# Differential Rewind Shafts

- More accurate tension control for light tension applications.
- Dynamically balanced central shaft.
- Suitable for cardboard and all types of plastic cores.
- Easier loading of cores and unloading of rolls.
- Controls torque over larger overspeed ranges.
- Springs ensure that all friction rings are engaged and gripping the cores across the full web width.
- Engineers review each application to provide a custom engineered solution.



# DOUBLE E COMPANY

Excellence in Engineering

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## THE DIFFERENTIAL REWIND PROBLEM

All rolls of material have differences in material thickness and/or coating thickness across the width of the web. These thickness variations are present in each wrap of the roll. When a master unwind roll is slit and then rewound, these thickness variations cause a different rewind torque requirement for each separate roll across the rewind shaft.

A "lock core" shaft can only transmit a single winding torque to all rolls, so some rolls may wind too loose and some too tight. This inconsistency can cause many quality problems. Some are immediately noticeable rejects such as broken webs, roll telescoping, weaving, starring, crushed wraps, or even crushed cores. Other problems related to roll hardness are often concealed in the wound roll, causing tension control difficulties and quality concerns in subsequent winding operations.

## THE DOUBLE E DRS SOLUTION

Double E's differential rewind shaft works like a "shaft within a shaft". Winding **cores** are mechanically locked onto one or multiple **friction rings**, depend-

ing on core width. When the **<u>outer race</u>** is rotated against the **<u>inner race of the</u>** 

3" and 6" standard core diameters; other sizes also available

> Friction rings from 3/8" up to 2" wide

friction ring, the expanding balls ride up cam ramps to center and grip the core. These friction rings then consistently slip like a clutch around a <u>central shaft</u>, which runs at an overspeed RPM. Similar to a strip shaft, this central shaft contains <u>air bladders</u> and <u>friction strips</u> running along the shaft. Winding torque to the friction rings (and consequently to the cores and

rolls) is controlled by adjusting the air pressure in the bladders. As the bladders expand, they press the friction strips out to exert force on the inner surface of the friction rings. Generally, as rolls build, air pressure is increased to deliver the proper winding torque. Because separate rolls require separate winding torques, some will slip more than others. Through this differential slipping, proper winding tension is maintained for each roll.

## FEATURES OF THE DOUBLE E DIFFERENTIAL SHAFT



Friction Ring Assembly: steel rings are robust and wear resistant

Outer Race: captures expanding balls

Inner Race: slips against central shaft, controlling torque with air pressure

**Central Shaft:** similar to a strip shaft using air to expand the friction strips, high grade steel, dynamically balanced

Air Bladder: controls winding torque

**Friction Strip:** low, medium, and high coefficient of friction available for various tensions

Expanding Ball: easier loading of cores, easier unloading of rolls

Core: Accommodates core sizes ranging from 2" up to 12".

# CHOOSING THE CORRECT

Step 1: Machine Type	Step 2: Identify the Winding Type	
Center Winder	LOCK CORE WINDING	Cores locked onto a standard winding shaft. Expanding lug types, strip type, leaf type or rope type. NOT differential - upgrade is often desired or needed.
Some have idling lay-on roller	SIDE FORCE DRS	Also known as "yoke system," "spacer differential" or "sideforce shaft." This winding type uses a solid shaft (not air expanding) with a yoke at the side of the machine pushing in along the shaft axis. Spacers are set between cores and side force presses on cores to regulate the amount of slip.
Center / Surface Winder Driven surface roller	CORE SLIP DRS	Looks like strip shaft, sometimes with adjustable stops to set core spacing. Differential slip is achieved by allowing the core ID to slip on the shaft OD.
Yes - DRS can be used in some cases. Surface / Drum Winder 	FRICTION RING DRS	Also known as "cam lock rings,""spacerless differential" or "true differential." Has sets of friction rings along the shaft length. Differential slip is achieved by allowing the friction ring to slip on the central shaft.

# DIFFERENTIAL SOLUTION

Step 3: Identify Problems	Step 4: Solution
Upgrade is needed. See "Differential Rewind Problem" on prior page.	Convert machine to differential winding using EE differential shaft – requires a new tension control system.
Core edges slipping against spacers creating dust which can contaminate finished rolls.	EE differential shaft cores are locked in place, friction rings slip on central shaft.
Core diameter and edges not cut squarely causing winding variation.	EE differential shaft cores do not rely on quality of cut core edge.
Poor control of winding torque in low tension applications due to high friction between cores and spacers.	EE differential shaft friction rings and central shaft are two precision machined surfaces for controlling torque.
Loading / unloading is time consuming due to managing spacers.	EE differential shaft does not use spacers.
High overspeed and high friction creates excessive heat.	EE differential shaft uses less overspeed to gain the correct amount of slip and slip occurs with much less friction.
Necessary for customer to inventory many size spacers.	EE differential shaft does not use spacers.
Core width needs to be in spec or when they are stacked against spacers, a cumulative effect may happen and a slit might not match its core position during setup.	EE differential shaft positions cores independent of core widths.
Cores slipping on shaft creates dust which can contaminate finished rolls.	EE differential shaft cores are locked in place, friction rings slip on central shaft.
Inconsistent core ID surface causes winding variations. Core ID surfaces are generally not designed for this.	EE differential shaft friction rings and central shaft are two precision machined surfaces for controlling torque.
Cannot control roll torque in low tension applications due to high friction between core and shaft OD.	EE differential shaft friction rings and central shaft are two precision machined surfaces for controlling torque.
High speed and high friction creates excessive heat.	EE differential shaft uses less overspeed to gain the correct amount of slip and slip occurs with less friction.
If core spacing stops are used in the shaft for core positioning, core edges can catch on the edges of the stops causing torque spikes and winder motor faults.	EE differential shaft does not use spacing stops.
Dust jamming up the rings causing more maintenance downtime.	EE differential shaft friction rings are manufactured with closer tolerances and tighter fit from ball to outer ring; ball seat allows less dust penetration.
Difficult for automatic loaders since cores need to be manually locked in place before winding begins.	EE differential shaft spring option is designed to fix this problem.
Not all rings engage the core when loading wider cores, causing winding variation from roll to roll.	EE differential shaft spring option ensures engagement of each ring.
Need to buy separate shafts for running 3" and 6" cores.	EE differential shaft provides a common central shaft; use a second set of rings when needed.
Loading cores outside of a machine; causes loss of core position if the rings unlock.	EE differential shaft spring option automatically engages each ring.
Core wobble causes weaving.	Larger diameter staggered balls and Spring design add stability. Each shaft engineered for core spacing requirements.
One winding direction.	New "BD" bidirectional rings.
Shafts and friction rings are heavy with higher rotating inertia.	EE differential shaft uses lightweight materials with lower inertia for better control.
Limitations on roll weight.	EE differential shaft offers 60mm or 100mm central shaft diameters and other options for higher weight capacity.
Button style is difficult to load and unload.	Ball style allows smooth loading.
Core diameter tolerance restrictions.	Larger diameter balls can handle larger diameter variation.

## DIFFERENTIAL REWIND SHAFT RING OPTIONS

#### **UDNS – Uni-Directional No Spring**

No spring assists in holding a core in place during loading. This ring has one working direction.

#### **UDSS – Uni-Directional Single Spring**

The spring assists in holding a core in place during loading. The springs also help assure every ring locks in place under a long core that covers multiple friction rings. This ring has one working direction.

#### UDDS – Uni-Directional Double Spring

The springs assist in holding a core in place during loading. They also help assure every ring locks in place under a long core that covers multiple friction rings. This ring has one working direction. This ring will provide a better gripping force than the UDSS on the core when rings are in a resting disengaged state. It is ideal when cores need to be positioned on the shaft off the winder and then the shaft is loaded.

#### **BDNS – Bi-Directional No Spring**"

No spring assists in holding a core in place during loading. This ring has two working directions, so both under-winding and over-winding can be achieved on the shaft without shaft disassembly.

One-inch wide spacer rings are also available to place between friction rings in certain applications. This option can reduce the price and weight of the shaft.



### ROTARY UNION OPTIONS

- External collar rotary unions remain on shaft journal and provide constant air while slipping on the outer diameter making a simple pneumatic retrofit. Air line runs to the collar rotary union with quick disconnect.
- "AT" model air-thru safety chuck. Pneumatically • actuates an O-ring sealed plunger into end of shaft journal. Allows shaft to be loaded into safety chucks.
- Custom pneumatic plungers to fit machine especially useful if retrofitting from side force type DRS.
- Standard end mount rotary unions can be replaced on cantilevered shafts permanently mounted to the machine.

### ALTERNATIVE SOLUTIONS

DRS-1000 - A simple lightweight carbon fiber shaft with a groove for holding keyed rewind spacers. This shaft can replace heavier shafts in existing side force differential winding applications.



**DF-500** - A torque latching chuck that can slide over a DRS-1000 shaft with alternating spacer rings. The chuck positively locks cores in place and allows side force differential winding without generating cardboard dust or heat.

## DIFFERENTIAL SHAFT SPECIFICATIONS

Company:	Date:						
Name:	Title:						
Address:	City:						
State: Zip:	Country:						
Telephone:	Fax:						
email:							
Application: Unwind ${\bf O}$ Rewind ${\bf O}$	Min. Web Tension (P.L.I.):						
Type of Winder: Surface $O$ Center/Surface $O$ Center $O$	Max. Web Tension (P.L.I.):						
Current Shaft Style: Lock Core ${f O}$ Side Force ${f O}$	Web Material:						
Core Slip $\mathbf{O}$ Friction Ring $\mathbf{O}$	Paper 🗅 Film 🖵 Other 🖵						
Machine Make and Model:	Basis Weight:						
Current Shaft Manufacturer:	Туре:						
Reason for Change:	Thickness:						
	Description:						
Nominal Core I.D. (x.xx decimal places):							
Core Tolerance:	Is the entire shaft removed from machine? Ves $\Omega$ No $\Omega$						
Core Material:	If yes (shaft removed from machine):						
Core Wall Thickness:	The unloading of rolls is done.						
Core samples may be requested on receipt of order.	$Manually \qquad Automatic Pusher \qquad O$						
Max. Slit Width: # RollsWeight (ea)	Shaft turns in slow reverse direction during unloading:						
Min. Slit Width: # Rolls Weight (ea)	Vac O Na O						
Minimum Spacing between Slits:	ies O ino O						
Max. Roll Diameter on Differential Shaft:	Position of Air Valve: Side A $\mathbf{O}$ Side B $\mathbf{O}$						
Support Separation:	Air valve is always located axially (on journal end)						
Web Speed:	Air pressure needs constant adjustment during run.						
Side Overall Shaft Length =							
Body Length =							
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