

4x4 State Transition Criteria

First we define Drive pressure, *drivepress*, as the pressure in the compartment which drives eversion. This is compartment 1 for the 1-compartment model and compartment 2 for the 2-compartment model. We then test some state variables to determine four boolean state transition conditions:

```

LoPress = drivepress < Pth1
HiPress = drivepress > Pth2
SlackGro = abs( th_dot - rReel*2*Ldot) < epsilon
noSlack = Lc < epsilon

```

LoPress and **HiPress** determine when the eversion process stops and starts respectively. **SlackGro** and **noSlack** define conditions for when material crumples inside the housing between the reel and the eversion tube.

We then construct a table determining all transitions between the four possible states (Table 1).

To: From:	Growing-Taut	Growing-Slack	Stuck-Taut	Stuck-Slack
	0	1	2	3
0		SlackGro	LoPress	LoPress and SlackGro
1	$L_c < \epsilon$		LoPress and noSlack	LoPress
2	HiPress	HiPress and SlackGro		SlackGro
3	HiPress and $L_c < \epsilon$	HiPress		

Table 1: 4x4 state transition diagram determining growing or stuck and taut or slack substates. State in each row makes transitions to column state when conditions in each cell are met. Blank cells indicating in the same state.

1 Tubing Resistance

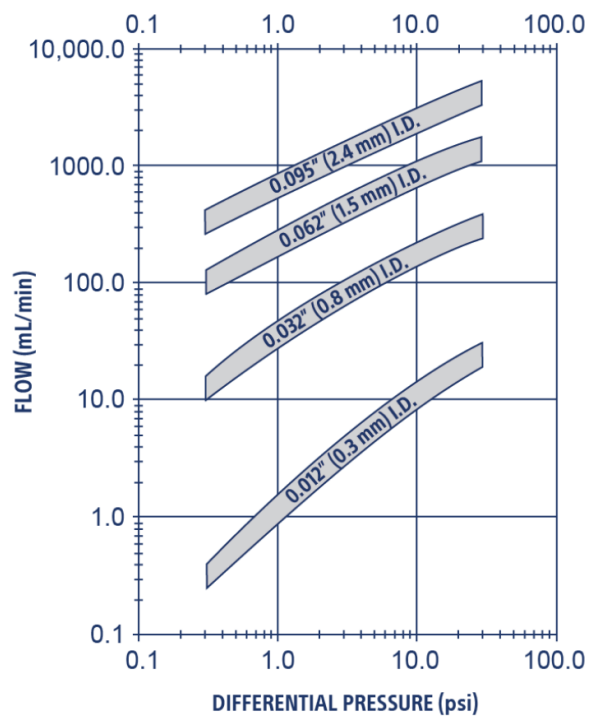


Figure 1: source: The Lee Company
<https://www.theleeco.com/support-resources/engineering-tools/reference-information/tubing-flow/>