MOOG
ANIMATICS

Control Solutions for Winding & Spooling

SPOOLING is the most effective way to conveniently package materials of exceptionally long length such as thread, film, wire and thermoplastics. Moog Animatics has been a long-time solution provider for winding and spooling applications, and has recently developed **new commands specifically for the winding industry.**

The integrity of the spool is often based on precise patterns and proper tension control throughout the winding process. Typically, the spooling material is fed at a certain rate while a guide traverses the material back and forth corresponding to a desired pattern. The position accuracy of a traversing guide is best maintained when it's linked to the rotational velocity of the winding spool. Selection of the proper traverse type for different materials is crucial, especially for profile materials that can't twist or tolerate excessive stress.

COMMON PROBLEMS IN WINDING & SPOOLING

- Material tension control
- Setting proper dwell points
- Overtravel and undertravel ("dog-bone" spools)
- Inadequate or excess stress on the spooling material
- Tapered patterns with low friction material
- Tapered patterns wound onto cylindrical cores

SMARTMOTOR™ SOLUTIONS

- Specialized commands for winding applications
- Reduced total cabling costs
- Easily add additional axes
- Auto-reversing electronic gearing
- Closed-loop system control
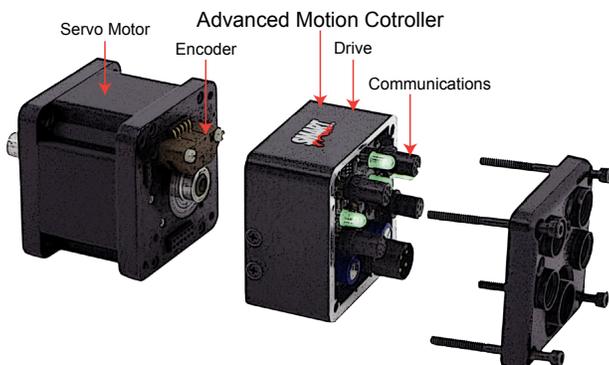
Precision Winding Applications:

- Fiber optic material
- Thread and yarn
- Paper, film and foil
- Medical catheters
- Microphone coils
- Copper and other wire
- Guitar strings
- Edge-wound voice coils
- Tape
- Filter media for sub-micron sized filter elements

Servo Motor
Advanced Motion Cotroller
Encoder
Drive
Communications

Define absolute or relative position control settings for

- Traverse points
- Spool widths
- Dwell points
- Slew

SOLUTION TO OVERTRAVEL AND UNDERTRAVEL

Problem
In winding towards one end of the spool, the traversing mechanism decelerates as it nears the flange to prevent collision. This deceleration causes material to build up faster on either end than across the middle, creating a dog bone shape that's wider at the two ends of the spool than it is in the middle.

SmartMotor Solution
To avoid a dog bone spool, use SmartMotor MFLTP and MFHTP commands to set traverse points slightly less than the length of the spool between the flanges. Dwell distance can also be set to cause the traverse mechanism to wait a certain amount of time at each end before changing direction. This allows material to fill into the gap between the flange and the set spool length.

With the SmartMotor you can...
Set gear ratios to change angle of wind using **MFMUL** and **MFDIV** commands
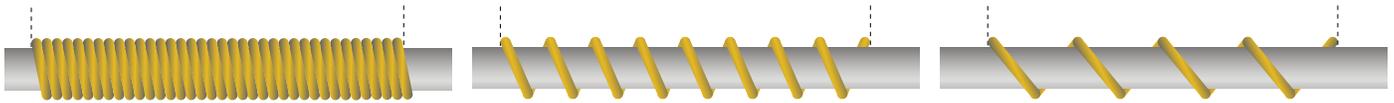
Set high and low traverse points to change spool width and position using **MFLTP** and **MFHTP** commands
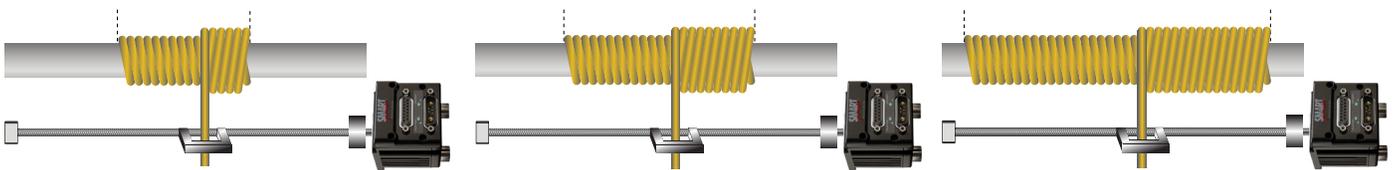
PROGRAM TAPERED WIND PATTERNS ONTO CYLINDRICAL CORES

Problem
Tapered wind patterns prevent the material from getting hung up while unwinding when it can only be pulled from the spool in a direction parallel to the spool's core. However, tapered steel cores cost more than cylindrical cores and complicate the winding process due to material slip. When using a tapered core for winding low-friction material, the material tends to slip to the smallest end of the core regardless of the tension level.

In addition, when creating a wind pattern where the core is straight but the exterior shape of the finished spool is tapered, traverse points are often difficult to program and control, resulting in poor wind quality.
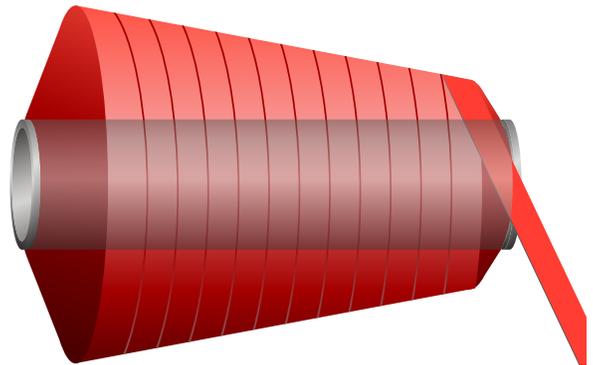
SmartMotor Solution
A program must be written that first builds a taper pattern onto the straight spool. As material is added, the wind width is then decremented in from one end to create the base taper layer. After the taper pattern is created, the material is traversed the full length of the spool. Because each wire revolution sits between the grooves of the previously wound layer, the tapered pattern remains intact without material slip.

A tapered wind pattern on a cylindrical core can be accomplished with an encoder to track angular position of the main spool, a screw-driven actuator to traverse the wire guide, and Moog Animatics Class 5 SmartMotors enhanced with the latest firmware. The Moog Animatics motion control system can be programmed to calculate the traverse speed by electronically gearing the spool encoder to the traverse axis.

SPOOL WINDING PATTERNS

Level Wind
The turnaround ends of each layer are at the same point
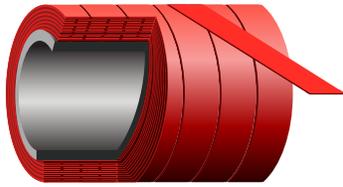
Tapered Wind On Cylindrical Core
(See previous page)
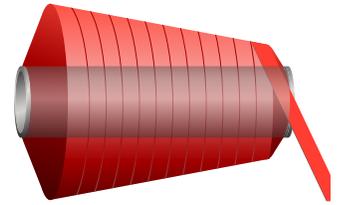
Index Wind
Programmed stacked lanes with precise programmed index to the adjacent lane also called step wind

Taper Wind
Each traverse layers a programmed amount from the edge to form a partial pyramidal shape
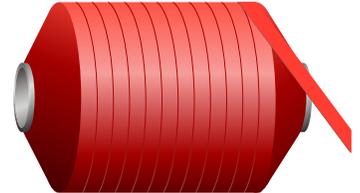
Reverse Taper Wind
(Inverse of taper)
Requires specially flanged reels
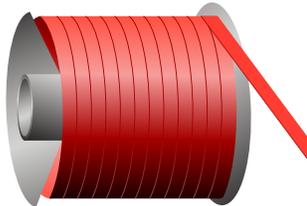
Virtual Flange Wind
Index wind pattern on the ends with level wind between ends
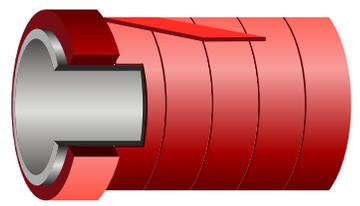
SPECIALTY WINDING PATTERNS INCLUDE:

- Step winding
- Lap winding
- Tapered winding on straight cores

- Variable pitch winding
- Auto-adjusted winding for variable width product

GAPLESS WINDING FOR IRREGULAR MATERIAL WIDTH
*Encoder Count Shift, Master Feed Rate Override*

The **ECS**(value) command automatically and immediately adds the *value* to incoming master counts as if the master counts had an instantaneous change in value. When issued, it's dynamic and immediate, not buffered, and no **G** command is required.

This command works on top of any gearing or camming mode. It has an intended, specific purpose and isn't suggested unless absolutely required. It is designed to account for changes in material width in a traverse and take-up winding application to allow for full packing of material onto spools.

This can be accomplished with hardware that dynamically detects material width as close as possible to where it is being wound onto the master spool, as shown in the adjacent figure.

The sensor reads material width and, through proper programming, the user can scale that material width input to encoder counts to dynamically shift the traversing slave (gearing) motor forward or backward in real time. Proper use of the **ESC** command along with Absolute Traverse Mode allows the user to maintain proper traverse points at each end of the spool while adjusting for variation in material width.
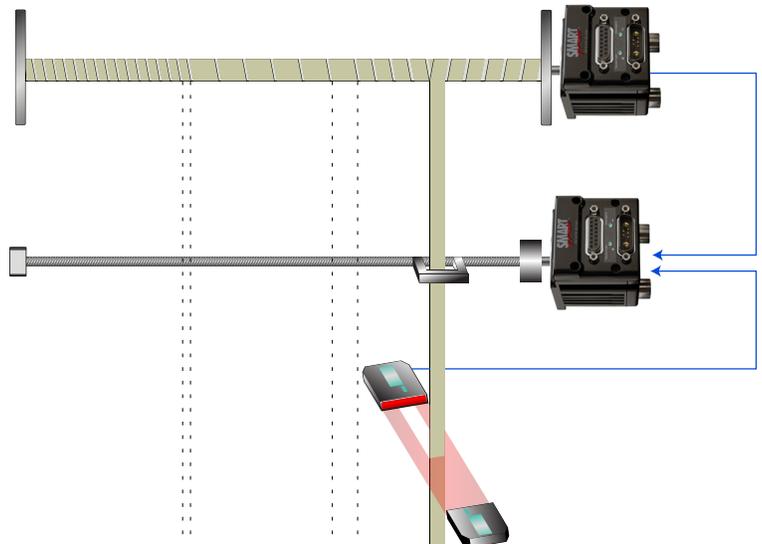
SMARTMOTOR WINDING COMMAND OVERVIEW

MFLTP	Mode Follow, Low Traverse Point, sets low traverse point <=MFHTP
MFHTP	Mode Follow, High Traverse Point, sets high traverse point >=MFLTP
MFCTP (*arg 1, arg 2*)	Sets control information for traverse mode
MFL (*dist, arg*)	Sets ramp distance at low travel end in traverse mode, arg 0=master, arg 1=slave
MFH (*dist, arg*)	Sets ramp distance at high travel end in traverse mode, arg 0=master, arg 1=slave
ECS (value)	Adds a one-time value of encoder counts to incoming master encoder counts

SAMPLE CODE

The following sample code demonstrates the use of the **MFSDC** (Mode Follow Slew Dwell Control) command. This example shows how the **MFSDC** command can be applied to a spool winding program to automatically perform a traverse profile across a spool with a user-defined dwell at the end for a specific input distance. This continues as long as the master encoder signal from the main spool is moving or until the motor is commanded to stop.

```
MFL (1000, 1)        ' Lower-end ramp
MFH (1000, 1)        ' Higher-end ramp
MFLTP=-1000          ' Lower traverse point (low  end of spool)
MFHTP=1000           ' Higher traverse point (high end of spool)
MFMUL=1              ' Ratio, multiplier for wind angle
MFDIV=1              ' Ratio, divisor for wind angle
MFSDC (4000, 2)      ' Dwell=4000, 2=active traverse mode
MFR                  ' Enable follow mode
G                    ' Begins move
```

After it's set up, the firmware controls the winding operation in the background, which allows user programs to run separately from the motion profiles. **This is SmartMotor multitasking at its best!** Because gearing can be run in the second trajectory move generator, you can also make position or velocity moves on top of traversing to allow for lap and step winding.

INDUSTRIES AND APPLICATIONS REQUIRING WINDING CAPABILITIES

INDUSTRY	*APPLICATION*
Semiconductor/Photonics	Fiber optic cable and wire manufacturing
Sound Engineering/Music	Edge wound voice coils
Medical	Microphone coils
Industrial	Catheter manufacturing
Textile	Copper wire
Telecommunications	Thread and yarn production
Filter Production	Cable winding
	Filter media for submicron sized filter elements

Contact us today for assistance with your motion control application.

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