ABOUT THE PRE-DEFINED PROCESS MODELS

The following process models are furnished with the software:

Generic - This is a generic linear process model which is compatible with all control strategies. The process variable and load ranges are in the English system of engineering units. The engineering units designations and the controller name are indicative of a temperature process.

The following table gives the output variables, process variables and loads which are used for various control strategies:

Control Strategy	PV-1	PV-2	PV-3	PV-4	Out-1	Out-1	Load-1	Load-2
Feedback	PV	Monitor	Monitor	Load 1	Control	Not used	Load	Not used
Dual Feedback	Cont #1	Monitor	Cont #2	Load 1	Control	Not used	Load 1	Load 2
Ratio	Monitor	PV	Monitor	Load 1	Control	Not used	“Wild”	Not used
Cascade	Pri PV	Sec PV	Monitor	Monitor	Sec Out	Not used	Pri Load	Sec Load
Feedforward-Add	Pri PV	Sec PV	Monitor	Monitor	Sec Out	Not used	Pri Load	Sec Load
Feedforward-Mult	Pri PV	Sec PV	Monitor	Monitor	Sec Out	Not used	Pri Load	Sec Load
Override	Pri PV	Monitor	Aux PV	Load 1	Lower	Not used	Load	Not Used
Decoupling-Fwd	Cont #1	Monitor	Cont #2	Load 1	Cont #1	Cont #2	Load 1	Load 2
Decoupling-Inv	Cont #1	Monitor	Cont #2	Load 1	Cont #1	Cont #2	Load 1	Load 2
Smith Predictor	PV	Monitor	Monitor	Load 1	Control	Not used	Load	Not used
Mod Smith Predictor	PV	Monitor	Monitor	Load 1	Control	Not used	Load	Not used
Internal Model Cont	PV	Monitor	Monitor	Load 1	Control	Not used	Load	Not used
Dahlin’s Algorithm	PV	Monitor	Monitor	Load 1	Control	Not used	Load	Not used

While the Generic model is compatible with all control strategies, it is not as suitable for demonstrating some process phenomena and control strategies. The model exhibits considerable interaction between PV-1 and PV-3, therefore it is very appropriate for demonstrating forward and inverted decoupling. For this same reason, it may not be satisfactory for use with the Dual Feedback control strategy; Generic1 model would be more appropriate for that purpose.

For demonstrating Ziegler-Nichols open and closed loop tuning, the Generic model will not yield similar tuning parameters for the two methods. While that may be a realistic situation, if comparable results from the two methods are desired, one should use Generic2 model.

> ***Generic** is used in Laboratory Exercises 1, 8, 9, 10, 19, 20, 21, and 22. Also by Feedback.stg, Feedback1.stg, Cascade.stg, Override.stg, DecupFwd.stg, DecupInv.stg, SmithPrd.stg, ModSmPrd.stg, IMC.stg and Dahlin.stg.*

Generic1 - This model is similar in structure to Generic, consequently is compatible with all control strategies. The process dynamics are different from Generic, however. The process variable and load ranges are in the SI system of units. Engineering units designations and controller names are indicative of a temperature process.

There is only slight interaction between PV-1 and PV-3, therefore, this model is suitable for demonstration of the Dual Feedback control strategy.

> ***Generic1** is used in Laboratory Exercise 1 and by DualFdbk.stg.*

Generic2 - This model is similar in structure and nomenclature to Generic. The dynamic properties have been chosen so as to yield comparable results when demonstrating open loop and closed loop Ziegler-Nichols tuning. Note however that this may not be a realistic situation; The Generic and Genericl models, which will not result in similar tuning using the two Ziegler-Nichols methods, are probably more representative of realistic situations.

> ***Generic2** is used in Laboratory Exercises 9 and 10, and by ZN_Tune.stg.*

Generic3 – This model represents a refrigeration system providing a coolant for process or environmental control purposes. It is representative of a process with a negative process gain. Discrete controls (available through View | Discrete Controls) can shut down the refrigeration compressor. This model is compatible with all control strategies. Process variables are displayed in the English system of engineering units.

__Generic3__ is used in Laboratory Exercise 1.

Generic4 – This is a linear model, configured to be used with MPC-ControLAB. It provides 2 PVs, 2 MV's and 2 load disturbances. There is interaction between the control loops. Load-1 affects only PV-1; load 2 affects only PV-2. This is the default process model which is read when MPC-ControLAB is started.

__Generic4__ is used in Laboratory Exercise 24, and in the MPC-ControLAB exercise.

Folpdt - The First Order Lag Plus Dead Time model consists of a first order lag, followed by dead time. It can be used for demonstrating a pure form of a model based control strategy, such as Smith Predictor, Modified Smith Predictor, Internal Model Control or Dahlin's Algorithm. Compatible with Feedback and all model based control strategies.

__Folpdt__ is used in Laboratory Exercises 1 and 21.

Flow - This model is representative of a flow loop with realistic characteristics, including fast dynamics, non-linearity, measurement noise, installed valve characteristics and valve hysteresis. The loop disturbance represents variations in system pressure. The loop should be run with the "Minutes" scale for the grid. Compatible with Feedback and all model based control strategies. Not compatible with the Ratio control strategy.

__Flow__ is used in Laboratory Exercises 2 and 4.

RatioFlo - This model demonstrating a flow loop whose set point is determined as a desired ratio to a "wild" flow. The required ratio is set by the operator. The controlled flow is indicated as a steam flow loop, whereas the wild flow is assumed to be a liquid process flow stream. This process model is only compatible with the Ratio control strategy.

__RatioFlo__ is used in Laboratory Exercise 14 and by Ratio.stg.

Temp - This model is representative of temperature control of a countercurrent heat exchanger. (It uses Builder function blocks HX-1 and HX-2.) The model includes a flow loop, with the characteristics of the Flow model. This model has characteristics of many real processes, including:

Limited range of controllability
Non-linear within the controllable range
Sticking valve (may be masked by the effect of a valve positioner)
Measurement noise on the secondary PV (flow) (may be turned off)
A smaller amount of measurement noise on the primary PV (temperature) (may be turned off)

Loop disturbances include variations in process flow rate and system pressure on the heating source. Both inlet temperatures may be changed via the "Process I Change Parameters' option. Compatible with Feedback, Cascade, both Feedforward strategies and all model based Control strategies. Measurement units are in the SI system.

__Temp__ is used in Laboratory Exercise 13.

Templ - This model is identical with the Temperature model except the valve has a positioner installed, thereby eliminating the effect of a sticking valve. Also, there is less measurement noise on the secondary PV (flow) loop.

__Temp1__ is not currently used in any laboratory exercises or control strategies.

Heater - This is a model of a process heater (perhaps with exaggerated dynamics) whose process gain, dead time and time constant all vary with process flow rate. It is a good model for demonstrating the advantage of multiplicative-feedforward control over additive-feedforward control. It can also be used to demonstrate scheduled tuning, and as a general example of process characteristics.

***Heater** is used in Laboratory Exercises 5, 16 and 17, and by Ffwd_add.stg and Ffwd_mul.stg.*

Pressure - This model represents the regulation of a pressure into a vessel or piping network. As such, the predominant dynamics resemble a first order lag with no appreciable dead time. Disturbances to the loop can be supply pressure, variable by the load control buttons, and system demand, accessible through the "Process | Change Parameters!" option. The model is compatible with Feedback and all model based control strategies.

***Pressure** is used by Laboratory Exercise 6.*

Pressur1 – This model represents a relief pressure controller of a process vessel. Because of greater capacity in the vessel, the dynamics are somewhat slower than in Pressure model. In addition, this model demonstrates the use of a fail-open valve, the need to reverse the output signal (similar to that of many DCS) and to properly select the reverse-direct acting function of the controller. The model is compatible with Feedback and all model based control strategies.

***Pressur1** is used by Laboratory Exercise 6.*

Level - This model represents an open vertical tank with a varying inflow rate and a controlled outflow. It is compatible with Feedback, Cascade and both Feedforward control strategies. Technical data for the tank simulation:

Diameter:	3.0 feet
Level measurement range (0 – 100%):	5.0 feet
Maximum inflow and outflow:	40 gpm

***Level** is used in Laboratory Exercises 7 and 12.*

Level2 – This model is similar to Level, except that it has an accessible parameter (lead time of a lead-lag block) whose sign can be changed, thereby demonstrating the inverse response associated with boiler drum level "shrink and swell." It is compatible with Feedback, Cascade and both Feedforward control strategies.

***Level2** is used in Laboratory Exercises 1 and 23.*

Valve - This model simulates a bench test of a valve and actuator which is being driven by a saw-toothed signal. It permits demonstrating the valve stem movement with and without a positioner, with a sticking valve gland, and the ringing effect sometimes found in high gain positioners. All the parameters can be changed via the "Process | Change Parameters" option. Although the model does not use a feedback controller, it can be called from any control strategy.

***Valve** is used in Laboratory Exercise 3.*