

## PID CONTROL

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**Keywords:** feedback control, proportional, integral, derivative, reaction curve, process with self-regulation, integrating process, process model, steady-state error, overshoot, decay ratio, rise time, settling time, gain margin, phase margin, action mode, ultimate sensitivity test, step response test, Ziegler–Nichols’ tuning methods, Chien–Hrones–Reswick’s tuning method, modulus-optimum tuning method, symmetrical-optimum tuning method, anti-windup, two-degrees-of-freedom controller

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### Summary

The PID controller which consists of proportional, integral and derivative elements, is widely used in feedback control of industrial processes. In applying PID controllers, engineers must design the control system; that is, they must first decide which action mode to choose and then adjust the parameters of the controller so that their control problems are solved appropriately. To that end, they need to know the characteristics of the process. As the basis for the design procedure, they must have certain criteria to evaluate the performance of the control system. The basic knowledge about those topics is summarized in this article.

### 1. Introduction

“PID” is an acronym for “proportional, integral, and derivative.” A PID controller is a controller that includes elements with those three functions. In the literature on PID controllers, acronyms are also used at the element level: the proportional element is referred to as the “P element,” the integral element as the “I element,” and the derivative element as the “D element.” The PID controller was first placed on the market in 1939 and has remained the most widely used controller in process control until today. An investigation performed in 1989 in Japan indicated that more than 90% of the controllers used in process industries are PID controllers and advanced versions of the PID controller.

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