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TECHNICAL INFORMATION FOR AIR ROLL LOCK DIFFERENTIAL SHAFTS

DESCRIPTION

This mandrel is currently offered for 3” ID cores, designed with a series of 1” wide chucks; and for 6” ID cores with 1” wide chucks. Rewind torque expands the chucks to grip the core ID. This is accomplished with an array of rollers that ride up cams to grip the core and prevent rotation and lateral movement. The chucks will automatically lock onto the core once the mandrel is rotated. To release the chucks stop the rotation and release the tension; a gentle pull on the finished rolls will cause the rollers to retract. The small spring plungers help ensure that all the chucks expand.

Torque control is provided by increasing the air pressure in the bladder, which presses on friction elements thereby increasing drag on the inner ring. Since the bladder is a closed tube no lubrication in the pneumatic line is required. This torque is proportional to air pressure and will not have any step changes as the air pressure is increased.

The advantage of this type shaft is that there is no rotational slip between the chuck and the core. This benefits winding in three ways: 1) no core dusting; 2) because the slipping takes place on a controlled surface, core conditions do not effect web tension; 3) lower web tensions can be achieved with heavier rolls than with direct friction type shafts.

TORQUE

The current shaft will produce about 0.60 IN-LB of torque per PSI for each linear inch (IN-LB/PSI/IN) of shaft for standard 3” & 6” units (.96 IN-LB for <u>large body</u> 6” versions). The torque range desired should require between 5 and 80 PSI to control the rewind tension. A small friction torque value is added due to roll weight – a common value is 0.2 LB-IN/LB/IN.

Example:
To determine the torque per linear inch (PLI) generated for an application that has a 20” diameter finished roll weighing 12 LB/IN and the machine puts 70 PSI into the shaft:

(0.6 IN-LB/PSI/LINEAR IN)(80 PSI) = 48.0 IN-LB/LINEAR IN
(48 IN-LB/LINEAR IN) / (10 IN RADIUS) = 4.8 PLI {LB/LINEAR IN}

Then add the friction component
(0.2 IN-LB/LB/LINEAR IN)(12 LB/LINEAR IN) = 2.4 IN-LB/LINEAR IN
(2.4 IN-LB/LINEAR IN) / (10 IN radius) = .24 PLI {LB/LINEAR IN}

Total PLI = 4.80 PLI + 0.24 PLI = 5.04 PLI

OVER-SPEED / UNDER-SPEED

When rewinding, in order to produce torque to the core, the differential shaft must always rotate faster than the roll of material. This excess RPM is called "over-speed" and should ideally be kept from 20-50 RPM. Too low of an over-speed (especially at larger diameters) may result in roll slippage. In general, this should never exceed 60 RPM relative to the winding material. **Any amount over this could result in excessive heat build up and permanent damage to shaft.** It is best that the over-speed be controlled as a fixed number, not as a percentage of line speed. This will insure that the over-speed is not too high at the core diameter or too low at finished roll diameter.

When unwinding, the difference in speed between the shaft and roll is referred to as under-speed. When using the shaft for unwinding, the reverse applies. The shaft should rotate 20-50 RPM slower than the roll in order to produce torque, and total difference in speed should not exceed 60 RPM.

Example:

Use the following example to help determine the ideal shaft speed for your Convertech differential application. Assume you are looking to achieve a web speed of 55 *ft/min* with a starting core diameter of ø3.5" and a finished roll diameter of ø20.0".

First, we must find the circumference of the starting and finished roll diameters which will give us the amount of material that is rewinding per revolution of the roll.

(1) $C = \pi D$ where: C = circumference of the roll (feet per revolution)
π = 3.14159 (unitless)
D = diameter of the roll (in inches)

for ø3.5" core (start of rewind): $C_{ø3.5"} = \pi D = \pi \times \left(\frac{3.5in}{} \times \frac{1ft}{12in}\right) =$ 0.92 *ft/rev*

for ø20.0" roll (end of rewind): $C_{ø20.0"} = \pi D = \pi \times \left(\frac{20.0in}{} \times \frac{1ft}{12in}\right) =$ 5.24 *ft/rev*

Next, since we know the desired web speed, we can calculate the starting revolutions per minute RPM (R_{pm}) using the following equation:

(2) $R_{pm} = F_{pm} / C$ where: R_{pm} = revolutions per minute of the core
F_{pm} = web speed (in feet per minute)
C = circumference of the roll (feet per revolution)

for ø3.5" core (start of rewind) using Equation (2) solving for $R_{pm\ @\ ø3.5"}$ we get:

$R_{pm\ @\ ø3.5"}$ = (55 *ft/min*) / (.92 *ft/rev*)
$R_{pm\ @\ ø3.5"}$ = 59.8 *rev/min*

for ø20.0" core (end of rewind) using Equation (2) solving for $R_{pm\ @\ ø20.0"}$ we get:

$R_{pm\ @\ ø20.0"}$ = (55 *ft/min*) / (5.24 *ft/rev*)
$R_{pm\ @\ ø20.0"}$ = 10.5 *rev/min*

This shows us that at the start of the rewind the roll will be spinning at approximately 60 RPM, but as the roll diameter increases, the RPM at the outer edge will decrease to approximately 10 RPM. For this example, since the **ideal overspeed is 20-50 RPM**, your Convertech differential shaft should be running at about 80-110 RPM to start and at about 30-80 RPM to finish. If you prefer or need to keep the differential shaft at a constant speed, about 80 RPM for the duration of the rewind would be acceptable.

MAXIMUM ROLL WEIGHT

Maximum roll weight should be developed with Convertech for all specific shafts.

ROLL WIDTH

There is no specific maximum roll length and all widths up to the maximum shaft length can be run. The minimum roll width is 1” on 3” & 6”diameter shafts.
Note: Narrow cores run on different amounts of segment will result in uneven tensions.

CORE SIZES

At this time, shafts for 3” ID cores and/or 6” ID cores are standard. For best results, see that the cores meet the following requirements.
For fiber cores, the tolerance on 3” ID cores is 3.010” to 3.045” and the 6” ID core is 6.015” to 6.045”. For plastic cores, the tolerance on 3” ID cores is 3.000” to 3.025” and the 6” ID core is 6.015” to 6.035. Other sizes are available as special orders. Cores should be free of burrs and rolled over edges to ease core loading and unloading also preventing damage to shaft.
Note: Cores outside of this range or cores that are out of round will affect performance of shaft.

LOADING AND UNLOADING CORES

It is recommended that shaft be supported and deflated while loading and unloading cores. Cores should be removed from the shaft, not the shaft being removed from the cores.
Note 1: Setting the shaft down and pulling it out of cores is not recommended and may cause damage to shaft.
Note 2: Winding thin walled cores at higher tensions may cause core to collapse, making roll removal difficult.

AUTOMATIC CORE STRIPPERS

It is recommended that the shaft be rotating a few RPMs and there is no air pressure in shaft when cores are removed automatically. This will insure rings will cam down and core will unload smoothly.

MAINTENANCE

Daily: Wipe down the mandrel with a dry rag, visually inspect the mandrel. Blow out any dirt trapped under the lugs, make sure that the rings spin freely.

Six-Twelve months: Heavy dirt and residual should be removed twice a year. In this cleaning the outer rings and cams are removed. To do this it is best if the shaft can be removed from the machine and supported vertically on one end. Failure to keep unit vertical will result in friction buttons falling out of unit. Remove the clamping collar from the shaft and slide the chuck assemblies off the shaft. Separate the outer ring from the cam, blow out and wipe off all surfaces of each component. Inspect the parts for uneven wear, replace as required. Outer rings with cuts and large nicks should be discarded. The gripping elements should float freely in the outer ring. The cam should turn freely inside the outer ring and the cam should turn freely on the shaft. The steel shaft should be wiped down to remove any grease build up. Remove friction buttons and measure with a caliper, any buttons shorter than .360" should be replaced.

Replace the cams by sliding them down the shaft. Install only a few at a time. Check the difference in height between the cams and the outer rings. When the difference between the ring and cam starts to exceed .020", slide one of the .015/.020" shims on the shaft. Repeat this process until the entire shaft is stacked. Hold two of the shims between the last chuck and the end cap to allow approximately .03/.04" clearance before tightening down the end cap.