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 recently developed **new commands specifically for the winding industry**.

The integrity of a spool of any material is primarily based on the wind pattern and proper tension control used 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 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
- Over-travel and under-travel ("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

**Define absolute or relative position control settings for**

- Traverse points
- Spool widths
- Dwell points
- Slew

All integrated motor products made by Moog Animatics are covered by patent number 5,912,541.
**SOLUTION TO OVER- AND UNDER-TRAVEL**

**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 heading back the other 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 & low traverse points to change spool width and position using MFLTP and MFHTP

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**PROGRAM TAPERED WIND PATTERNS ON CYLINDRICAL CORES**

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. 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.

**Problem**
In addition, when creating a wind pattern where the exterior shape of the finished spool is tapered while the core was straight, traverse points are often difficult to program and control, resulting in a poor-quality wind.

**SmartMotor Solution**
A program must be written that will first build a taper pattern onto the straight spool. As material is built up, the wind width is decremented in from one end to create the base taper layer. Once the taper pattern had built up, the material is traversed the full length of the spool. Since each wire revolution sits in between the grooves of the previously wound layer, the tapered pattern will remain intact without the material slipping.

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.
**Level Wind**
The turnaround ends of each layer are at the same point.

**Index Wind**
Programmed stacked lanes with precise programmed index to the adjacent lane also called step wind.

**Reverse Taper Wind**
(Inverse Of Taper)
Requires specially flanged reels.

**Taper Wind**
Each traverse layers a programmed amount from the edge to form a partial pyramidal shape.

**Virtual Flange Wind**
Index wind pattern on the ends with level wind between ends.

**Specialty Winding Patterns Include:**
- Step winding
- Lap winding
- Tapered winding build up 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) will automatically and immediately add the ‘value’ to incoming master counts as if the master counts actually had a jump change in value instantaneously. When issued it’s dynamic and immediate, not buffered and no G command is required.

This command will work on top of any gearing or camming mode. It has an intended, specific purpose and isn’t suggested unless absolutely required. The purpose is to account for changes in material width on a traverse and take-up winding application to allow for full pacing 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.

In the diagram to the right, 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 backwards in real time. Proper use of the ESC command along with Absolute Traverse Mode will allow the user to maintain proper traverse points at each end of the spool while adjusting for material width variances.
SAMPLE CODE

The below 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 profile back and forth across a spool with a user defined dwell at the end for a specific span of input distance. This will continue as long as the master encoder signal from the main spool is moving or until the motor is told 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.

Once set up, the firmware controls the winding operation in the background, allowing user programs to be running completely separate from the motion profiles. This is SmartMotor multitasking at its best. Since 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 as well.

INDUSTRIES AND APPLICATIONS REQUIRING WINDING CAPABILITIES

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Contact us today for assistance with your motion control application.