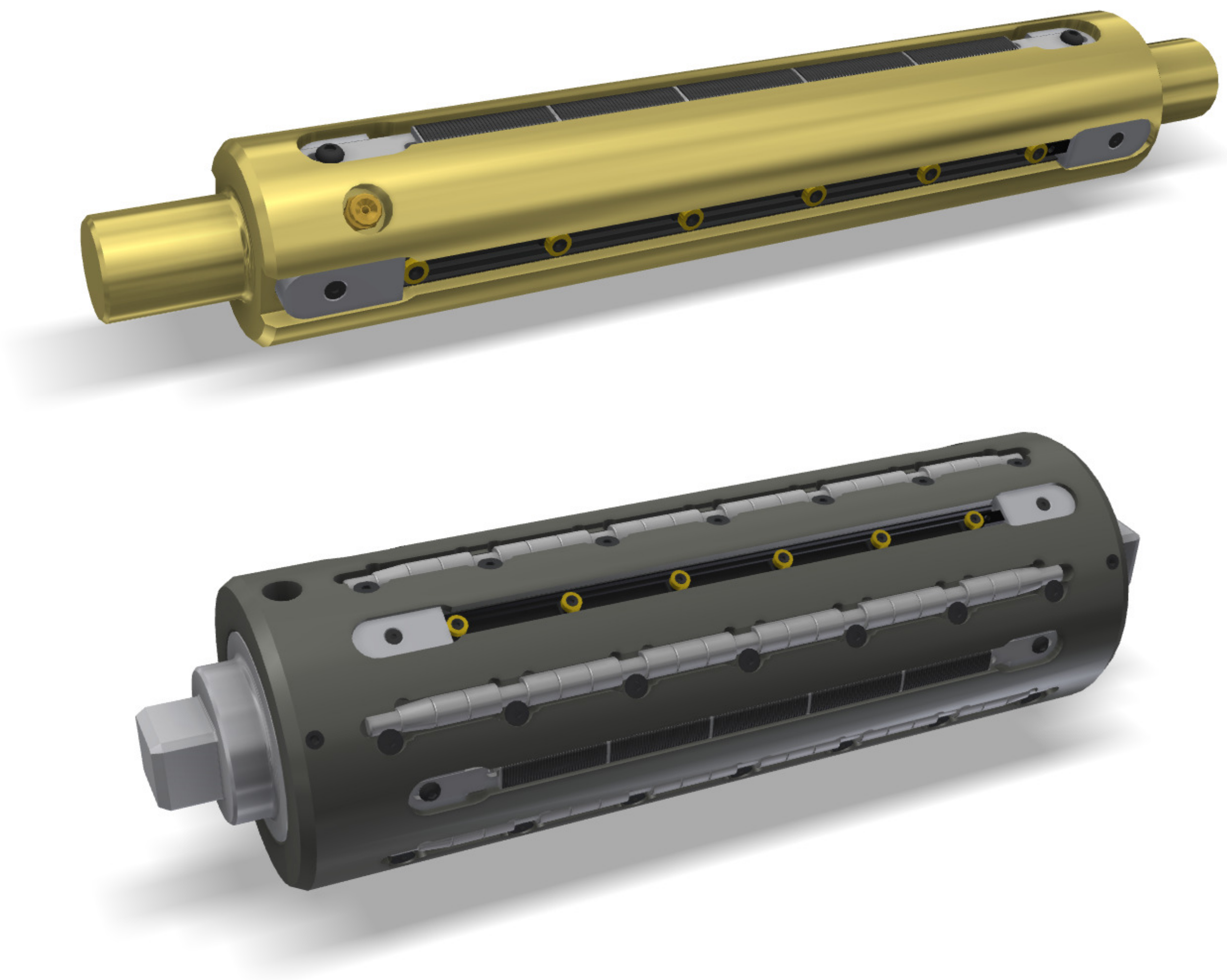
# 1250-DFX & 1250-DFB Differential Shafts

## Operation and Maintenance



# Important Safety Instructions

When using this Goldenrod product, basic safety precautions should always be followed to reduce the risk of personal injury. Your company's safety instructions and procedures should always be followed. When using this product with any other equipment or machinery, all safety requirements stipulated by that equipment or machinery manufacturer must be followed. Compliance with local, state, and federal safety requirements is your responsibility. No part of these or the following instructions should be construed as conflicting with or nullifying the instructions from other sources. Be familiar with the hazards and safety requirements in your work environment and always work safely.

1. Read and understand all instructions and shaft design application limits before operation.

2. Never use this product for a purpose or in a machine that it was not specifically designed for.

3. Do not exceed the operation loads for this shaft as noted on its engineered drawing.

4. Inspect the shaft for wear and/or other safety and functional deficiencies daily, before each use.

5. Wear safety glasses or proper eye protection when inflating or deflating or otherwise operating the air system.

6. Do not remove or otherwise alter any setscrews or fastening devices prior to using this product.

7. Do not operate this product if any setscrews or other fastening devices are missing.

8. Do not lift shaft manually if it is beyond your capacity. Loads over 1/3 your body weight may be prohibitive. Consult your company safety policy.

9. When lifting a shaft, use proper lifting techniques, keeping back straight and lifting with the legs.

10. Do not carry or lift this product over wet or slippery surfaces.

11. Use appropriate mechanical lifting devices, such as a hoist or shaft puller, for heavier shafts.

12. When performing maintenance or repair procedures, do not pressurize the shaft if journal screws are loose or missing.

13. When performing maintenance procedures, do not pressurize the shaft if the journal is missing.

14. All replacement parts used on this product should be made to original Goldenrod specifications.

15. All maintenance and repair procedures performed on this product should be done to Goldenrod specifications by qualified personnel.

# Contents of This Manual

# General Shaft Care

## Maintenance Schedule

- Inspect the shaft for wear and safety or functional deficiencies daily, before use.
- During operation shifts, use compressed air to keep shaft free of dust and debris.
- Remove sticky residue as needed.
- Replace damaged or worn out components as needed.

## Shaft Cleaning

- Clean shaft with a soft cloth.
- If necessary, a mild solvent such as isopropanol, ethanol, or acetone may be used. Apply this solvent to the cloth, not directly to the shaft. Ensure that the shaft slot and all parts are wiped completely dry of solvents before beginning reassembly.
- Avoid lubricants as they accumulate dust, preventing the shaft from functioning properly. Petroleum-based lubricants will damage polyurethane bladders.

## Differential Ledges

- Differential ledges are made up of several interlocking elements that snap together with metal tabs. Check that the differential elements are snapped together with no gaps.
- The differential ledge crimping lugs have an adjustable top piece that slides to remove remaining slack in the ledge. Do not make squeeze the elements too tightly; firm finger pressure is good.

## Core Stop Ledges

- Check that there is minimal room for the core stop cassettes to move side-to-side. Use the Core Stop Positioner on each cassette to remove slack.
- Ensure tightness of core stop set screws to prevent core stop movement.
- Seized core stop ball bearings can decrease winding performance. Consider replacing core stops that no longer turn freely.

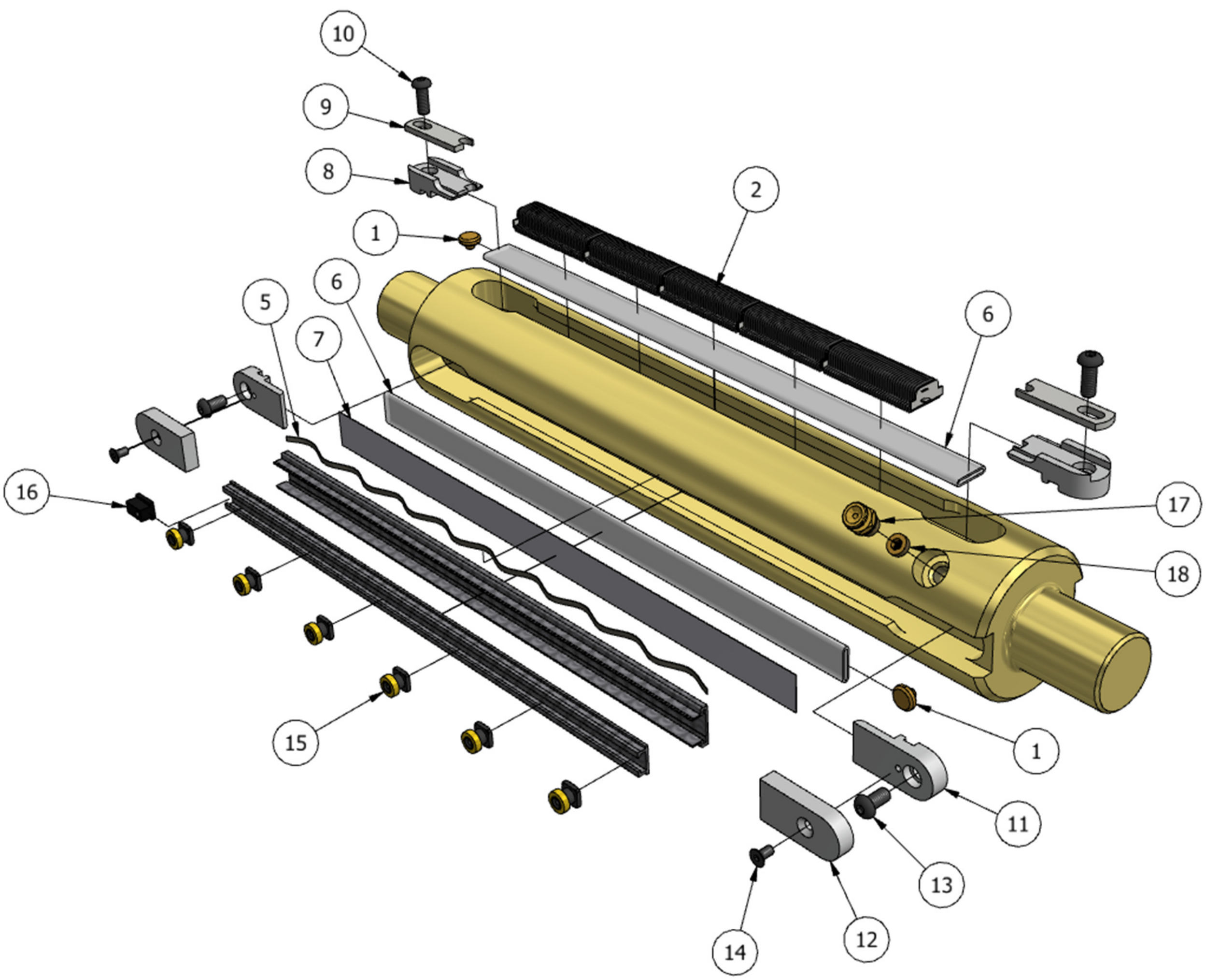
## Roller Bearing Ledges

- Avoid blowing compressed air directly into the roller bearing ledge slots while the bearings are installed. Doing so may introduce debris into the bearings.
- Periodically check that all the roller bearings spin freely. Consider replacing any that cannot be turned by finger pressure.

# Component Names and Part Numbers: DFX and DFB

These are the parts found in a typical 1250-DFX shaft. A 1250-DFB shaft will have some additional parts, which are illustrated on the following page. Your customized shaft may vary. Some parts are cut to size for your shaft length, so have your serial number ready when ordering replacement parts.

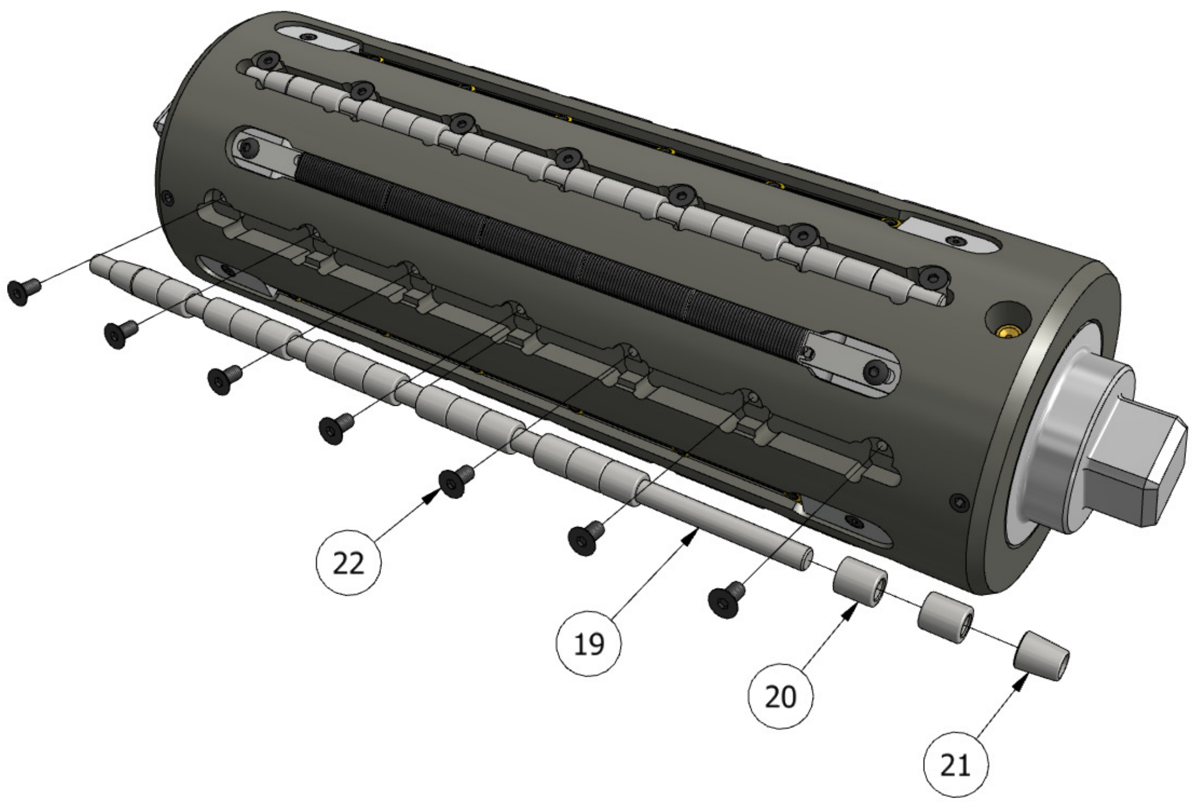
| Item | Part No. | Description | Item | Part No. | Description |
|---|---|---|---|---|---|
| 1 | BP-15 | Air Connector | 10 | BHCS M6x16 | Button Head Cap Screw |
| 2 | DE-4520 | Differential Element | 11 | DCB-4520 | Crimping Lug |
| 3 | CSC-20 | Core Stop Ledge | 12 | DCT-4520-8 | Crimping Lug |
| 4 | SRL-20 | Spring Retaining Ledge | 13 | BHCS M6x12 | Button Head Cap Screw |
| 5 | DS-254 | Wavy Deflation Springs | 14 | FHCS M4x8 | Flat Head Cap Screw |
| 6 | UT-20 | Urethane Bladder | 15 | CSRB-DFX | Core Stop |
| 7 | PL-20 | Bladder Protector | 16 | CSP-.5 | Core Stop Positioner |
| 8 | CLA-4520-B | Crimping Lug | 17 | AV-PD14 | Air Valve |
| 9 | CLA-4520-T | Crimping Lug | 18 | PD-14 SCREEN | Particulate Filter |



# Component Names and Part Numbers: DFB Only

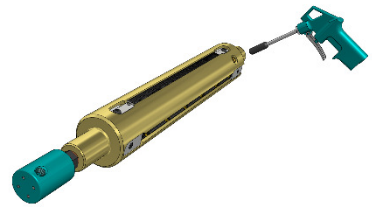
A 1250-DFB shaft will have all the common parts found on the preceding page, plus the roller bearing parts shown here. Your customized shaft may vary.

| Item | Part No. | Description | Item | Part No. | Description |
|---|---|---|---|---|---|
| 19 | DRILROD-0.375 | Hardened Steel RB Base Shaft | 21 | SLR-.625 | Special Lead Roller |
| 20 | BRG-610 | Needle Roller Bearing | 22 | FHCS M6x12 | Flat Head Cap Screw |



# Operation

## Air System



Successful operation of the Goldenrod Model DFX or DFB Differential Shaft depends upon proper internal air pressure. The Goldenrod Model DFX or DFB is equipped with two air inlets, one for controlling tension and the other for activating the core stop ledge.

Your Goldenrod shaft may use one of these two typical designs to supply continuously variable air pressure to the differential ledges:

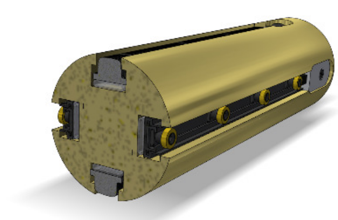
- "Lift-out" shafts need an easily removable air inflation system. Quick disconnects can work well. Non-rotating quick disconnect connectors may be used in front of the rotary union. This ensures that the rotation happens in the union and not in the quick disconnect fitting.
- Cantilevered or flange mounted shafts are ideal for supplying constant air to the shaft. Often these shafts can be supplied with a dual port rotary union that would eliminate the need for manual air gun inflation of the core stop ledge.

## Cores

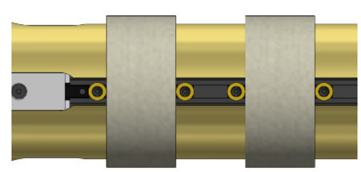
Always check the fit of the cores on the shaft when starting use of a new shaft design. Check not just a few cores but all cores for the first 5 to 10 trial runs. A core that is too tight or a core cut too long may lock onto the shaft. Nothing sours a trial like having to cut cores off a shaft after the webs have broken.

Measure core internal diameters to verify they are within specification. Inspect the core edges and internal diameter surface. Loose inner wraps can hang up on ledge slots and cause the core to collapse or lock onto the shaft. Loose particles or ragged edges on the core edges create debris and may be a problem for some customers.

## Core Stop Ledge Setup



There are two core stop ledges on a model DFX shaft, three on a model DFB. Individual core stops need to be positioned properly on each ledge. Position core stops on each side of where cores will be placed. Install cores manually along the length of the shaft without inflating core stop ledge.



Put a small amount (5-10 psi) into the differential ledge to help retain cores in position. Core stops should be positioned to allow about 1/32" gap total between the two core stops and the core. The core stops are designed to rotate with the core if they do touch. This rotation design minimizes dust generation.

When the position of each core stop is satisfactory, tighten the set screw that runs through the center of the bearing to lock it in place.

NOTE: The core stops must not create drag on the core. Make sure there are no core stops under the cores. The minimum allowable gap is a function of the core cut length tolerance. A single core out of tolerance will require the repositioning of only 2 core stops.

After setup, inflate the core stop ledge and deflate the differential ledge. Spin the cores by hand to check for drag on the core stops and adjust if necessary. Repeat for all core stop ledges.

HINT: Another simple way of setting up the core stops is through the use of ID/OD calipers. Use the inside and outside jaws alternately. The inside jaws are used where cores are and the outside jaws are where the cores are not. Fixtures can be manufactured to ease core stop setup on or off line.

For slit widths above three inches, the second core stop ledge may not be required. Testing and experience with each material is the only way to know if both core stops are required.

Once cores are set, determine necessary air pressure for tension ledges. Initial ballpark settings are as follows:

| Air Pressure | Tension |
|---|---|
| 6-10 PSI | 1 PLI |
| 15-25 PSI | 2 PLI |
| 30-35 PSI | 3 PLI |
| 40-45 PSI | 4 PLI |

With trials and testing, minor adjustments to the pressure can optimize the shaft for your cores. A simple "air pressure vs. tension" test utilizing a test core and spring scale can be used to verify tension.

HINT: During initial setup, a fiber core of known width can be mounted on the shaft. Attach a cord or cable to the core. Attach a spring scale to the cord. Put a known air pressure into the shaft and pull on the scale attached to the cord. Try this test every 5 psi. Tabulate or graph your results. If the roll weights are high and contribute significantly to the tension you may need to perform the same tension test with a full diameter slit roll.

Verify the overspeed by putting a black mark on the core edge and shaft body. This is simply a quick visual check. As the roll builds and the diameter increases the rewind shaft needs to slow down to maintain the correct overspeed.

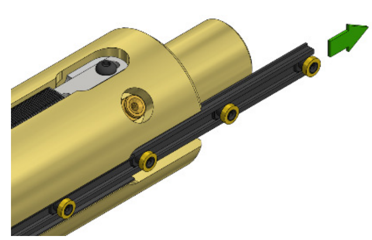
HINT: **Overspeed is typically set at 5-10%.** Mark the edge of a core with a black marker to visualize the amount of overspeed. The shaft must have overspeed to function. There are 4 slots in a 3"diameter DFX shaft. With 25% overspeed, which is usually too much overspeed, the marked core will move from 1 slot to the next slot per rotation on a 4-ledge shaft. 10% over speed will move the mark about an inch on a 3" diameter shaft.

## Core and Roll Removal

To remove the cores from the shaft, deflate both the differential element bladders and the core stop bladders. The core stop ledges will retract, allowing the cores to slide off the shaft. Core stops will remain locked in position in the core stop tray.

## Core Stop Tray Quick-Change

Goldenrod differential shafts are capable of switching slitting setups in less than a minute. Once a core stop cassette has been set up for each slit width you will be winding, simply unscrew the top crimping lug at the end of the slot that has a relief cut for core stop cassette installation. Pull up on the cassette you are removing (a small screwdriver hooked into the cassette makes this easier), pull it out, and slide in the other cassette. Then just screw the crimping lug back in.



# Maximizing Winding Quality

For successful differential winding, we need to control tension and overspeed of the differential shaft. It is best to have both web tension and roll diameter sensors to do so. Always start with light tension if possible. Start with low overspeed, light lay-on pressure, and low air pressure in the shaft (around 4 – 10 psi). It is always easier to increase the parameters than it is to decrease them.

The rewind tension is influenced by the roll weight, the air pressure in the differential elements, and the lay-on pressure (nip pressure). The roll weight is of course not adjustable, so tension control must be achieved via the lay-on pressure and the air pressure in the differential ledges.

## Tension

In general, as the roll diameter increases, the air pressure in the shaft must be increased to maintain the same tension. This is due to the change in moment arm length. Roll weight increases as diameter builds and taper tension will reduce the amount of air pressure change required.

Taper tension is the practice of decreasing web tension as roll diameter increases. Taper tension helps prevent telescoping, crushed cores, and overly tight or loose rolls. Any roll built in excess of about 18" diameter will require taper tension.

Obtaining diameter information through an ultrasonic sensor and using that to control the air in the differential shaft will work. This is not as accurate as a load cell but it is much more accurate than the alternative of having an operator manually adjust the air pressure as he notices changes in the rewind roll diameter. If we assume that we know the required air pressure for a given material at the core outer diameter, then we can trim that pressure as the diameter increases. The operator programs a starting air pressure and as the diameter increases the system automatically changes the air pressure. This system can also account for increases in roll weight and taper tension.

## Overspeed

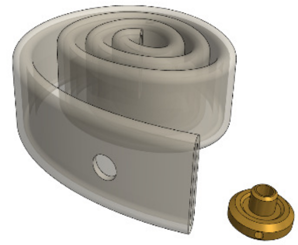
If we know the line speed (usually via a rotary encoder on an idler of known diameter) and the rewind roll diameter, we can calculate the required rewind motor speed. The roll diameter information can again be an ultrasonic sensor, a lay-on type position sensor, shaft position sensor (center surface Cameron type), or calculated from material thickness and footage. Most machines have a speed sensor of some type. This tension and overspeed information need to be fed to a simple controller to maintain overspeed and ultimately create a successful differential rewind upgrade.

## Unwind Tension

Start with a light brake if possible. If you need 20 psi of air in the shaft to start the web there is probably too much brake force. It is very important that the unwind tension remains constant. A dancer or load cell should control the brake. If the unwind tension is not constant it is very difficult to maintain a constant rewind tension. Make sure the dancer is not at the full top or bottom of its travel range.

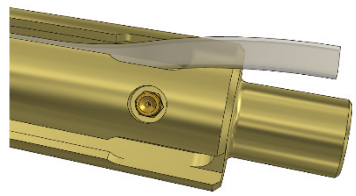
# Maintenance Procedures

## Replacement of Air Bladders

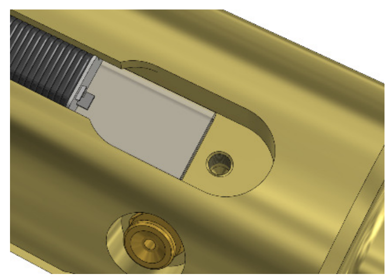


**1.** Bladder material supplied for replacement will be longer than the required finished length. Do not cut bladders to length until instructed. Bladders are made from either clear polyurethane (typical) or weaker but more-flexible black rubber.

**2.** Deflate the shaft. To remove the bladder you will first need to remove the ledge covering it. Follow the ledge replacement instructions in the appropriate section below to remove the ledge and uncover the bladder.



**3.** Pull the bladder (and plastic liner, if there is one) out of the slot. Be careful not to lose the air bushing and O-ring that conduct air to the bladder in some shafts. Retrieve the button-shaped brass air connector from the bladder if you will be reusing the connector.



**4.** If you bought replacement bladders with air connectors pre-installed, skip this step. To install air connectors yourself, use a Goldenrod bladder punch to punch a hole in the bladder with the correct inset and diameter. Stick a thin tool, such as a small hex key with the tip filed to a slight taper, into the air connector's side hole. Use this tool to push the connector into the end of the bladder until the inlet pops through the punched hole in the bladder.

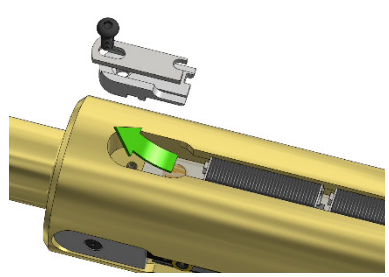
**5.** Clean the ledge slot, ensuring that it is dry before installing the new bladder. Place the air connector inlet into the air hole, found at one end of the slot, and press the bladder into the slot. Cover the bladder with the plastic liner at this point if applicable, and screw the crimping lug in to crimp the air end of the bladder.

**6.** Install the ledge back into the slot. The uncut bladder (and plastic liner) should be hanging out of the slot. You may pull gently on the bladder to prevent it from bunching up, but do not stretch it out.

**7.** Pressing the bladder into the end of the slot with one hand, draw a cut line on the bladder about 1/8" from the edge of the M6 screw hole. Cut along this line. Regular, sharp scissors will do. Screw in the crimping lug. Inflate the shaft and check for leaks. Never inflate a bladder without the ledge installed.

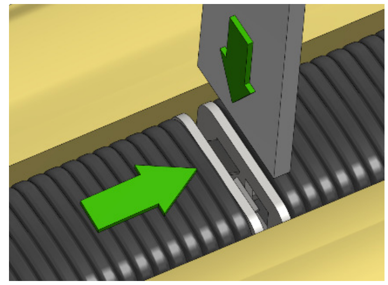
## Replacement of Differential Ledge Elements

**1.** Each differential element is comprised of approximately 30 individual wafer-thin, abrasion-resistant, molded thermoplastic pieces held together by metal end pieces and an internal spring clip. Each element is 2.157" long by standard. Custom-length elements are available and installed in the same manner.



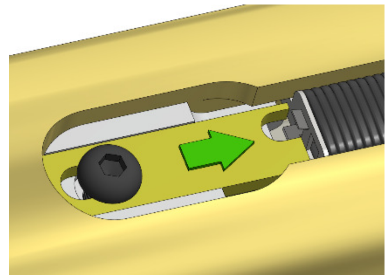
**2.** With the shaft fully deflated, remove the crimping lug from one end of the differential element row and slide out the DE-4520 elements. The elements are connected to each other with metal tabs on the ends, so you may need to insert a thin piece of metal between the elements to disconnect them from each other. Do not remove the bladder from the slot unless replacing it.

3. Tap the new elements on a flat surface to help align the individual plastic pieces, then slide the elements into the differential ledge slot. Be sure to not to install them into the core stop ledge slot; your Goldenrod engineered drawing may help to tell which slot is which.



4. The elements must be re-connected to each other, so install a few at a time, then insert a thin piece of metal between the elements and press them together until they are linked. There should be no gap between the elements.

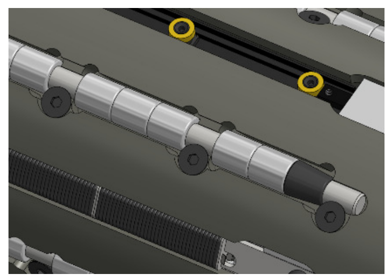
5. Use the adjustable top plate on the differential ledge crimping lugs to compress the differential elements together. Damage may result if the rows of elements are loose. Re-adjust these blocks after the first few days of use, as micro-wearing will occur between the plastic pieces.



## Replacement of Roller Bearing Ledges (DFB Only)

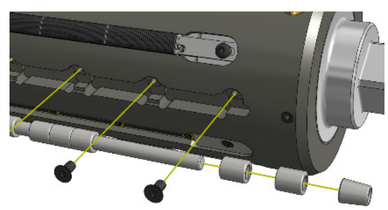
1. A 6″ 1250-DFB shaft will have 6 staggered rows of needle roller bearings called roller bearing ledges. See page 4 for an exploded view. The bearings are arranged in groups of three, and each bearing is .625″ wide. The bearings ride on a hardened, ground steel rod. The bearings at either end of the rod are each replaced by a Special Lead Roller, which eases core insertion.

2. To remove a roller bearing ledge from the 1250-DFB shaft, unscrew the flat head cap screws that hold the ledge in place. Lift out the steel base rod with the roller bearings still on it. Take this opportunity to clean the ledge slot. Do not use compressed air to blow out the ledge slot while the bearings are installed, as this can force debris into the bearings.



3. Slide the needle roller bearings off of their steel base rod. Be careful not to allow dirt to get inside any bearings that you will reuse.

4. Open the new package of roller bearings and slide as many as needed onto the base rod. The roller bearings will need to be spaced in groups of three, one group per dogbone-shaped pocket in the ledge slot. Remember: a special lead roller fills the last space at each end of the rod, pointing outward.

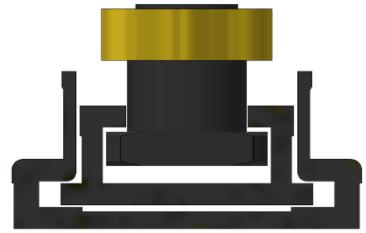


5. Reinstall the base rod with its roller bearings into the main shaft body. The roller bearing ledge slots are all identical, and the base rods and bearings are interchangeable between slots (rod length may be unique to your custom airshaft). Secure the rod into the slot using 12 mm length M6 flat head cap screws.

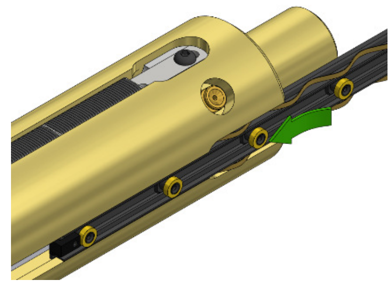
## Replacement of Core Stop Ledges

1. Core stop ledges are made up of two interlocking tracks, the Spring Retaining Ledge and the Core Stop Cassette. To replace only the Core Stop Cassette, simply remove the top crimping lug from the end of the ledge with a ledge installation relief cut in it and slide the cassette out.

**2.** Take the top lug off and slide the whole ledge out the side with the relief. If replacing the air bladder, you will need to remove the both the top and bottom crimping lugs from both ends of the ledge slot and replace the bladder and plastic liner before continuing.



**3.** Core Stop Cassettes and Spring Retaining Ledges are supplied precut to the appropriate length for your shaft. Slide the Core Stop Cassette into the Spring Retaining Ledge. Install the wavy deflation springs into the arc-shaped cuts in the sides of the spring retaining ledge.



**4.** Holding the springs down as you go, push the ledge down into the slot from the side of the slot with the ledge installation relief. Screw the crimping lug back into position. See the Operations section for core stop setup procedures.

# Troubleshooting

| Problem | Possible Cause | Recommended Solution |
|---|---|---|
| Differential elements do not activate | Air Leak or obstruction in air system. | Make sure crimping lug screws are tightened to 20-30 lb·in. Inflate bladders and use soapy water at crimping lugs to locate leaks. Replace bladders or air lines as needed. |
| Differential elements do not activate | Differential elements jammed with core dust or debris | Remove cores; use compressed air to remove dust and debris. |
| Tensions segments do not retract | Differential elements jammed with core dust or debris | Cut web and cores from shaft; use compressed air to remove dust and debris |
| Differential elements do not retract | Overheated shaft has deformed the bladder(s) | Cut web and cores from shaft; replace bladder(s). |
| Overheated shaft | Shaft spins inside cores after winding operation has stopped | Stop shaft rotation when not in winding operation |
| Overheated shaft | Excessive friction caused by dust or residue buildup on shaft | Stop winding operation; remove cores and clean shaft (see Shaft Care section on page X). |
| Overheated shaft | Excess overspeed | Reduce winding speed: 10% max overspeed; recommend 5%. |
| Core stop tray does not lift when air is applied | Leak or obstruction in air system | Remove core stop tray from shaft. Check bladder for holes, deformation or debris around air fittings. |
| Different tension from individual shafts (duplex winding) | Leak or obstruction in air system | Check all bladders for holes, deformation or debris around air fittings. |
| Excessive core dust | Poor quality cores with rough edges | Replace cores. |
| Cores stuck on shaft | Excessive tension crushing core | Reduce winding speed: 5% overspeed recommended. Lower the range tension pressure or adjust taper tension. Check Bleeder Valve adjustment. |
| Cores stuck on shaft | Core crushed by web shrinkage (e.g., stretchable materials) | Cut web and core from shaft |
| Cores stuck on shaft | Core residue binding core to shaft | Cut web and core from shaft. Use a rag damp with small amount of mild solvent, such as rubbing alcohol, to clean the shaft. Let shaft dry completely before reloading cores. |
| Cores stuck on shaft | Damaged tension segments are not retracting | Cut web and core from shaft; replace differential element strip. |
| One rewind slit is wandering | The lay-on roller is skewed or may be in uneven contact with the web | Adjust/repair the lay-on roll(s). |

# Other Considerations

## Ultrasonic Distance Sensors

An ultrasonic distance sensor can provide an output proportional to the diameter of a roll of material as it winds on a machine. Diameter measurements are used for the following: to control a motor to maintain or match line speed, inertia compensation in a tension control, or to control a clutch or brake to change material tension as the roll diameter changes.

If using an ultrasonic diameter sensor to monitor rewind roll diameter, check its operation to make certain it is working properly. This sensor is used to monitor roll diameter and send a signal that will convert into the appropriate air pressure to your Goldenrod differential shafts. Put your hand in front of the sensor at different distances and check for a change in overspeed of the shaft. If the tension is also controlled by the diameter sensor, check for a change in air pressure in the shaft.

## Load Cells

A load cell is a sensor that converts force into a signal that can be used by your machine for tension feedback control. Unlike a dancer or an ultrasonic distance sensor, a load cell's measurement of tension is direct instead of inferred. Load cells are therefore the most accurate and preferred way to control web tension. However, not all older machines can be retrofitted with load cell feedback.

## Taper Tension

Taper tension is important and is used in most slitter rewinders. As a roll is built, constant tension squeezes inner layers and can cause wrinkling, starring, and crushed cores. Check for the presence of some taper and if it is controllable. A taper tension setting of 40% is typical. This means that tension will taper off linearly from 100% at the core diameter to 40% at maximum roll diameter.

## Lay-On Arms

If using lay-on arms, you should easily be able to lift the lay-on arms. The faster the line speed, the more lay-on pressure is required. If cores are collapsing check the lay-on force. This is often overlooked. Ensure that each of the individual lay-ons exert the same or similar force. Some systems automatically increase lay-on pressure as the line speed increases. It may be a programmable parameter.

HINT: Do the lay-ons contact at the same angle? Do the lay-on air cylinders both push the rolls down or does one push and the other pull? This is common on center – surface winders, i.e. Cameron. If the geometries are not identical the differential air pressure and lay-on or nip pressures of the 2 shafts may need to be very different.

## For help or spare parts

Call 1-800-GOLD-ROD (1-800-465-3763) or send an email to cservice@goldenrodcorp.com.

## For direct service

Contact your area sales representative. An interactive sales and service map can be found at www.goldrod.com/saleschart.php.

Goldenrod Corporation
25 Lancaster Drive
Beacon Falls, CT 06403
Phone: 1-800-GOLD-ROD or 203-723-4400
Fax: 203-723-8230