Rough Guide of DCS and Measurement (e.g. Wireless) Sample Times for Loops

Type of Process Loop	Process Deadtime	Process Time Constant	Practical Sample Time	Ultimate Sample Time
Pipe Liquid Flow	0.05 - 0.5 sec	0.5 - 5 sec	2 sec	0.1 sec
Pipe Gas Flow	0.1 - 0.5 sec	1 - 10 sec	1 sec	0.1 sec
Pipe Liquid Pressure*	0.05 - 0.5 sec	0.2 - 1 sec	0.1 sec (VFD)	0.02 sec (VFD)
Column Pressure!	1 - 10 sec	10 - 100 sec	10 sec	1 sec
Furnace Pressure*	0.1 - 0.5 sec	0.2 - 20 sec	0.1 sec (VFD)	0.02 sec (VFD)
Vessel Pressure!	0.2 - 1 sec	10 - 100 sec	10 sec	1 sec
Surge Control*	0.05 - 0.5 sec	0.2 - 10 sec	0.1 sec (Boosters)	0.02 sec (Boosters)
Liquid Level!	0.05 - 0.5 sec	10 - 100000 min	300 sec	60 sec
Exchanger Temperature	0.2 - 2 min	0.5 - 5 min	10 sec	2 sec
Batch Temperature!	1 - 10 min	5 - 100000 min	150 sec	30 sec
Runaway Temperature!	0.5 - 5 min	1 - 100 min	10 sec	5 sec
Column Temperature	2 - 100 min	10 - 1000 min	300 sec	60 sec
Furnace Temperature	0.2 - 2 min	0.5 - 5 min	10 sec	2 sec
Vessel Temperature	1 - 10 min	5 - 50 min	150 sec	30 sec
Column Composition	1 - 50 min	10 - 1000 min	300 sec	60 sec
Furnace Oxygen	0.2 - 1 min	0.2 - 1 min	10 sec	2 sec
Vessel Composition	0.5 - 5 min	5 - 50 min	150 sec	30 sec
Inline (Static Mixer) pH	2 - 10 sec	2 - 10 sec	2 sec	0.5 sec
Vessel pH	0.5 - 5 min	1 - 50 min	30 sec	5 sec

Practical sample time is for typical slow tuning and **ultimate** sample time is for fastest possible tuning and is approximated as 1/10 the sum of the minimum total loop deadtime and minimum process time constant

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Table Notes

• - denotes loop uses a variable frequency drive or a positioner with tuned volume boosters so that the deadtime, deadband, and resolution limit of the final element is negligible. If a conventional control valve or damper is used for these loops, you can multiply the sample times for asterisked items by a factor of 5. The 0.02 sec sample time is equivalent to an analog device.

! - denotes an integrating response whose integrating process gain is the inverse of the process time constant shown

!! - denotes a runaway response that can accelerate and reach a point of no return

For surge control, it assumed that a volume booster has been added to the each of the positioner outputs to reduce the pre-stroke dead time to less than 0.2 seconds. A valve with excessive sticktion and backlash will add significant deadtime to the response to unmeasured disturbances that deteriorates the ultimate limit to possible performance.

For inline (static mixer) pH control, the largest time constant comes from the sensor lag or the process variable filter time with a nominal value of 5 seconds.

For the vessel pH control it is assumed the mixing time is less than 30 sec and the reagent delivery time delay is negligible by injection of the reagent into a recirculation line just before it enters the vessel. The lower value for the time constant is for a set point on a steep titration curve that cause the pH to move much faster than for a linear response. The response can look like a runaway as the pH accelerates through the neutral region.

For level control set point changes, the deadtime observed is usually about 10 times larger than the actual process deadtime due to level measurement sensitivity limits and noise. For unmeasured disturbances the deadtime observed is often about 20 times larger than the actual process deadtime because of the amount of time it takes the slowly changing controller output to get through the resolution limit and deadband of the control valve.

The loop should be closely monitored and tested for any increase in sample time.