

Magnus VLF

Engine Backbone Alignment

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Revision History

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1. INTRODUCTION

To ensure that plate loading and clamping is consistently reliable, use this procedure to check that the backbone, drum, and drum lock are correctly aligned. This should correct or minimize errors in plate loading, plate registration detection, backbone operation, and drum errors.

2. TOOLS REQUIRED

- Creo safety override key.
- Drum encoder alignment block (Creo part number 690-00477A)
- Two 17 mm open-end wrenches for adjusting the backbone (thin wrenches work best).
- Hex key set (metric)
- Vernier caliper or pocket ruler.
- Drum support jig (Creo part number 92-0081A) or a ¾ x 2 x 24 in. piece of wood and a piece of foam.

3. PREPARATION

Before beginning this procedure, the device must be installed and operating. This includes:

- Turning the device power on.
- Setting up communication with workstation.
- Turning on the main air supply.
- Checking that the drum is working properly.
- Opening Service Shell to enter commands.
- Setting the safety override key to mechanical hazard.

Useful Service Shell commands include:

- `>>help [command area]`
- `>>drum init` - to initialize the drum after a bit of work or a flyoff
- `>>flyoff clear` - to clear a flyoff if you tripped the flyoff sensor
- `>>Drum move 97.002` - to set the drum lock, the drum must be set at 97.002°
- `>>backbone init` - when the device cannot find the position of the backbone

- To find the state of a part of the device use its name. For example:
  ```
  >>drum
  >>backbone
  >>loadtable
  ```

4. BACKBONE ALIGNMENT PROCEDURE

4.1 Aligning the encoder

If the alignment of the encoder is being questioned, then consider aligning it correctly before proceeding with this procedure. Follow the procedure located on the TechPlanet procedures page for the Magnus VLF: Aligning the Encoder.

4.2 Centering the trailing edge clamps

In this section you will adjust the backbone side-to-side movement to center the trailing edge clamps (TECs) on the drum straps. Check all the clamps. Make sure the backbone has the correct side-to-side play when finished. Also make sure the side plates are not pried apart excessively when getting rid of the side to side play. The distance between the inside surfaces of the backbone tilt plates should be 2600 mm ± 1 mm.

To check the TEC positions:

1. Type `>>Drum Move 0` to move the drum to the 0 position.
2. Type `>>Backbone Tiltedload` to move the backbone to tilted load.
3. Type `>>TEC on` to place the TEC on the drum.
4. Inspect the location of the clamps. Take care not to trip the flyoff sensor during inspection.
5. Type `>>TEC getclamp` to retrieve the TEC from the drum.

If adjustment is necessary:

6. Loosen the two cap screws holding the end block in place at each end of the backbone. If you find the access difficult, the roller backbone can be removed. Adjust the position of the end blocks so that the tabs on the TECs will be centered on the drum strap ± 1.0mm.



Figure 1: Centering the TECs to the drum straps

7. When the adjustment is made, and the clamps are more centered, tighten the screws holding the end blocks. Confirm there is a side play clearance of 0.1 to 0.5 mm between the roller on the end block and groove in the tilt plate. Also ensure the end block and tilt plate are parallel to ensure the vertical rollers do not bind [use a hex key to determine if the end block is parallel to the tilt plate]. Notice that the roller backbone has been removed for clarity.

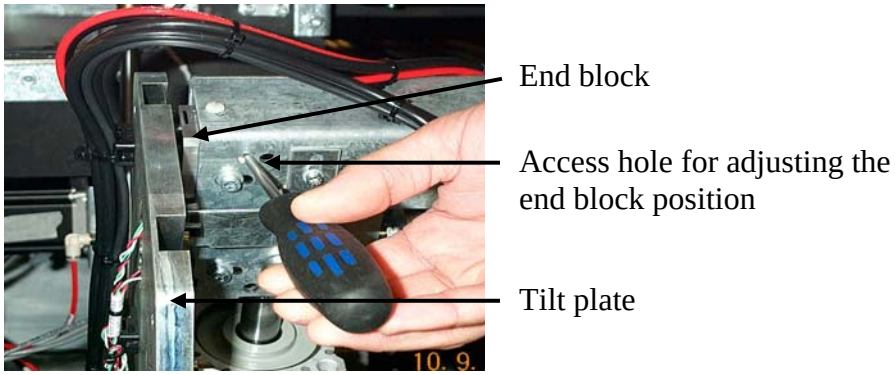


Figure 2: Adjusting the TECs

8. Confirm that the roller backbone has a side play of 0.5 to 1.0 mm.
9. Check the repeatability of the clamp positions by cycling the TECs on and off the drum a few times. Ensure the drum is at position 0 before proceeding.

4.3 Checking the LEC/TEC cylinder stroke

The two cylinders, one on each end of the backbone, make it possible for the TECs to be put on or taken off the drum and for the leading edge clamps (LECs) to be opened. When the backbone moves down onto the drum it causes the 20 pole pushers that hold the TECs to deflect upward. This deflection should be between 1 and 2 mm on the center pole pushers. The outer pushers will have a different deflection but should remain equal at each end of the backbone.

To check the LEC/TEC stroke:

1. Type `>>Drum Move 0` to move the drum to the 0 position.
2. Measure the amount the center two pole pushers protrude when the backbone is in the up position. Take the same measurement in the down position. The difference between the two should be 1-2 mm for both center pole pushers. If it is not, proceed to step 3, otherwise proceed to step 5.

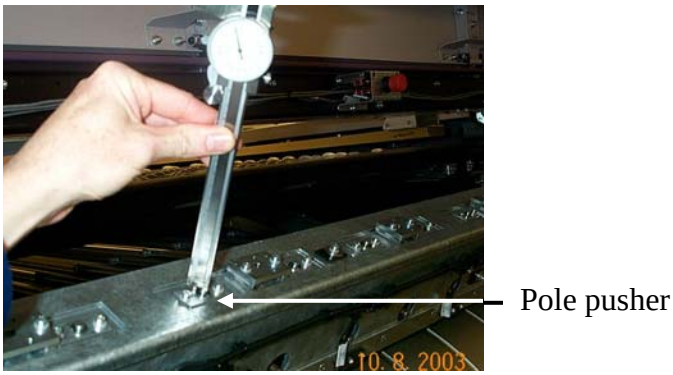


Figure 3: Measuring the center pole pushers

Adjusting process:

3. Type `>>TEC on` .
4. Adjust the LEC/TEC cylinder length to change the deflection (for more deflection, make the cylinder shorter).
5. Once the center pushers have the correct stroke, measure the outer pushers on each end of the backbone—they should have an equal amount of deflection with tolerance ± 0.5 mm . This adjustment requires shortening one cylinder and lengthening the other cylinder equally to ensure that the center pole pushers do not change in deflection.
6. After adjusting the LEC/TEC cylinder lengths, ensure that the jam nut on each cylinder rod is tightened.

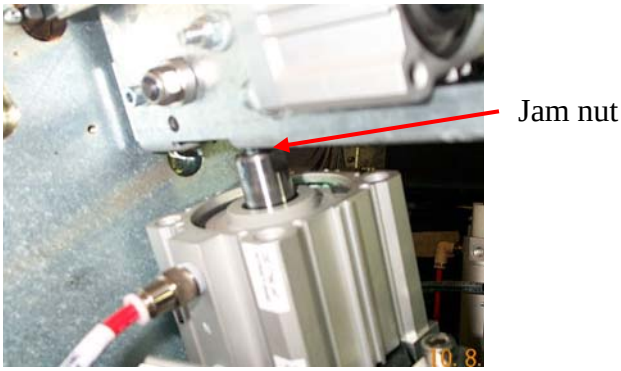


Figure 4: Tightening the cylinder jam nuts

4.4 Checking that the backbone is parallel to the drum

The backbone side plates for the LEC/TEC backbone must be adjusted so that the backbone is parallel for both the TEC plate alignment and the LEC push pin alignment to the holes in the LEC on the drum. This adjustment is done via the tilt cylinders. Check the position that the backbone places the TECs at the service park position.

Checking process:

1. Type `>> TEC PutClamp ServicePark .`
2. Measure the distance between the clamps and the TEC park pins at the end of the drum—the distance should be the same ± 0.2 mm. The distance will be larger or smaller at the center of the drum due to backbone assembly and deflection.

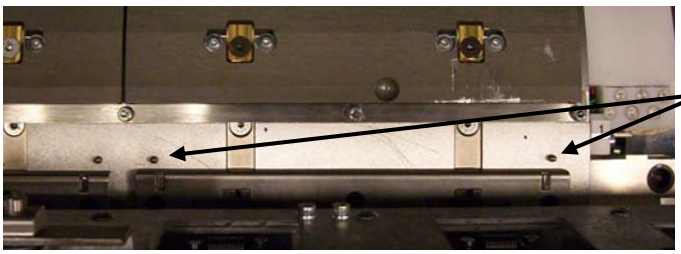


Figure 5: TEC service park position

3. Type `>> TEC GetClamp ServicePark`. If the distances were not equal ± 0.2 mm for the home and away clamps, then continue to step 4.

Adjusting process:

4. Adjust the away tilt cylinder to adjust the distance to the park pins at the end of the drum.
    a. When loosening and tightening the jam nut ensure that you only allow the nut to turn and not the cylinder rod, this will keep the adjustments you make consistent.
    b. The threads on the tilt cylinder are 1.5 mm/revolution. Therefore, for every 1 mm that the TECs are not parallel, adjust the cylinder length by turning the cylinder rod 2/3 of a turn (240°).
    c. The home and away side tilt cylinders can be adjusted from the top or bottom; or both, if a large adjustment is needed. Adjusting from the top is easier. Use thin wrenches if you have them, otherwise use the open end wrenches. Ensure that there is an adequate amount of thread, threaded into the cylinder rod ends, and ensure that the jam nuts are tightened when adjustments are finished.

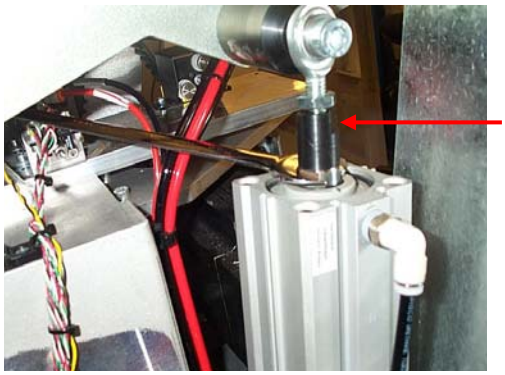


Figure 6: Adjusting the tilt cylinders

d. If a parallelism error has been corrected, release the stress in the torque tube by loosening and retightening the collars. Do not allow the backbone tilt plates to spring outward.

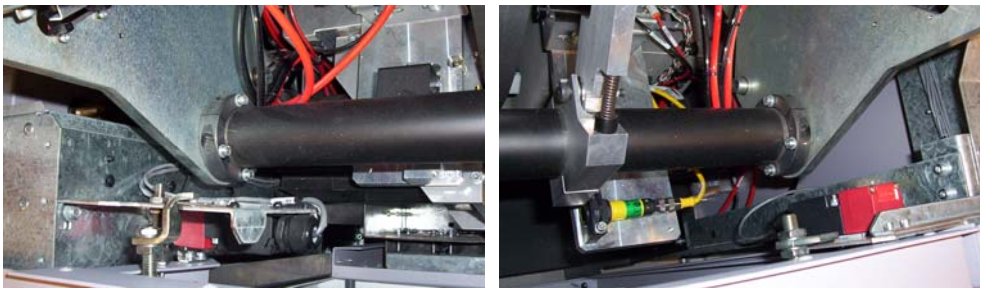


Figure 7: Tilt plate torque tube and collars

4.5 Adjusting the backbone tilt

In this section you will align the LECs pushpins with the spherical depressions or holes in the LECs. This will ensure that the LECs are opened properly and with the correct timing relative to the drum lock engagement and the registration probe connection to the contact block assembly. This will require reaching in under the roller to feel the LEC push pin engage with the hole in the LEC; if the push pin moves toward the front of the LEC as it enters the LEC hole, then the backbone needs to be tilted toward the front of the LEC. Conversely, if the pushpin moves away from the front of the LEC as it enters the LEC hole, then the backbone needs to be tilted away from the front of the LEC. The intent is to average the position so that some probes are aligned and others are slightly toward and away from front of the LEC.

If alignment is necessary, you must adjust the tilt cylinder lengths on the both the home and away side equally so as not to lose parallelism with the drum from the previous adjustment.

1. Switch the service safety override key into the override position.
2. Open the rear hood and remove the back panels.
3. Type `>>drum move 97.002` to move the drum to 97.002.
4. Type `>>backbone horizontalload` to move the backbone to the horizontal load position.

5. Hold the drum in position using the drum support jig (Creo part number 92-0081A). If you do not have the jig, use a thin 19 x 38 x 500 mm (¾ x 1½ x 24 in.) clean board and some packing foam.



Figure 8: Drum support jig (left) or wooden support (right)

   a. Type `>>drum` to confirm the drum position. Adjust as required until the drum is 97.002°.

   b. Ensure the jig holds the drum in place so that it cannot be moved out of position easily.

6. Remove the cylinder clevis clip and disengage the LECs lock/unlock cylinder. The cylinder will spring out about 12 mm once the clevis is released.

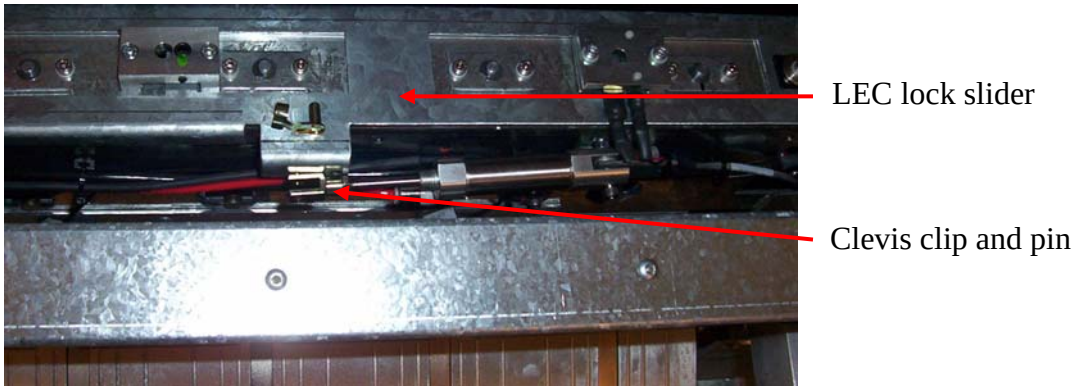


Figure 9: Removing the lock/unlock cylinder clevis clip

   You may need a tool to pry on the clevis to reduce the load of the pin to get the pin in and out of the clevis.

7. Shift the LEC lock slider to the home side of the drum to engage the LEC plungers.

8. Soften the force in the LEC/TEC cylinder by removing just enough air to make the LEC backbone move down easily and spring up. The LEC push pins should only touch the LEC when you push down by hand on the LEC.

a. Press the emergency stop switch.

b. Use the black tube to bleed some of the air from the LEC/TEC cylinder holding the backbone up. Bleed just enough air to allow the back bone to be pushed down easily by hand and then spring back up.



Figure 10: Bleeding the LEC/TEC cylinder

c. If you bleed too much air, remove the emergency stop and type LEC off, and try again.

9. Move the drum lock out of the way so it does not engage the drum lock block on the drum. If you do not do this, the drum lock may move the drum and you will have to reset the drum to 97.002° before continuing.

10. Push down on the backbone and watch or feel the LEC push pins engage the LEC on the drum. If you find access to the LEC push pin and LEC difficult, you may find it easier to remove the roller backbone to do the checking and adjustment.

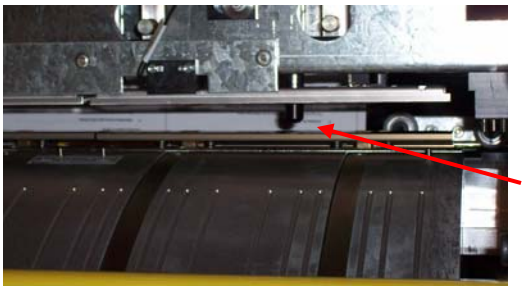


Figure 11: LEC push pin

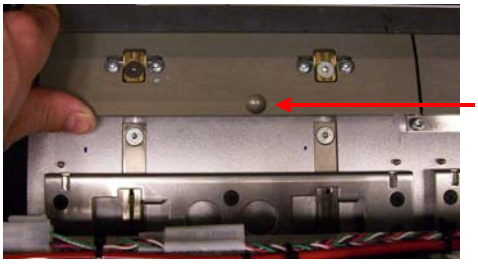


Figure 12: LEC clamp hole

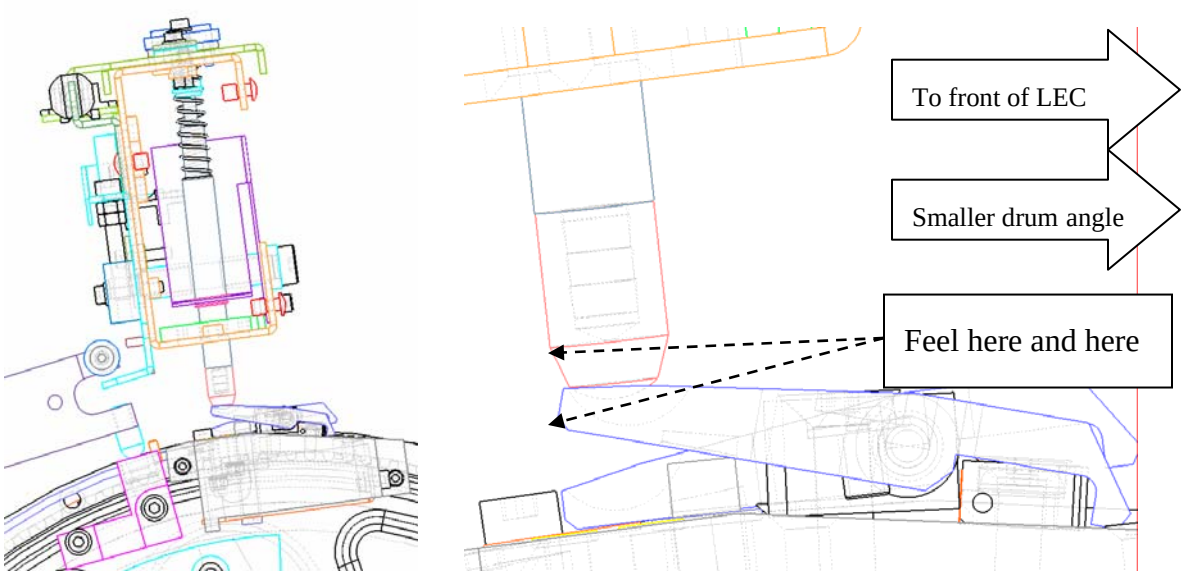


Figure 13: LEC pushpin vs LEC hole

11. If the push pins do not engage in the center of the clamp hole, then adjust the tilt cylinders to make them line up. To do this you must adjust the tilt cylinder strokes on the both the home and away side equally so as not to lose parallelism.
12. Check the home and away clamps and the two center clamps.
13. Confirm that the LEC push pin to LEC hole deflection less than ± 1 mm when checking the other six clamps.
14. Check that the drum is still at 97.002° ±0.018° during all of this adjustment.
15. Tighten the rod end jam nuts that have been loosened on the tilt cylinders. Do not allow the cylinder rod to rotate during adjustment.
16. Reassemble the LEC lock cylinder.

4.6 Adjusting the drum lock and drum lock lifter bracket

The drum lock is used to hold the drum in place while the LEC and probe assembly prepare the drum to accept or release plates. Special care must be taken when installing the lifter bracket, because it holds the drum lock up off the drum when the backbone is in the up position. If the bracket fails causing the drum lock to drop while the drum is turning, serious damage will result. To set the drum lock, the drum must be set at 97.002°. You should be able to continue on from the previous section.

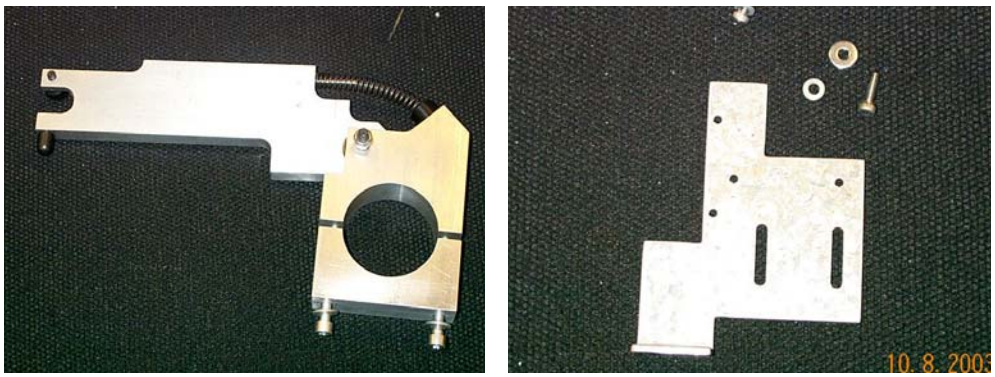


Figure 14: Drum lock (left) and drum lock lifter bracket (right)

1. Remove the jig from under the drum.
2. Release the emergency stop switch.
3. Type `>>drum` . To avoid backbone assembly vibration, the drum angle should be 97.002°.
4. Loosen the drum lock attachment to the backbone torque tube and move the drum lock so that is lines up with the hole.
5. Set the drum lock so that the side to side play [home/away] of the drum lock arm is averaged so the midpoint of play lines up the drum lock pin with the hole.
6. To get the drum lock pin to go into the hole without engaging the LEC, you will need to loosen the fasteners on the drum lock lifter bracket to allow the drum lock pin down into the hole. Check that the drum lock pin aligns with the hole in the drum lock bracket.

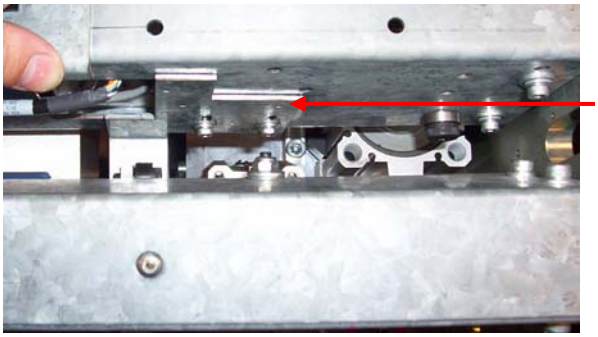


Figure 15: Drum lock lifter bracket

7. When the drum lock is in place, tighten up the collar clamp. Tighten the screws evenly to avoid the collar sliding around the pipe and misaligning it.

8. When one screw is tightened the collar will move and may cause the backbone to vibrate. Damp out the vibration by placing your hand on the drum. Continuously read the drum position during the adjustment, type `>>drum .`

9. Adjust the screws on the drum lock collar to move the actuated position of the drum lock relative to the backbone 97.002° . If you are finding it extremely difficult to achieve the 97.002° position, 97.020° and 96.984° are also acceptable positions.

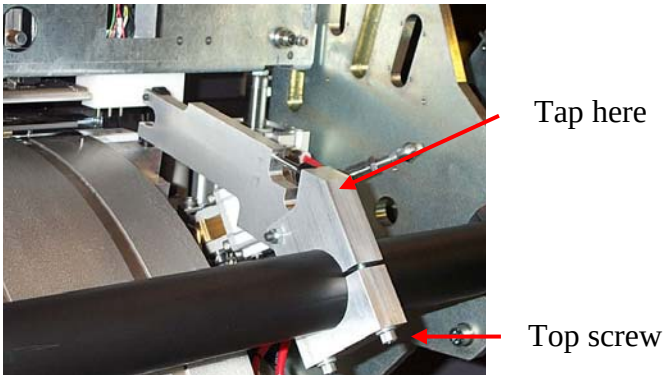


Figure 16: Drum lock

   a. To make the angle smaller, tighten the top screw and loosen the lower screw.

   b. To make the angle larger, loosen the top screw and tighten the lower screw.

   c. If the angle is not changing tapping on the pivot part of the collar will make the angle smaller.

   d. Once done, tighten these two screws evenly until tight.

10. Slide the drum lock lift bracket up the backbone to its highest position and tighten the two screws. To prevent the drum lock from hitting the drum during the next step, ensure that the drum lock arm roller is resting on the tab.

11. If you triggered the flyoff sensor during the previous adjustments, type `>>flyoff clear` to clear it. Also type the following commands:

   a. `>>roller off` to move the roller off the drum

   b. `>>LEC off` to move the LEC off the drum

   c. `>>drum move 97.002` to move the drum to 97.002°

   d. `>>backbone horizontalload` to move the backbone to the horizontal load position

   e. `>>LEC on` to open the LEC

12. Loosen the mounting screws for the drum lock lift bracket and adjust the bracket so that there is about 0.25 to 0.5 mm of clearance from the underside of the tab and the fully engaged drum lock arm above the drum lock pin. The drum lock bracket lower edge should be parallel to the edge of the backbone.

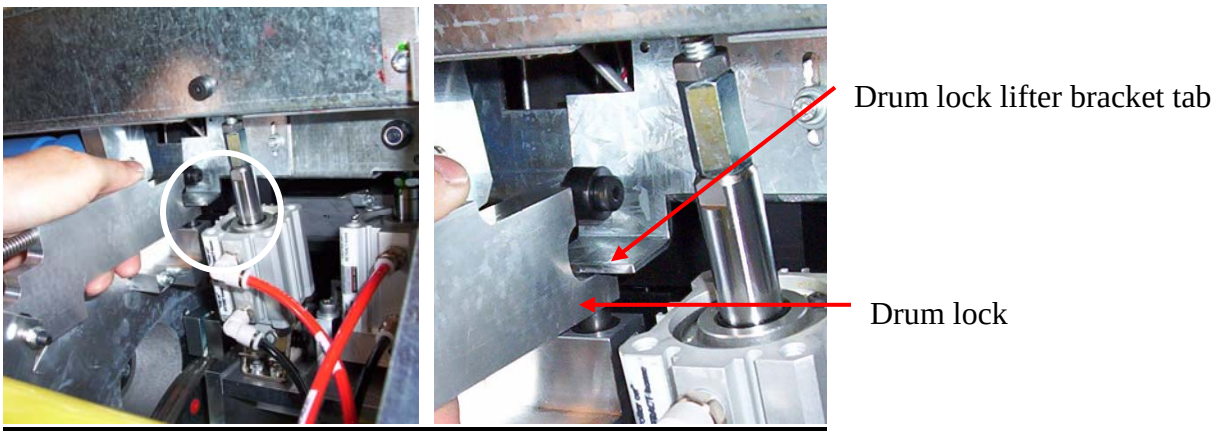


Figure 17: Drum lock clearance

13. Adjust the drum lock lifter bracket when the LEC is engaged. To do this:

    a. Ensure the drum lock pin is engaged in the drum lock block on the drum.

    b. Move the drum lock bracket so that there is a small gap, 0.5 to 1 mm, between the underside of the lift bracket tab and the top of the drum lock arm.

    c. Set the bracket so that the bracket tab is parallel with the plastic wheel on the drum lock.

    d. Tighten the screws on the drum lock lift bracket. Use heavy washers with Bellville spring washers to secure the bracket. The bracket must never slip as this will cause the drum lock to hit the drum causing major damage.

14. Type `>>LEC off` to raise the backbone.

15. Check that the drum lock pin ball clears the drum lock receptacle and registration contact block on the drum by more than 1.0 mm.

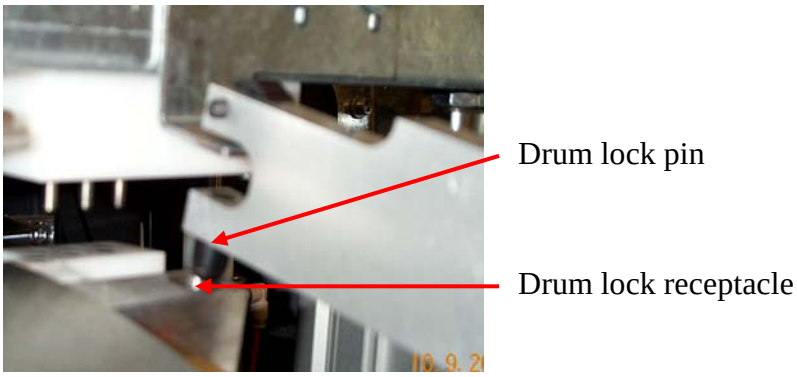


Figure 18: Drum lock lifted by lifter bracket

Note: Ensure that the fasteners are tight. The bracket must never slip as this will cause the drum lock to hit the drum causing major damage.

4.7 Adjusting the registration probes

1. Place the drum at 97.002°, and the backbone in the horizontal load position, and the LECs on.

2. Check the alignment of the probes with the contacts—they should be parallel and in line with each other by ± 1.5 mm.

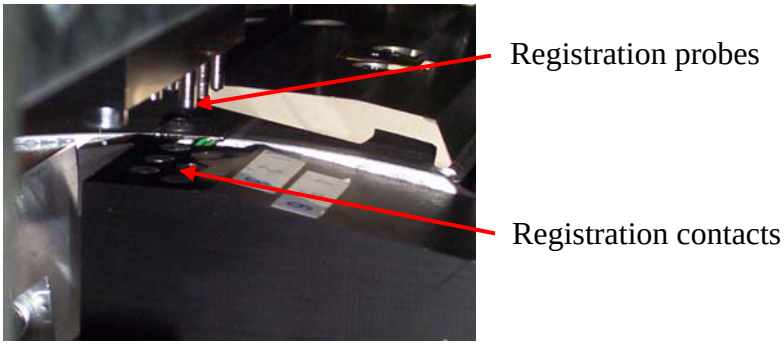


Figure 19: Registration probe alignment

If there is not enough clearance to make the contact block line up with the probe assembly, then add slots to the plastic block of the registration contact block assembly on the drum to allow it to be moved into a more correct position. The slots should only allow the block to slide circumferentially around the drum and not radially.

4.8 Checking the TEC park position

In this section you will check the TECs park position.

1. Type `>>tec putclamp servicepark` to place the trailing edge clamps on the drum roughly 2 mm from the drum pins.

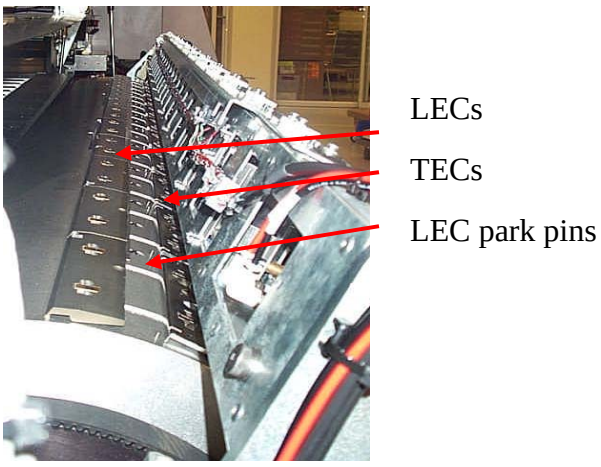


Figure 20: TEC clamps in the park position

If the clamps are closer than 1 mm from the drum's TEC park pins, adjust the **set mh tecparkpos** to a smaller angle. If the clamps are farther than 2.5 mm from the TEC park pins, adjust the set **mh tecparkpos** to a larger angle. To do that, type:

a. `>>TEC getclamp servicepark`

b. `>>set mh tecparkpos [new number]`
where the new number is approximately 4 mm per degree on a 53 in. drum and 5 mm per degree on a 63 in. drum. Ensure the angle chosen is an increment of the encoder. Divide your chosen angle by 0.018, round that number to the nearest whole number, and multiply by 0.018 to get the angle you will enter into the service shell.

2. Type >>TEC putclamp servicepark
3. Check position of TECs and repeat step 1 if necessary.
4. To confirm that the true park position of the TEC is correct:

a. Once the clamps have been placed on the drum and the service park position has been determined, slide all of the clamps on the drum up until they touch the TEC park pins on the drum.

b. Type `>>tec getclamp park` to raise the TEC from the drum. If the clamps do not raise, then there is either a firmware problem or the **set mh TEClamppos** parameter is not correct (default value is -1).

4.9 Calibrating the backbone and the load table plate length sensors

Calibration must be done with a large plate that will trip all three of the load table plate length sensors in the load table front beam near the engine. To manually load the large plate and perform the calibration routine during loading:

1. Type `>>load m [length around drum] s [length along drum] ms 1 manual calibrate`
2. Follow the prompts in service shell to load the plate into the device via the pullout load table.
3. Prepare to hold a start button to unload the plate to the load table after the calibration is done.

4.10 Adjusting the away side roller cylinder

The away side roller has an adjustable valve that does not normally need adjustment after factory assembly. If adjustment is needed:

1. Fully close the valve and then open it three full turns.
2. Type `>>roller on` and `>>roller off` to see if the roller moves up and down evenly. Make fine adjustments as necessary.
3. Lock the nut on the thread after adjustment.

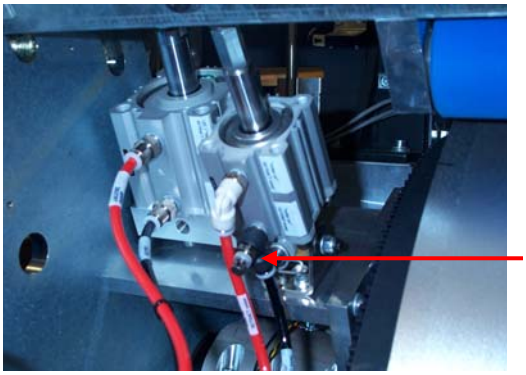


Figure 21: Away side roller cylinder

4.11 Checking the sensor tabs

Although adjustment is not usually required, checking it will ensure completeness of the backbone alignment procedure. Adjust if necessary.

1. Check that the TEC sensor tab trips the sensors and extend as deeply as possible into the sensor gap. There should not be more than 1 mm of clearance between the tab and bottom of the sensors. Bend the tab to obtain this clearance if necessary.
2. Similarly, check the roller sensor tab.
3. Clean all debris from the TECs, straps, and backbone.

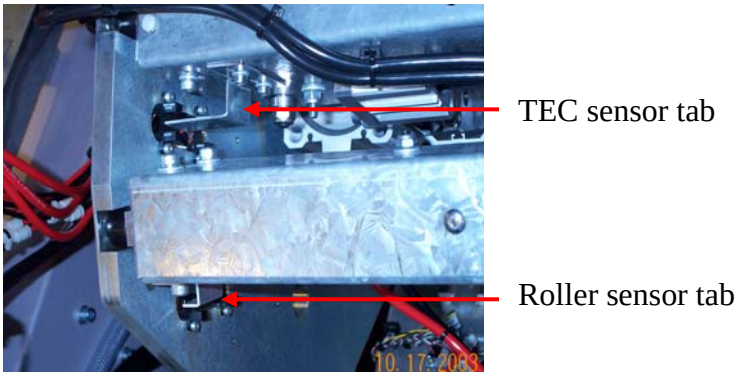


Figure 22: Sensor tabs

4.12 Checking the edge detect position and position 2

This is required to ensure the drum position matches an encoder increment during the edge detect.

1. Set the position for the first edge detect strip. To do this:
    a. Calculate the position: 1.7÷0.018=94.4; 94(discard decimal)*0.018=1.692
    b. Type `>>set edge drumpos 1.692`
2. Set the position for the second edge detect strip. To do this:
    a. Calculate the position: Angle÷0.018=ab.cd; ab(discard decimal)*0.018= new angle
    b. Type `>>set edge drumpos2 [new angle]`

5. FINAL RESULT

The result of this procedure should do the following:

- Ensure that the LECs are properly opened.
- Ensure that the drum lock is fully engaged before the LEC push pins contact the LEC clamps.
- Ensure that the drum lock is fully engaged before the probes touch the contacts.
- Avoid drum out of position errors due to encoder positions that are difficult to hold. For example, the static positions that are not encoder increments.
- Avoid drum oscillations due to encoder positions that do not match encoder increments that the device can “see”.
- Improve the TECs placement on the drum.
- Reduced loading and registration errors on the device.