Cohen–Coon PI and PID Tuning

PI and PID settings by the Cohen–Coon open-loop rules from the process gain, time constant and dead time of a step test (first order plus dead time).

Method: G.H. Cohen and G.A. Coon; Theoretical consideration of retarded control; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Process gain (change in output / change in controller output)	2.0000	
Process time constant	60.000	s
Dead time	10.000	s

Calculated results

Parameter	Value	Unit
PI controller gain	2.7417	
PI integral time	24.730	s
PID controller gain	4.1250	
PID integral time	23.023	s
PID derivative time	3.5294	s

Notes for this case

- Cohen–Coon settings are aggressive (quarter-decay); many engineers start with half the gain.

Formula and method

$$\text{PI}: \quad K_c = \frac{\tau}{K_p \theta}\left(0.9 + \frac{\theta}{12\tau}\right), \quad T_i = \theta\,\frac{30 + 3\theta/\tau}{9 + 20\theta/\tau}$$

$$\text{PID}: \quad K_c = \frac{\tau}{K_p \theta}\left(\frac{4}{3} + \frac{\theta}{4\tau}\right), \quad T_i = \theta\,\frac{32 + 6\theta/\tau}{13 + 8\theta/\tau}, \quad T_d = \frac{4\theta}{11 + 2\theta/\tau}$$

Variables

K_p	Process gain (change in output / change in controller output)	-
τ	Process time constant	s
θ	Dead time	s
$K_{c,PI}$	PI controller gain	-
$T_{i,PI}$	PI integral time	s
$K_{c,PID}$	PID controller gain	-
$T_{i,PID}$	PID integral time	s
$T_{d,PID}$	PID derivative time	s

Method and standards

Cohen–Coon process reaction curve rules.

Assumptions and limits

- Self-regulating first-order plus dead-time process; θ/τ outside about 0.1 to 1 is flagged.
- PID settings for the ideal (parallel, ISA standard) form K_c[1 + 1/(T_i s) + T_d s]. A series (interacting) controller needs its settings converted.

References

- G.H. Cohen and G.A. Coon
- Theoretical consideration of retarded control
- Trans. ASME 75 (1953) 827

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/instrumentation/control-loops/cohen-coon-tuning

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.