13. Spread the wings. If you have not previously mounted the front of the sail, work slowly and carefully, making sure that the sail rides forward as necessary at the nose without catching.

Be careful: you can easily tear the sail open at the nose at this point.

15. Feed the sweep wire through the keel pocket.
16. Finish the assembly of the glider completely according to normal assembly procedures.
17. Do a very careful and complete preflight of the glider according to the normal preflight procedure as explained earlier in this manual.
18. During a hang check, with the pilot pushed out (full aft CG), the backup loop should have a minimum of 2 inches and not more than 3 inches of slack.

Glider Tuning

CG adjustment

This has already been covered in the section of this manual on using your wing tufts. Wills Wing recommends that tuning other than CG adjustment be performed by your Wills Wing dealer.

Turn trim

Turns are caused by an asymmetry in the glider. If you have a turn, first try to make the glider symmetrical in every way. If a turn only appears at VG settings of 3/4 to full tight, it may be an indication that the sprogs are set asymmetrically. See the section below on tip wand receptacles.

Airframe

Check the leading edges for possible bent tubes. Check that the keel is not bent to one side. Check for symmetrical twist in the leading edges by checking for symmetry in the alignment of tip wand receptacles.

Battens

Check the battens for symmetrical shape

Tip Wand Receptacles – checking rotational alignment

The plastic plug that fits directly into the rear leading edge determines the rotational alignment of the tip wand. This plug is secured against rotation by a small screw in the end of the leading edge. There are five holes in the plastic cap, allowing for two notches of rotational adjustment on either side of the normal, center hole. A label on the rear leading edge shows the range of adjustment, and how the glider is adjusted at the present time, and shows which direction to adjust the cap to correct a turn.



Sail tension

Check for symmetrical sail tension on the leading edges. In order to check this, sight the hem of the sail at the bottom of the leading edge tube relative to the noseplate on each side. On T2s produced before June 2006, leading edge sail tension is adjusted by adjusting the strap where the sail mounts to the rear leading edge. This strap should be just slack when the VG is set full loose, and should become snug as the VG is tightened. On later model T2s, the sail anchor is not adjustable.

Sail tension at the tip is also affected by the length of the tip wands. A one eighth of an inch difference (3mm) in the length of the tip wand can make a noticeable difference in how a glider handles. If you

have a glider that is a little too stiff, you might try shortening the wands by an eighth inch by carefully cutting off the thick end of the wand and beveling the cut edge with a file or sandpaper.

Twisting a tip

After you have made everything symmetrical, if you still have a turn, you can correct it by rotating one or both tip wand receptacle end caps. A left turn is corrected by twisting the left sail plug counter clockwise (moving the wand receptacle down) or twisting the right sail plug counter clockwise (moving the wand receptacle up), or both as indicated on the labels at the end of the leading edge. Twist clockwise on either or both plugs to correct a right turn. Note that the mechanism of adjusting the sail wand receptacle for tuning out a turn in the glider is the same as performing the same tuning function on a conventional tip, although the direction of rotation seems to be opposite. For example, to remove a right turn, if working with the right wing tip, you would rotate the end cap clockwise, so as to rotate the wand down, thus depressing the right wing tip. On a conventional wingtip, you would rotate the end cap counter clockwise, because doing so would rotate the wingtip downwards. The aerodynamic effect is the same, even though the direction of rotation appears at first glance to be opposite. Adjustments are best made in one “notch” increments. If you have rotated the right wing down both available notches, and still have a right turn, you can rotate the left wing up.

To rotate the tip wand receptacle end cap, remove the screw, rotate the cap to align the next hole, and re-install the screw. Note that it is acceptable to use up to three holes of adjustment from the initial center position, even though the caps are normally only drilled with two holes on each side of center. You can drill a third hole at the same additional distance if you need more adjustment.

Batten tension

The outboard most batten on each wing is tensioned by looping the batten string over the notched end of the batten twice. The remaining battens are all fitted with lever tips. The outboard batten with strings should be adjusted quite tight for maximum sail cleanliness.

On the battens fitted with lever tips, it is important to adjust the lever tips to set the right batten tension. The lever action makes it easy to have the battens set too tight. Batten tension is best judged by noting at what point the batten begins to tension the sail as you pivot the lever tip down into its locked position. This is the point at which chordwise slackness begins to be pulled out of the sail, the high point of the batten begins to make a prominent ridge in the top surface, and a noticeable increase in resistance is felt in pivoting the tip downwards. On any battens inboard of the crossbar junction, this point should not come until the lever tip is within no more than the last 20 to 30 degrees of travel before becoming straight. On battens outboard of the crossbar junction, this point should come when the lever is between 30 and 40 degrees of straight. To lengthen the batten, simply unscrew the batten tip shank from the batten, to shorten the batten screw the tip further in. Each three turns changes the length of the batten by 1/8 of an inch.

Car Top Mounting and Transport

Improper or careless transport of your glider can cause significant damage. You should transport your glider on a rack that has at least three support points that span at least 13' of the length of the glider. These should be well padded and at least four inches wide to distribute the load. Your glider should be securely tied down with webbing straps which are at least 1/2" wide, but not tied so tightly or with such a small diameter rope that the Mylar insert is permanently deformed. If you drive on rough roads where the glider receives impact loads, you should take extra care to pad your glider internally when you pack it up

In Closing - A Few Final Words on Your Safety

With proper care and maintenance, your glider will retain a high level of airworthiness for some years. Because of the relatively short history of hang gliding, and the rapid advances in new designs, we do not have a lot of information about the ultimate service life of a hang glider. We do know that ultraviolet (UV) damage to the sail from sunlight is probably the limiting factor in the life of your sail. Try to avoid exposing your sail to sunlight any time you are not actually flying it.

We also know that there are forces in nature that can be so violent that they can result in fatal accidents regardless of the airworthiness of your aircraft. Ultimately your safety is your responsibility. Know the limitations of your knowledge, skill and experience, and know the limitations of your aircraft. Fly within those limitations.

Analysis of accidents across the whole spectrum of aviation shows that most accidents are caused by avoidable errors in pilot decision-making. The quality of your decisions as a pilot is the single most important determining factor in your safety. In light of this, it becomes illustrative to ask the question, “Why do pilots make bad decisions that lead to accidents?” This is a complex question. For a more detailed treatment of it, we invite you to read the article “Why Can’t We Get A Handle On This Safety Thing” published in the September 1998 issue of Hang Gliding Magazine, and also published on our web site at www.willswing.com. In brief, one answer to the question of why pilots make bad decisions seems to be that pilots are rewarded and reinforced for making bad decisions. This happens because most bad decisions do not result in an accident, and therefore they appear to the pilot to be good decisions. If they don’t result in an accident, how do we know they’re bad decisions? Think of it this way: in any decision you make; Do I fly today? (are these conditions within my abilities?), Is the glider well enough balanced for me to start my launch run?, Do I have enough room to turn back into the hill in this thermal?, Can I continue to drift over the back in this weakening lift and still glide back above the ridge top and avoid the rotor?, - there is a percentage of certainty involved. If you make decisions at the 99% level of certainty, the vast majority will be “rewarded” as good decisions. However, if they’re only 99%, they are really bad decisions, because in one out of 100, you will be wrong. Since the consequences of being wrong can be as serious as a fatal accident, any decision that can be wrong is a bad decision. The logical conclusion of this analysis of safety is that most pilots are making far too many bad decisions. (If they weren’t, we wouldn’t see nearly as many accidents in the sport). The logical conclusion from that is that not only can you not use a “good” result as evidence you made a good decision, you also cannot use other people’s decision making as an example for your own. If you want to “beat the odds” and have better personal safety than the statistical average, you have to make better decisions than the average pilot. That will sometimes mean

choosing not to fly at all, and it will sometimes mean passing up that turbulent thermal that is too close to the hill, and as a result going down to the LZ instead of staying up. It will sometimes mean cutting an XC flight short to take advantage of a more suitable landing area. In each of these cases, your friends may well not take the conservative route, and in most cases they will be rewarded with successful flights. In the end, however, making the more conservative decision will mean you'll still be around to fly another day.

Have fun. Fly safely. See you in the sky!

Wills Wing, Inc.

www.willswing.com

HGMA AIRWORTHINESS STANDARDS

HGMA T2 154 COMPLIANCE VERIFICATION SPECIFICATION SHEET

GLIDER MODEL: T2 154

MANUFACTURED BY: Wills Wing, Inc.

All dimensions in inches; weights in pounds.

NOTE: These specifications are intended only as a guideline for determining whether a given glider is a certified model and whether it is in the certified configuration. Be aware, however, that no set of specifications, however detailed, can guarantee the ability to determine whether a glider is the same model, or is in the same configuration as was certified, or has those performance, stability, and structural characteristics required by the certification standards. An owner's manual is required to be delivered with each HGMA certified glider, and it is required that it contain additional airworthiness information.

1. Weight of glider with all essential parts and without coverbags and non-essential parts: 72 - 75.5, depending on options
2. Leading Edge Dimensions
 - a. Nose plate anchor hole to:
 1. Crossbar attachment hole 131.9
 2. Rear sail attachment point 195
 - b. Outside diameter at:
 1. Nose 2.44
 2. Crossbar 2.44
 3. Rear sail attachment point 1.97
3. Crossbar Dimensions
 - a. Overall pin to pin length from hole at leading edge bracket attachment to center of load bearing in at center plate 120.1
 - b. Largest outside dimension 3.25
4. Keel dimensions; least and greatest allowable distances, whether variable through tuning or through in-flight variable geometry, from the line joining the leading edge nose bolts to:
 - a. The center of the xbar load bearing pin at the center plate 33.0 - 37.3
 - b. The pilot hang loop 50.75 - 52.25
5. Sail Dimensions
 - a. Chord lengths at
 1. 3 ft outboard of centerline 66
 2. 3 ft inboard of tip 46
 - b. Span (extreme tip to tip) 403 (VGT)
6. Location of Information Placard Keel
Location of Test Fly Sticker Keel
7. Recommended Pilot Weight Range 185 - 285
8. Recommended Pilot Proficiency USHGA Advanced

HGMA AIRWORTHINESS STANDARDS

HGMA T2 144 COMPLIANCE VERIFICATION SPECIFICATION SHEET

GLIDER MODEL: T2 144

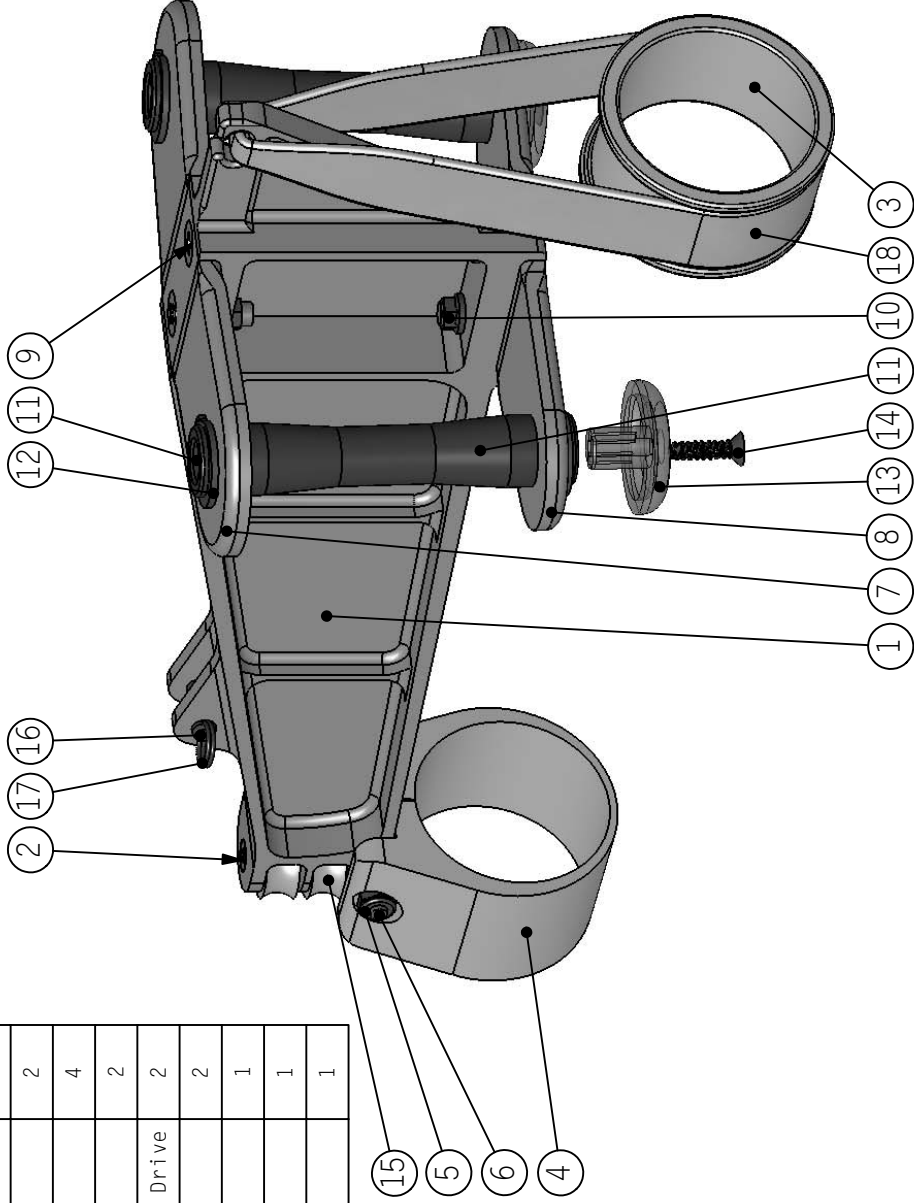
MANUFACTURED BY: Wills Wing, Inc.

All dimensions in inches; weights in pounds.

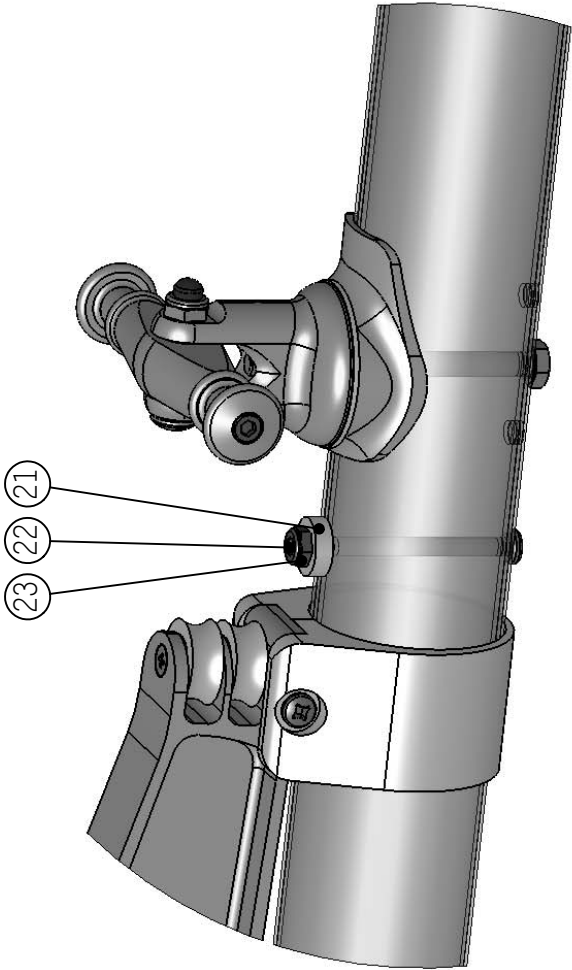
NOTE: These specifications are intended only as a guideline for determining whether a given glider is a certified model and whether it is in the certified configuration. Be aware, however, that no set of specifications, however detailed, can guarantee the ability to determine whether a glider is the same model, or is in the same configuration as was certified, or has those performance, stability, and structural characteristics required by the certification standards. An owner's manual is required to be delivered with each HGMA certified glider, and it is required that it contain additional airworthiness information.

1. Weight of glider with all essential parts and without coverbags and non-essential parts: 69.5 - 73, depending on options
2. Leading Edge Dimensions
 - a. Nose plate anchor hole to:
 1. Crossbar attachment hole 127.6
 2. Rear sail attachment point 186.5
 - b. Outside diameter at:
 1. Nose 2.44
 2. Crossbar 2.44
 3. Rear sail attachment point 1.97
3. Crossbar Dimensions
 - a. Overall pin to pin length from hole at leading edge bracket attachment to center of load bearing in at center plate 116.1
 - b. Largest outside dimension 3.25
4. Keel dimensions; least and greatest allowable distances, whether variable through tuning or through in-flight variable geometry, from the line joining the leading edge nose bolts to:
 - a. The center of the xbar load bearing pin at the center plate 31.75 - 36.25
 - b. The pilot hang loop 49.75 - 51.25
5. Sail Dimensions
 - a. Chord lengths at
 1. 3 ft outboard of centerline 65
 2. 3 ft inboard of tip 45
 - b. Span (extreme tip to tip) 389.5 (VGT)
6. Location of Information Placard Keel
Location of Test Fly Sticker Keel
7. Recommended Pilot Weight Range 160 - 235
8. Recommended Pilot Proficiency USHGA Advanced

ITEM	Part No	Description	QTY.
1	20G-4012	Xbar Center Wedge Type 3 Talon 2	1
2	10C-1161	BOLT NAS 517-3-16	1
3	15J-3034	Xbar Wedge T2 Front Sled	1
4	15J-3035	Xbar Wedge T2 Rear Sled	1
5	10N-1130	LOCKNUT LOMPRO 3/16 AN364-3	1
6	10C-4221	NAS623-3-22	1
7	20C-1768	XBAR PLATE TOP CNTR RND CXBAR TYP2	1
8	20C-1764	XBAR PLATE BOTM CNTR RND CXBAR TYP2	1
9	10C-2061	NAS517-4-6	4
10	10N-1740	CLINCH NUT 1/4 MS21042-4	4
11	10K-4060	HINGE PIN COMPOSITE XBAR TYP 2	2
12	10S-1110	C-CLIP FUSION XBAR PIN	4
13	15J-3036	Bumper, Xbar Hinge Pin Type 2	2
14	10K-2110	Screw Flat Head 10-14 x 3/4 Torx Drive	2
15	20P-1230	PULLEY HARKN SHEAVE TOP LEG VG	2
16	10G-2210	MS20392-3C21	1
17	10P-1100	SAFETY RING AN 9491 SMALL	1
18	45K-1314	XBAR STRAP FRONT WEDGE HOLD DOWN	1




ITEM	Part No	Description
21	10U-5110	WASHER NYLON .620 X .210 X .192
22	10C-4341	NAS623-3-34
23	10N-1130	LOCKNUT LOWPRO 3/16 AN364-3



DETAIL C
SCALE 1 : 2

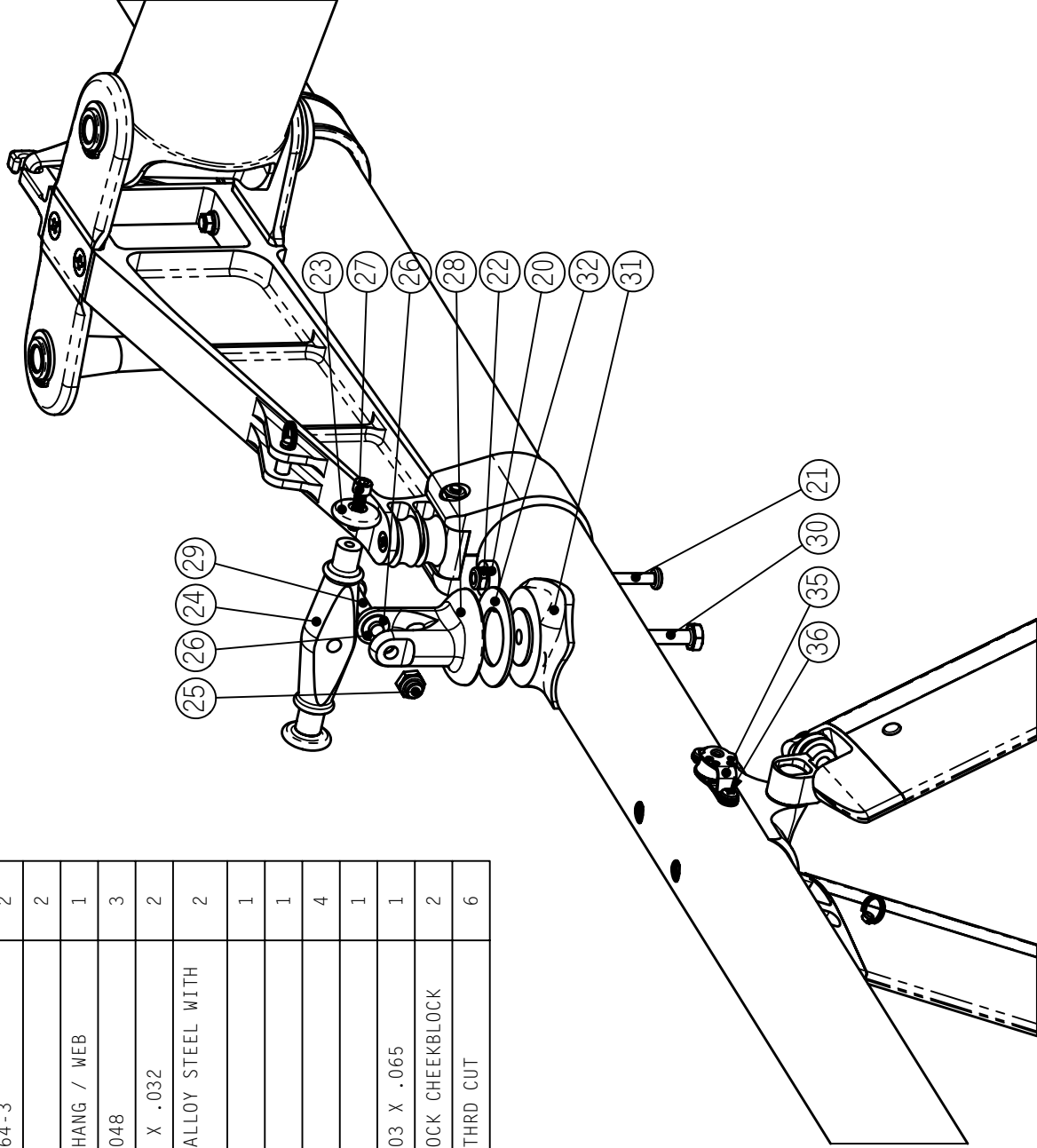
T2 144 stop restricts rear travel 1-11/16, which is approximately 25% of the total range
T2 154 stop restricts rear travel 1-7/16, which is approximately 20% of the total range



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TITLE: T2 VG Restrictor		REVISION: A	
SLODWF ID: T2 Airframe	DOCUMENT ID:	DRAWN: 10/27/2005	REVISED: 10/27/2005
		STATUS: Released	BY: PEARSON

ITEM	Part No	Description	QTY.
20	10U-5110	WASHER NYLON .620 X .210 X .192	3
21	10C-4341	NAS623-3-34	1
22	10N-1130	LOCKNUT LOWPRO 3/16 AN364-3	2
23	20G-2825	SPREADER BAR T2 CAP	2
24	20G-2824	SPREADER BAR T2 PILLAR HANG / WEB	1
25	10N-0040	LOCKNUT LOW PRO 52NKTE-048	3
26	10U-6135	WASHER DELRIN .5 X .265 X .032	2
27	10K-2024	CAP SCREW 10-32 X .500 ALLOY STEEL WITH THREAD LOCK SIDE PELLET	2
28	20G-2834	Tower, T2 Hang System	1
29	10C-5161	NAS623-4-16	1
30	10A-2311	AN4-31A	4
31	20G-2833	SADDLE, T2 HANG SYSTEM	1
32	10U-6441	WASHER DELRIN 1.75 X 1.03 X .065	1
35	20P-1237	PULLEY HARKN 16mm AIRBLOCK CHEEKBLOCK	2
36	10M-1651	SCREW PAN 8-32 X .375 THRD CUT	6



WALLS WING

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TITLE: **T2 Center Keel**

SLDDWF ID:
T2 Center Keel

DOCUMENT ID:

DRAWN:
3/1/2005

REVISED:
3/1/2006

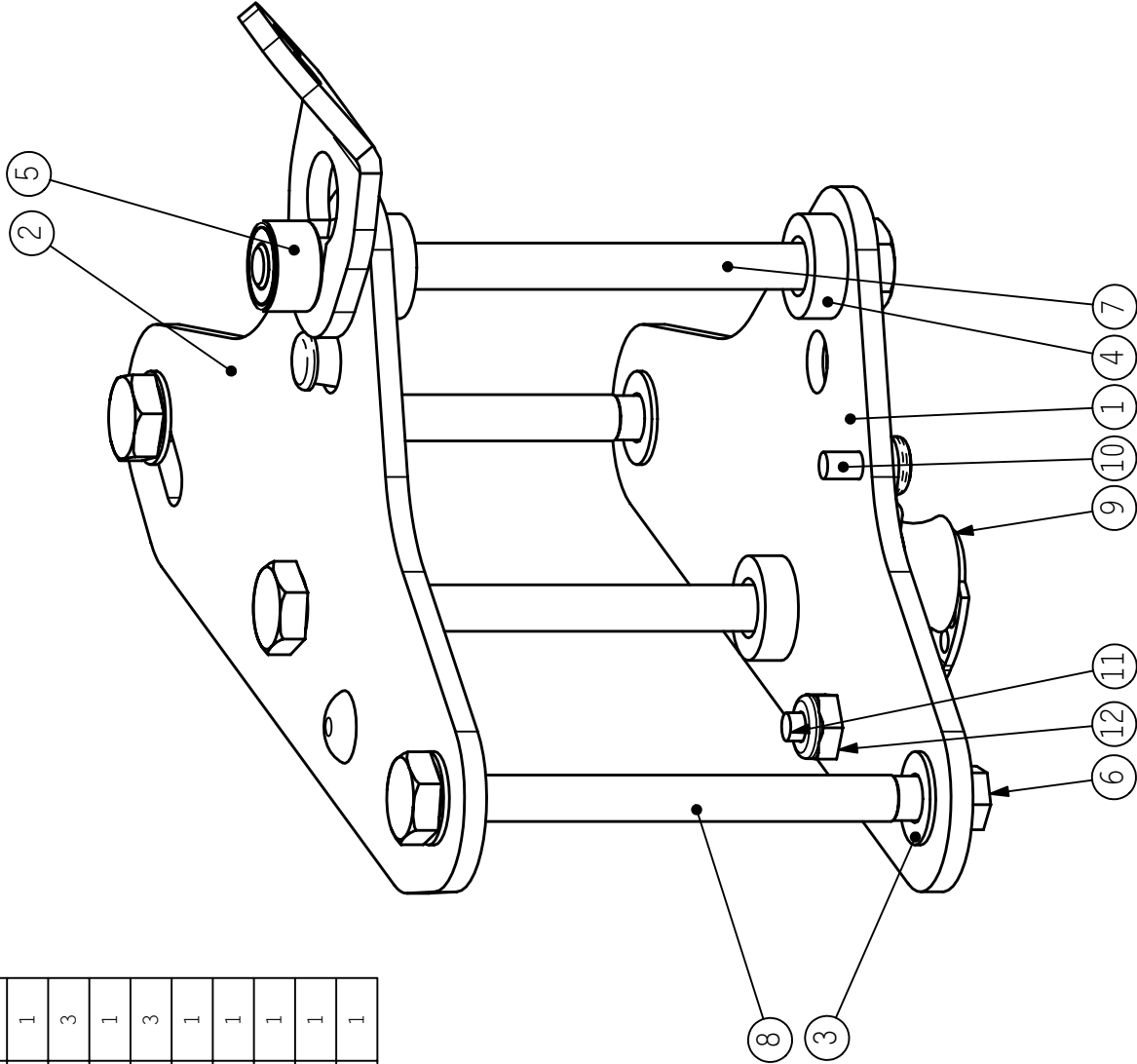
STATUS:
-

BY:
PEARSON

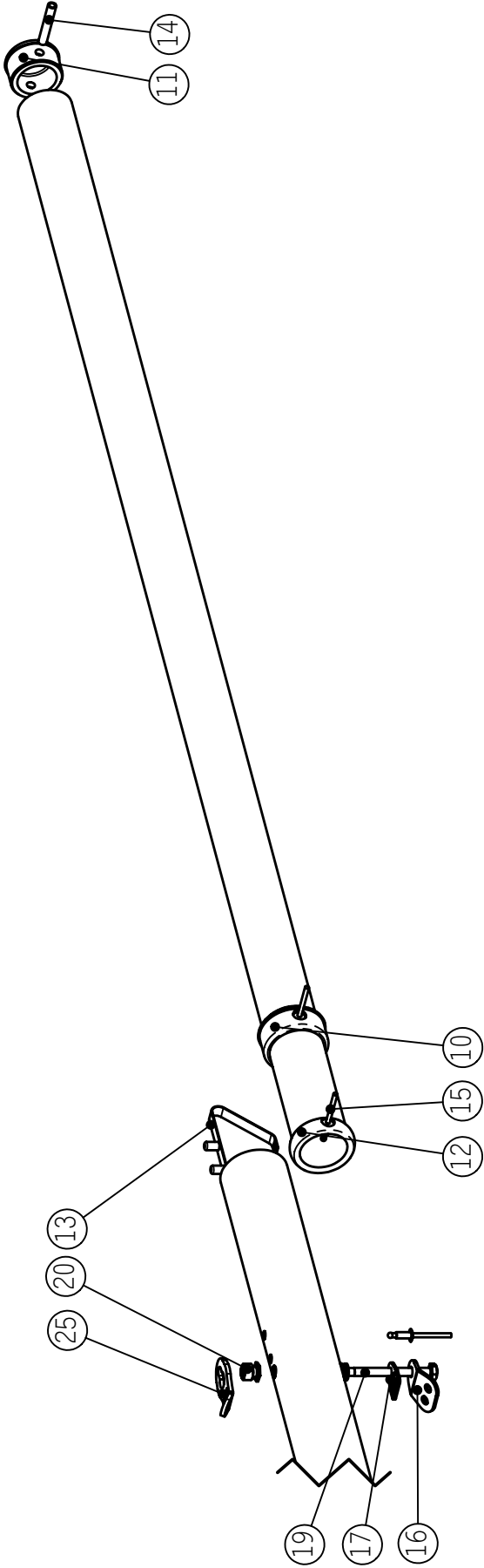
REVISION:

A

ITEM	Part No	Description	QTY.
1	20C-1638	NOSEPLATE UNIVERSAL 2003	1
2	20C-1634	NOSEPLATE TALON ASSY W BUTN LOC	1
3	10U-1141	WASHER STEEL AN960-416 1/4 THIN	6
4	10T-5103	SPACER NY .560 X .320 X .187	4
5	20G-2905	KEYHOLE COLLAR NUT ASSY	1
6	10N-1740	CLINCH NUT 1/4 MS21042-4	3
7	10A-2331	AN4-33A	1
8	10A-2311	AN4-31A	3
9	20P-1237	PULLEY HARKN 16mm AIRBLOCK CHEEKBLOCK	1
10	10M-1651	SCREW PAN 8-32 X .375 THRD CUT	1
11	10C-0071	NAS623-2-8	1
12	10N-1220	LOCKNUT LOWPRO 0832 SS	1
13	40P-3203	WIRE SET BOTTOM FRONT SLIPSTREAM	1



ITEM	Part No	Description	QTY.
10	15J-3041	REDUCER, 52MM TO 42MM REAR	1
11	15J-3040	ENDCAP, 42MM MACHINED	1
12	15J-3042	REDUCER, 52MM TO 42MM FRONT	1
13	20A-1511	BUTTON SPRING HAULBACK LOCK	1
14	NA	6061 d.25 x 1.6, Retains Stinger Bungee	1
15	10R-0366	RIVET AL 3/16 X .375 CHAAPQ6-4	3
16	40P-3302	WIRE SET BTM REAR SLPSTR-LTSTR	1
17	20E-2321	TANG 1 HOLE 2 SLOT 5/8 WEBBING	1
19	10A-2271	AN4-27A	1
20	20G-2903	Collar Keyhole Low-Pro Nose	1
21	10N-1740	CLINCH NUT 1/4 MS21042-4	1
25	40P-4210	WIRE XBAR SWEEP T2 W/PULLEY	1



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TITLE:
T2 Rear Kee1

REVISION:
A

SLODWF ID:

T2 Rear Kee1

DOCUMENT ID:

DRAWN:

3/1/2005

REVISED:

3/1/2006

STATUS:

-

BY:

PEARSON

ITEM	Part No	Description	Inboard Rt	Outboard Rt	Outboard Lt	Inboard Lt
1	20G-2451	BRACKET LE SPROG HINGE 52 RIGHT	-	-	1	-
2	20G-2452	BRACKET LE SPROG HINGE 52 RIGHT	-	1	-	-
3	40M-1163	Sprog Assy - 1.0 7075 w/cable	1	1	1	1
4	20G-2441	Sprog Fork Stainless	1	1	1	1
5	20G-2448	Sprog Fork Hinge Pillar	1	1	1	1
6	10N-3010	Nut Sprog Adjustment	1	-	-	1
7	10C-4081	NAS623-3-8	1	1	1	1
8	10N-1730	CLINCH NUT 3/16 MS20142-3	1	1	1	1
9	10C-2361	NAS17-4-36	-	1	1	-
10	10T-4113	BUSH SS .312 X .028 X .240	-	1	1	-
11	10B-2191	AN24-19A	-	1	1	-
12	10N-1740	CLINCH NUT 1/4 MS21042-4	-	1	1	-
13	10R-0366	RIVET AL 3/16 X .375 CHAAPQ6-4	-	1	1	-
14	10N-0040	LOCKNUT LOW PRO 52NKTE-048	-	1	1	-

Technical drawing of a sprocket assembly. The drawing shows a side view of the assembly with various dimensions and callouts. Dimensions include 24.000, 23.250, and OAL. Callouts 2 through 14 point to specific components of the assembly.

5/1/2005 T2		
Cut Length	Inner	Outer
Cable	3/32 1X19	3/32 1X19
T2 144 OAL	36.125	30.375
T2 154 OAL	37.500	30.750

TITLE: Sprog Assy T2

SLDOWF ID: T2 sprog assy

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DOCUMENT ID: NA

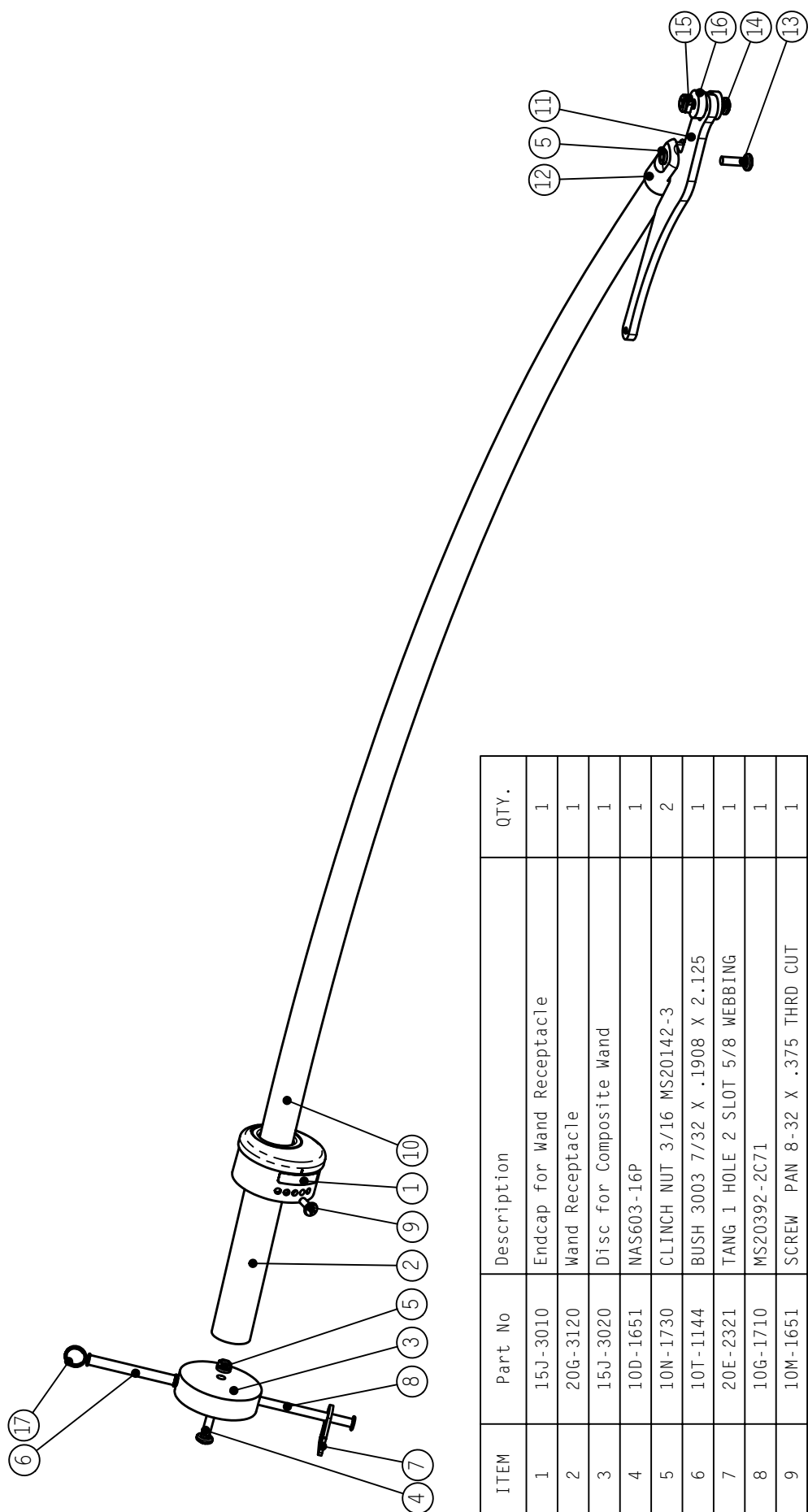
DRAWN: 5/1/2005

REVISED: 3/1/2006

STATUS: NA

BY: PEARSON

REVISION: B



ITEM	Part No	Description	QTY.
1	15J-3010	Endcap for Wand Receptacle	1
2	20G-3120	Wand Receptacle	1
3	15J-3020	Disc for Composite Wand	1
4	10D-1651	NAS603-16P	1
5	10N-1730	CLINCH NUT 3/16 MS20142-3	2
6	10T-1144	BUSH 3003 7/32 X .1908 X 2.125	1
7	20E-2321	TANG 1 HOLE 2 SLOT 5/8 WEBBING	1
8	10G-1710	MS20392-2C71	1
9	10M-1651	SCREW PAN 8-32 X .375 THRD CUT	1
10	40R-7601	Tip Wand	1
11	20G-3140	Wand Lever	1
12	20G-3130	Wand Cup	1
13	10D-1101	NAS603-10P	1
14	10C-4121	NAS623-3-12	1
15	10N-1130	LOCKNUT LOWPRO 3/16 MS21083-N03	1
16	10U-5110	WASHER NYLON .620 X .210 X .192	2
17	10P-1100	SAFETY RING AN 9491 SMALL	1
18	70G-4019	PLACARD - SAIL ADJUSTER ALIGN	1



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TITLE:
Tip Wand Assembly

SUDDWF ID:
rear leading edge and wand

DOCUMENT ID:

DRAWN:
3/6/2003

REVISED:
3/22/2006

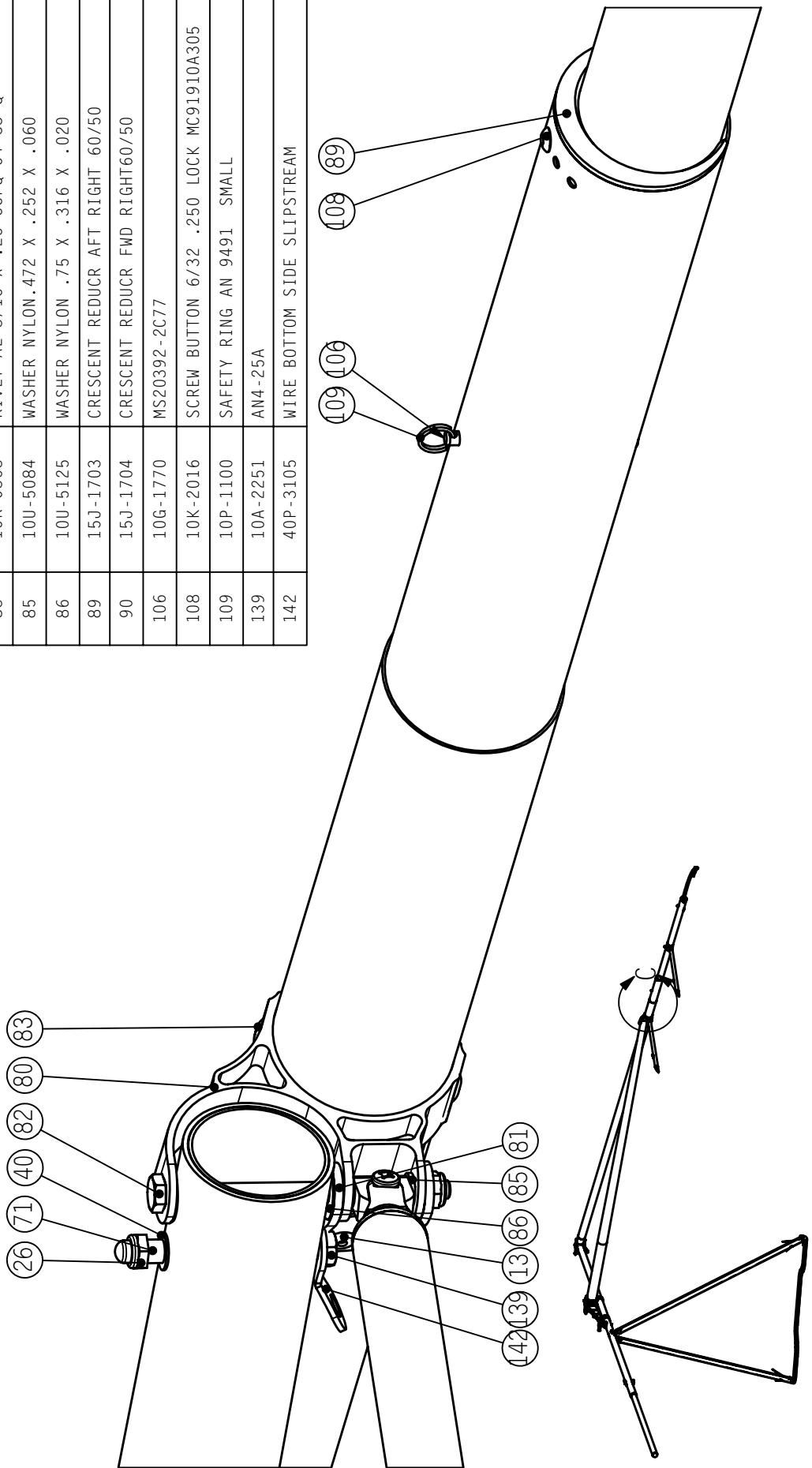
STATUS:


BY:
PEARSON

REVISION:

E

ITEM	Part No	Description
13	10R-0366	RIVET AL 3/16 X .375 CHAAPQ6-4
26	10N-0040	LOCKNUT LOW PRO 52NKTE-048
40	10U-1141	WASHER STEEL AN960-416 1/4 THIN
71	10T-4113	BUSH SS .312 X .028 X .240
80	20G-2461	BRACKET 62MM XBAR-LE CC
81	20G-2460	BRACKET 62MM LE U
82	10A-2371	AN4-37A
83	10R-0363	RIVET AL 3/16 X .25 CCPQ-64 SS Q
85	10U-5084	WASHER NYLON.472 X .252 X .060
86	10U-5125	WASHER NYLON .75 X .316 X .020
89	15J-1703	CRESCENT REDUCR AFT RIGHT 60/50
90	15J-1704	CRESCENT REDUCR FWD RIGHT60/50
106	10G-1770	MS20392-2C77
108	10K-2016	SCREW BUTTON 6/32 .250 LOCK MC91910A305
109	10P-1100	SAFETY RING AN 9491 SMALL
139	10A-2251	AN4-25A
142	40P-3105	WIRE BOTTOM SIDE SLIPSTREAM





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TITLE: T2 XB-LE

SLDDWF ID: T2 XB-LE

DOCUMENT ID:

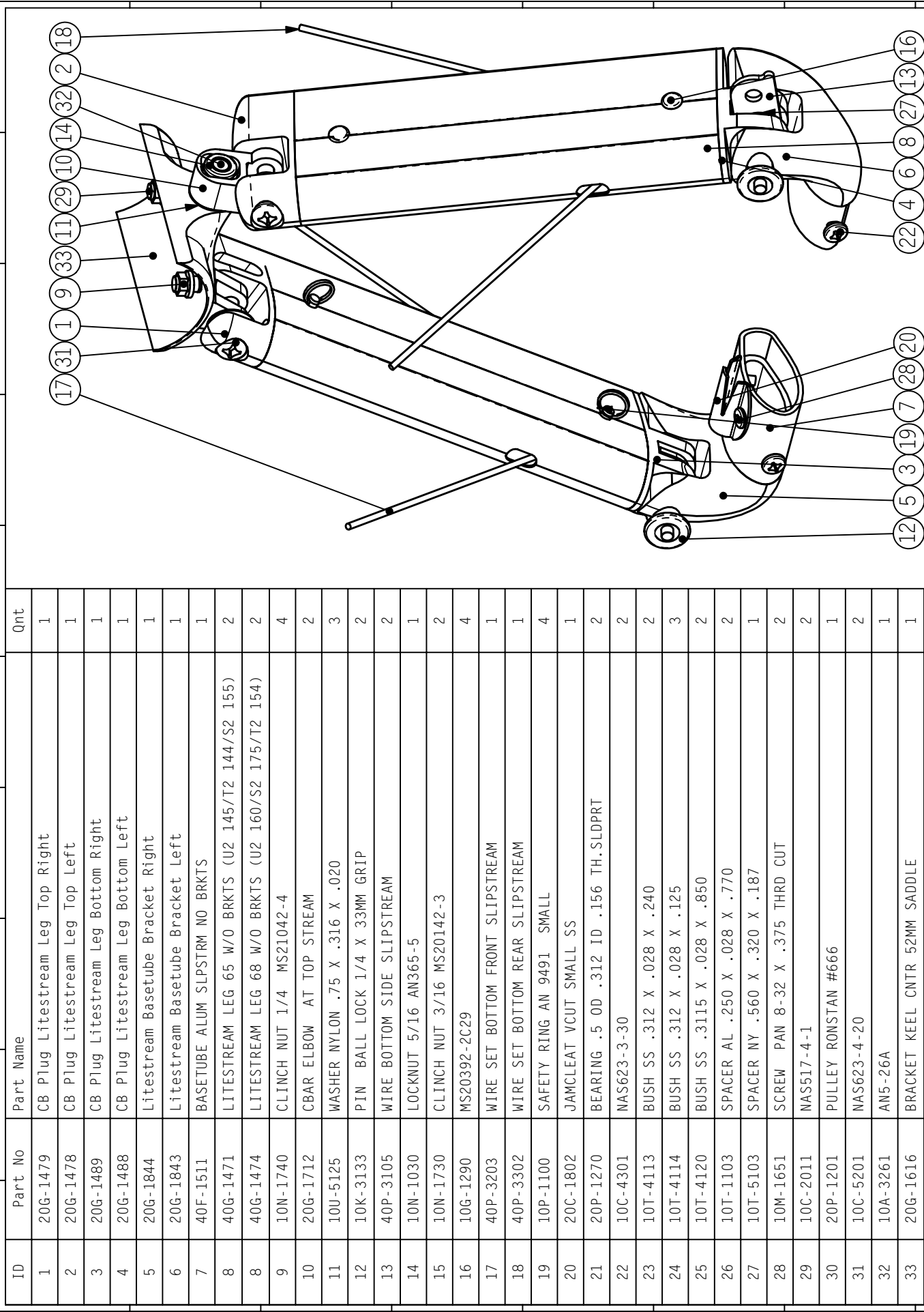
DRAWN: 5/1/2006

REVISED: 5/1/2006

STATUS: -

BY: PEARSON

REVISION: A



ID	Part No	Part Name	Qnt
1	20G-1479	CB Plug Litestream Leg Top Right	1
2	20G-1478	CB Plug Litestream Leg Top Left	1
3	20G-1489	CB Plug Litestream Leg Bottom Right	1
4	20G-1488	CB Plug Litestream Leg Bottom Left	1
5	20G-1844	Litestream Basetube Bracket Right	1
6	20G-1843	Litestream Basetube Bracket Left	1
7	40F-1511	BASETUBE ALUM SLPSTRM NO BRKTS	1
8	40G-1471	LITESTREAM LEG 65 W/O BRKTS (U2 145/T2 144/S2 155)	2
8	40G-1474	LITESTREAM LEG 68 W/O BRKTS (U2 160/S2 175/T2 154)	2
9	10N-1740	CLINCH NUT 1/4 MS21042-4	4
10	20G-1712	CBAR ELBOW AT TOP STREAM	2
11	10U-5125	WASHER NYLON .75 X .316 X .020	3
12	10K-3133	PIN BALL LOCK 1/4 X 33MM GRIP	2
13	40P-3105	WIRE BOTTOM SIDE SLIPSTREAM	2
14	10N-1030	LOCKNUT 5/16 AN365-5	1
15	10N-1730	CLINCH NUT 3/16 MS20142-3	2
16	10G-1290	MS20392-2C29	4
17	40P-3203	WIRE SET BOTTOM FRONT SLIPSTREAM	1
18	40P-3302	WIRE SET BOTTOM REAR SLIPSTREAM	1
19	10P-1100	SAFETY RING AN 9491 SMALL	4
20	20C-1802	JAMCLEAT VCUT SMALL SS	1
21	20P-1270	BEARING .5 OD .312 ID .156 TH.SLDPRT	2
22	10C-4301	NAS623-3-30	2
23	10T-4113	BUSH SS .312 X .028 X .240	2
24	10T-4114	BUSH SS .312 X .028 X .125	3
25	10T-4120	BUSH SS .3115 X .028 X .850	2
26	10T-1103	SPACER AL .250 X .028 X .770	2
27	10T-5103	SPACER NY .560 X .320 X .187	1
28	10M-1651	SCREW PAN 8-32 X .375 THRD CUT	2
29	10C-2011	NAS517-4-1	2
30	20P-1201	PULLEY RONSTAN #666	1
31	10C-5201	NAS623-4-20	2
32	10A-3261	AN5-26A	1
33	20G-1616	BRACKET KEEL CNTR 52MM SADDLE	1

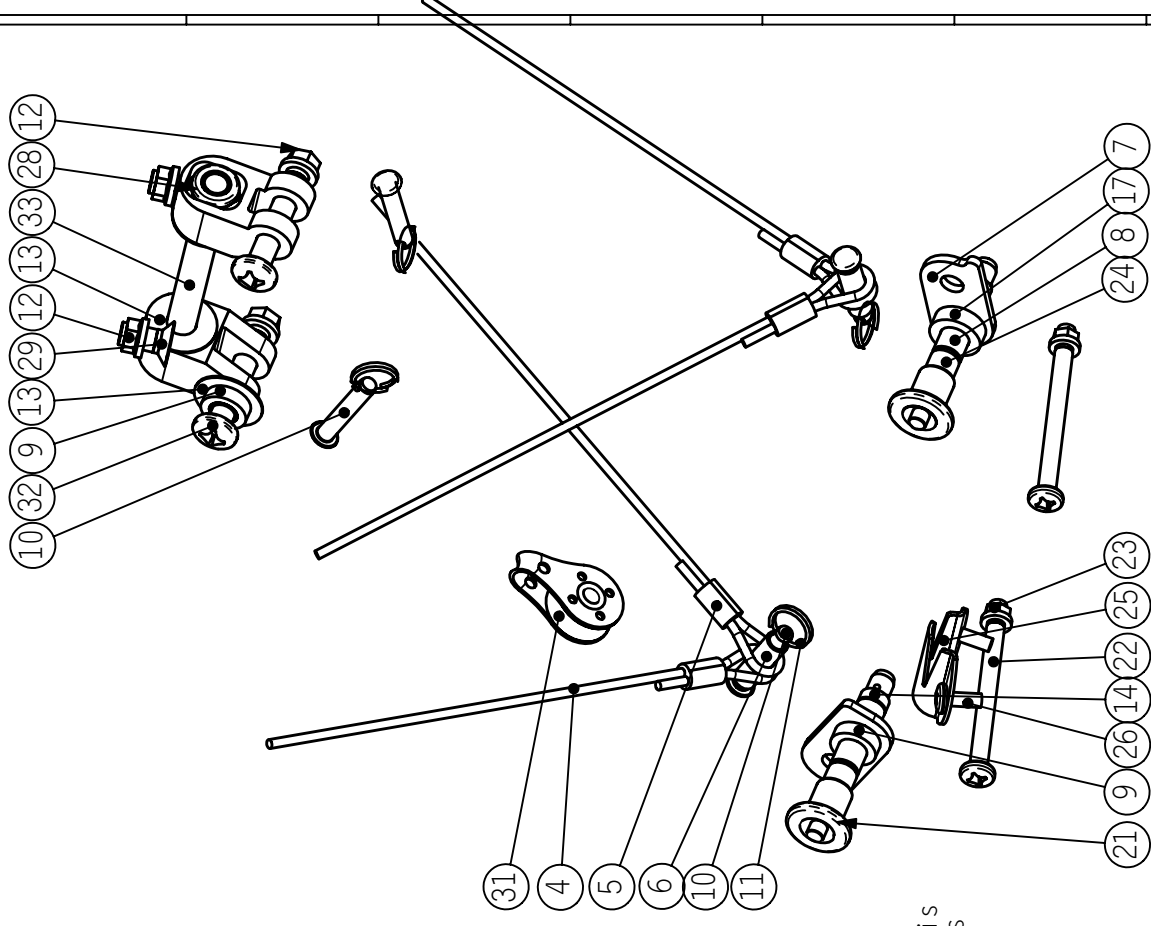
TITLE: T2 Litestream Control Bar Assy		PART NO: NA	REVISION: A	T.U.S. .X ± .05 .XX ± .015 .XXX ± .003 .XXXX ± .0005 ANGLES ± 1/2°
SLDDWF ID: U2 Litestream C		DRAWN: 7/28/2004	REVISED: 5/1/2006	STATUS: .
		MATERIAL:	BY: PEARSON	

ID	Part No	Part Name	Qnt
4	40P-3203	WIRE SET BOTTOM FRONT SLIPSTREAM	1
5	40P-3302	WIRE SET BOTTOM REAR SLIPSTREAM	1
6	10T-1103	SPACER AL .250 X .028 X .770	2
7	40P-3105	WIRE BOTTOM SIDE SLIPSTREAM	2
8	10T-4120	BUSH SS .3115 X .028 X .850	2
9	20P-1270	BEARING .5 OD .312 ID .156 TH.SLDPRT	2
10	10G-1290	MS20392-2C29	4
11	10P-1100	SAFETY RING AN 9491 SMALL	4
12	10N-1740	CLINCH NUT 1/4 MS21042-4	4
13	10U-5125	WASHER NYLON .75 X .316 X .020	3
14	10T-4114	BUSH SS .312 X .028 X .125	3
17	10T-5103	SPACER NY .560 X .320 X .187	1
21	10K-3133	PIN BALL LOCK 1/4 X 33MM GRIP	2
22	10C-4301	NAS623-3-30	2
23	10N-1730	CLINCH NUT 3/16 MS20142-3	2
24	10T-4113	BUSH SS .312 X .028 X .240	2
25	20C-1802	JAMCLEAT VCUT SMALL SS	1
26	10M-1651	SCREW PAN 8-32 X .375 THRD CUT	2
27	20G-1712	CBAR ELBOW AT TOP STREAM	2
28	10N-1030	LOCKNUT 5/16 AN365-5	1
29	10C-2011	NAS517-4-1	2
31	20P-1201	PULLEY RONSTAN #666	1
32	10C-5201	NAS623-4-20	2
33	10A-3261	AN5-26A	1

5/01/2003 Assembly Notes:

Item 25,15 permanent press fit in Basetube Brackets
Item 9 removeable fit in bottom leg plug. Front side of bushing is knurled for tight fit. Install from front to rear. Retains sidewire, VG bearing, washers and spacers.

Item 7 slip fit assembly aid for FR-RR wires in bottom leg plug.



WALLS WINGS

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TITLE:

T2 Litestream Control Bar Assy

SLDDWF ID:

U2 Litestream C

MATERIAL:

DRAWN:

7/28/2004

REVISED:

5/1/2006

STATUS:

-

BY:

PEARSON

REVISION:

A

T.U.S.

.X ± .05

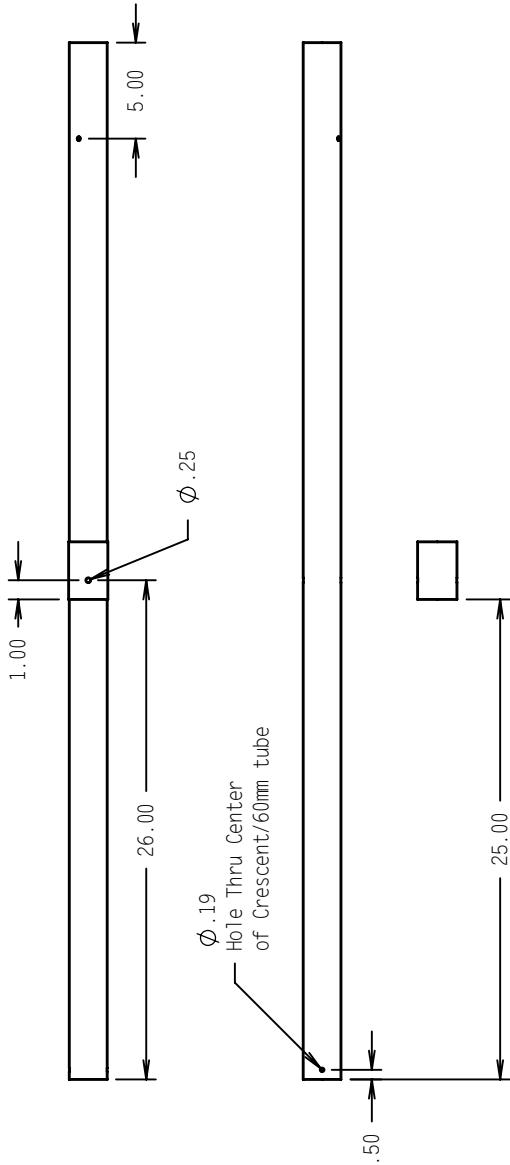
.XX ± .015


.XXX ± .003

.XXXX ± .0005

ANGLES ± 1/2°

Item	Part Name	Length	Length mm	Material	Weight	QTY.
1	T2 140 Rear LE tube	54.00	1371.6 mm	50mm x 0.9mm 7075-T6	1.133	1
2	T2 140 Rear LE s1v	3.00	76.2 mm	52mm x 0.9mm 7075-T6	0.065	1





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TITLE: **T2 144 Rear Leading Edge**

SLDDWF ID: **T2 144 Airframe**

PART NO: **40C-3200**

REVISION: **B**

REVISION: T.U.S. .X ± .05
.XX ± .015
.XXX ± .003
.XXXX ± .0005
ANGLES ± 1/2°

BY: **PEARSON**

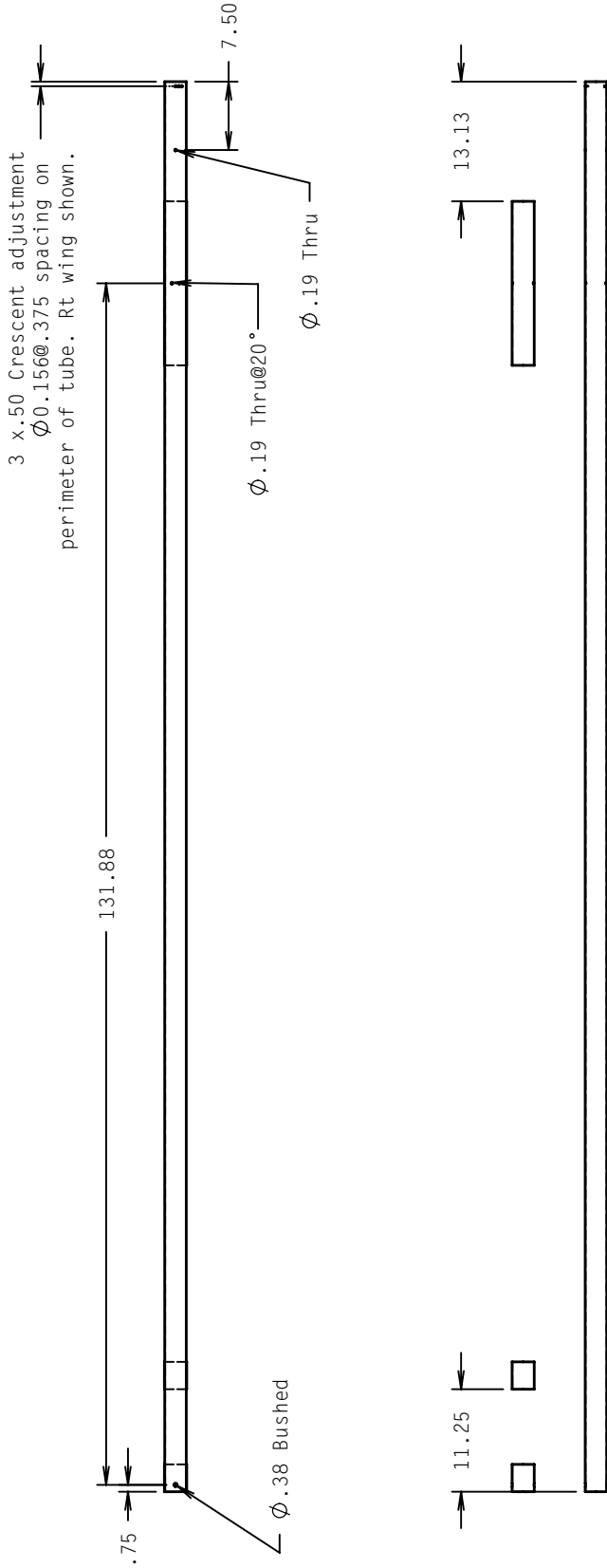
DRAWN: **1/5/2005**

REVISED: **3/1/2005**

STATUS: **Released**

Mass = 1.198 pounds

Item	Part Name	length	Length mm	Material	Weight	QTY
1	T2 150 Front LE tube	154.75	3930.6 mm	60mm x 0.9mm 7075-T6	4.087	1
2	T2 150 Front LE front slv	3.00	76.2 mm	62mm x 0.9mm 7075-T6	0.078	1
3	T2 150 Front LE middle slv	18.00	457.2 mm	62mm x 0.9mm 7075-T6	0.491	1
4	T2 150 Front LE front slv2	3.00	76.2 mm	62mm x 0.9mm 7075-T6	0.078	1



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TITLE: **T2 154 Front LE**

SLODWF ID: **T2 154 Airframe**

PART NO: **40C-2210**

REVISION: **D**

REVISION: T.U.S. .X ± .05
 .XX ± .015
 .XXX ± .003
 .XXXX ± .0005
 ANGLES ± 1/2°

REVISOR: **PEARSON**

STATUS: **Released**

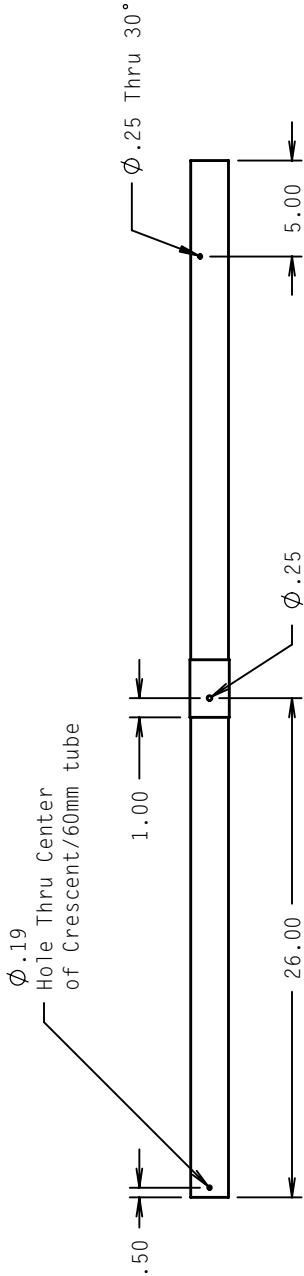
DATE: **8/17/2005**


DRAWN: **1/5/2005**

MATERIAL: **NA**

Mass = 4.734 pounds

Item	Part Name	Length	Length mm	Material	Weight
1	T2 150 Rear LE tube	54.00	1371.6 mm	50mm x 0.9mm 7075-T6	1.133
2	T2 150 Rear LE s1v	3.00	76.2 mm	52mm x 0.9mm 7075-T6	0.065





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TITLE:

T2 154 RLE

SLDDWF ID:

T2 154 Airframe

PART NO:

40C-3200

REVISION:

B

DRAWN:

1/5/2005

REVISED:

3/1/2005

STATUS:

Released

BY:

PEARSON

T.U.S.

.X ± .05

.XX ± .015

.XXX ± .003

.XXXX ± .0005

ANGLES ± 1/2°

Mass = 1.198 pounds