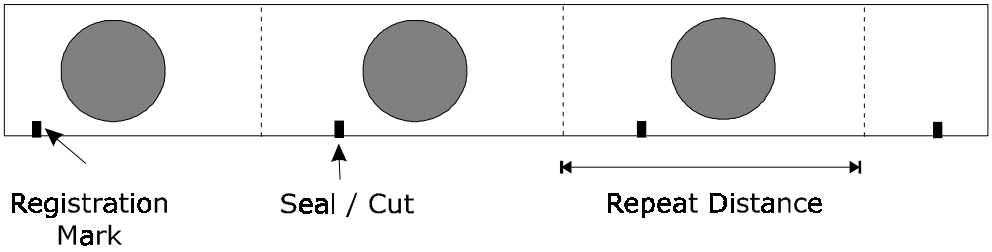
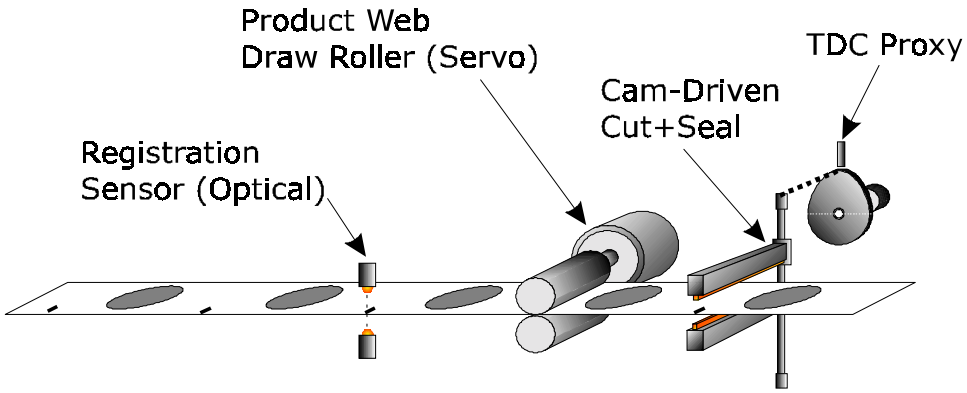
Plastic Bag Manufacturing

A continuous 'tube' of plastic film is to be formed into bags by sealing and cutting the tube at the required bag size. The film is pre-printed with a custom logo including a registration mark at a known fixed pitch equal to the bag size.



The MC2xx controls two servo axes. One drives a mechanical cam to seal and cut the end of the bag. The other drives the pinch-roller mechanism to feed the film.



The machine timing is determined by the action of the seal/cut arrangement and the film feed can only occur when then sealer is clear of the plastic film, which is between 180 and 360 degreed on t he cam. As the gearing of cam-driven sealer is not exact, we need to zero the encoder count once per revolution. A proximity sensor is mounted at TDC to do this.

Solution

In this type of application, the registration control works by measuring any error on the current move, and applying a correction to the next. The correction will typically be a proportion of the measured error, in our example 0.4 - this is in effect a proportional gain on the registration and is necessary to prevent over-correction causing an instability in the draw.

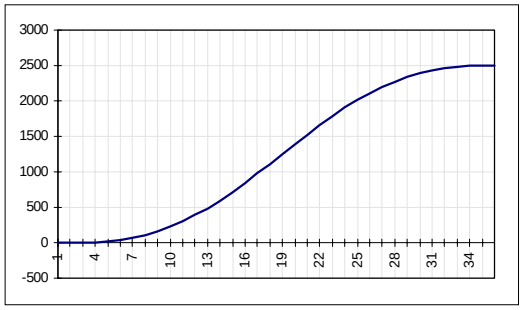
Code Example

```
init:
   BASE(ax_draw)

mainlp:
   BASE(ax_seal)
   REGIST(3)
   WAIT UNTIL MARK
   OFFPOS = -REG_POS

   BASE(ax_draw)
   REGIST(3)
   MOVELINK(draw_length+reg_adjust,180,30,30,ax_seal,2,180)
   WAIT UNTIL MARK or MTYPE=0
   IF MARK THEN
      ‘ Reg mark seen, calculate error
      reg_err=expected-REG_POS
      reg_adjust=reg_err*0.44 ‘ Adjust by reg.‘gain’
   ELSE
      ‘ Did not see reg mark
      reg_misses=reg_misses+1
      IF reg_misses>max_reg_misses THEN GOTO reg_failed
   ENDIF
GOTO mainlp
```

Our simple example above uses a MOVELINK command to feed the product through the seal mechanism. this is fine where speed is not a major factor, however the trapezoidal move profile is not the most suitable for very high speed applications where an ‘S’ ramp profile would be more suitable. The following example demonstrates how a software cam profile can be used to achieve this.



This example shows an ‘S’ ramp cam scaled to a total movement of 2500 edges . When using a CAM we use the TABLE to define the shape of the cam profile. The actual move is then achieved with a CAMBOX command.

The CAMBOX provides us with a vary flexible approach in that we only need to define the shape of the cam, the scaling is continuously variable by simply changing the value of the SCALE parameter.

‘S’ Profile

The above profile is very simple to calculate. It is generated by subtracting a sin profile from a simple linear ratio.

For the sin part of the equation, it is simplest to consider the cam over 360º. The equation would therefore be:

$$cam\_point = \left(\frac{angle}{360} \times cam\_scale \right) - \left(SIN(ang) \times \text{'S'scale} \right)$$

linear part - sin profile

The example graph above was generated in a spreadsheet using this same equation with 37 points from 0-360º in 10º increments. The value of cam_scale was 2500 and s-scale was 400. (16% of the cam scale is the maximum achieved before negative values are generated). A spreadsheet is a useful tool to visualise the profile as the results can be seen immediately.

The following code sample demonstrated the same equation implemented in TrioBASIC, to fill the first 37 locations in the TABLE memory. Note the use of a scaling constant **DEGRAD** to convert the angles from degrees into radians, which are required by the SIN finction.

CODE EXAMPLE

```
filltable:
  degrad=2*PI/360
  cam_scale=2500
     s_scale=cam_scale*0.16

  FOR ang=0 TO 360
      cpoint=INT((ang/360*cam_scale)- SIN(ang*degrad)*s_scale))
       TABLE(ang/10,cpoint)
  NEXT ang
```

This can be tested in Motion Perfect with the Oscilloscope tool, the above code generated the profile shown below left. Note that the scope channel 4 is used to display **table** values. The range is defined in the configuration settings, below right: