

# PID TUNING CALCULATOR (STEP TEST AND ULTIMATE GAIN)

Project: TIC 2101 reactor temperature

Calc no: CALC TUNE 001 Rev: 0

Yellow cells: enter data. Grey cells: calculated automatically. Free template from [instrumentationblog.in](http://instrumentationblog.in)

## Step test (first order plus dead time)

|                                  |     |                            |   |
|----------------------------------|-----|----------------------------|---|
| Process gain K (% PV ÷ % output) | 1.5 | Time constant $\tau$ (min) | 4 |
| Dead time $\theta$ (min)         | 1   | Lambda $\lambda$ (min)     | 4 |

## Ultimate gain test (optional)

|                  |   |                          |   |
|------------------|---|--------------------------|---|
| Ultimate gain Ku | 4 | Ultimate period Pu (min) | 2 |
|------------------|---|--------------------------|---|

## Controller settings (ideal form, times in minutes)

| Method             | Gain Kc | Proportional band (%) | Ti (min) | Reset (repeats/min) | Td (min) |
|--------------------|---------|-----------------------|----------|---------------------|----------|
| ZN open loop P     | 2.667   | 37.5                  |          |                     |          |
| ZN open loop PI    | 2.400   | 41.7                  | 3.330    | 0.300               |          |
| ZN open loop PID   | 3.200   | 31.3                  | 2.000    | 0.500               | 0.500    |
| Cohen–Coon PI      | 2.456   | 40.7                  | 2.196    | 0.455               |          |
| Cohen–Coon PID     | 3.722   | 26.9                  | 2.233    | 0.448               | 0.348    |
| Lambda PI          | 0.533   | 187.5                 | 4.000    | 0.250               |          |
| IMC PID            | 0.667   | 150.0                 | 4.500    | 0.222               | 0.444    |
| ZN closed loop PI  | 1.800   | 55.6                  | 1.667    | 0.600               |          |
| ZN closed loop PID | 2.400   | 41.7                  | 1.000    | 1.000               | 0.250    |

Ziegler–Nichols and Cohen–Coon give fast, oscillatory responses (quarter decay). Lambda and IMC give smooth, robust loops; choose  $\lambda$  between  $\tau$  and  $3\tau$ , and at least  $3\theta$ . Convert to your controller's form (series or parallel) if it is not ideal.

| Tuned by   | Approved by |
|------------|-------------|
| Name:      | Name:       |
| Signature: | Signature:  |
| Date:      | Date:       |