

## Motor Selection Process

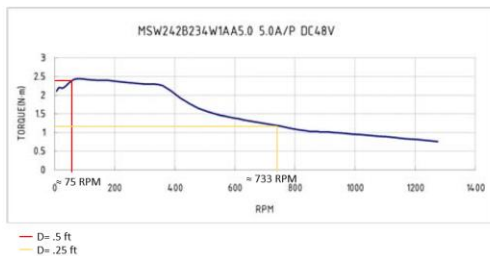
### Friction Calculations

- $\rho_{PVDF}$  ranges from 1.82 to 4.68  $\frac{lbm}{ft^3}$  Assume higher
- $L_{spool} = 120 \text{ ft}$
- $A = \frac{\pi((D_o)^2 - (D_{in})^2)}{4} = \frac{\pi((3/12)^2 - (1.5/12)^2)}{4} = .0368 \text{ ft}^2$
- $V = A * L_{spool} = 4.416 \text{ ft}^3$
- $m_{spool} = V * \rho_{PVDF} = 4.416 \text{ ft}^3 * 4.68 \frac{lbm}{ft^3} = 20.67 \text{ lbm}$
- $\mu_s = .23, \mu_d = .17$  PVDF to Steel friction from Kynar
- $F_{motor} > F_{friction} = \mu_s * N = .23 * 20.67 \text{ lbm} * 1 \frac{lb_f}{lb_m} = 4.75 \text{ lb}_f$

### Torque and Recommended Motor

- Assuming a diameter of 1, .5 and .25 ft
- $\tau_{1} = 4.75 \text{ lb}_f * .5 \text{ ft} * 1.5 \text{ (error factor)} = 3.56 \text{ ft-lb}_f = 4.82 \text{ N-m}$
- $\tau_{.5} = 1.78 \text{ ft-lb}_f = 2.41 \text{ N-m}$
- $\tau_{.25} = .89 \text{ ft-lb}_f = 1.205 \text{ N-m}$
- Based on this is recommend the NEMA 24 Stepper Motor [MSW242B234W1AA5.0](#) or the NEMA 34 Stepper Motor [MSW342B244W1AA6.0](#) depending on the diameter of the driving wheel

NEMA 24 Torque vs Speed chart



NEMA 34 Torque vs Speed chart

