Furnace Controllers

TEMPERATURE CONTROLLER SELECTION

Thermolyne

Type F1700 with CP53600

- *— Easy installation*
- *— Superior temperature control*
- *— Simple selection process*

PRODUCT DESCRIPTION

Controller Recommended Packages

Listed in the chart are the Thermolyne furnace models which require an automatic temperature controller for operation. This chart allows you to select the temperature controller that best suits your requirements. Detailed specifications on each temperature controller are found on the following page. Controllers come with appropriate thermocouple for each furnace.

FURNACE CONTROLLER SELECTION

Thermolyne Furnace Model #	Control Group B Automatic Single Set Point	Control Group C Programmable, 2 ramp and 2 dwell segments	Control Group D Programmable, 8 ramp and 8 dwell plus RS232 communication 4 stored programs
Type F1600			
FA1630 & FA1630-1	CP53610	CP53610-70	CP53640
FA1635 & FA1635-1	CP53615	CP53615-70	CP53645
FA1638 & FA1638-1	CP53610	CP53610-70	CP53640
Type F1700			
FA1730 & FA1730-1	CP53610	CP53610-70	CP53640
FA1736 & FA1736-1	CP53715	CP53715-70	CP53745
FA1738 & FA1738-1	CP53610	CP53610-70	CP53640
FA1740 & FA1740-1	CP53610	CP53610-70	CP53640
FA1746 & FA1746-1	CP53715	CP53715-70	CP53745
FA1748 & FA1748-1	CP53610	CP53610-70	CP53640
Type F1800			
FA1850 & FA1850-1	CP53750	CP53750-70	CP53780
3FA1850 & 3FA1850-1	CP53710	CP53710-70	CP53740
3F1856 & 3F1856-1	CP53715	CP53715-70	CP53745
3FA1858 & 3FA1858-1	CP53710	CP53710-70	CP53740
Type F31700			
F31758	CP53710	CP53710-70	CP53740
F31750	CP53710	CP53710-70	CP53740
F31756	CP53715	CP53715-70	CP53745

Furnace Controllers

TEMPERATURE CONTROL INFORMATION

Thermolyne

TEMPERATURE CONTROL: PRECISION AND ACCURACY

The temperature control system in Thermolyne furnaces consists of four major components: an analog or digital controller, a power-switching device, heating elements, and a thermocouple sensor (Figure 1). All of the Thermolyne furnace control systems are closed-loop for accuracy and safety. In a closed-loop system, the temperature sensed by the thermocouple gives a feedback signal to the controller that in turn regulates power to the heating elements by means of the switching device. The selection of components within the control loop for a particular furnace model is largely based on the desired operating temperature range and the magnitude of overall temperature error that is acceptable within that range. The overall error is defined as the difference between the set value and the actual value of the furnace chamber or load. The overall error is broken down into the precision of the temperature reading and its accuracy.

Temperature precision is largely determined by the controller. Our low cost furnaces use analog controllers and all other Thermolyne furnaces utilize microprocessor (digital) three-term controllers (Proportional + Integral + Derivative or PID). PID control is very precise in that small fluctuations in chamber temperature are quickly adjusted to maintain the set temperature. In addition, the PID type controller reaches the desired chamber temperature without "overshooting" the value. The analog control maintains the set chamber temperature nearly as precisely as the PID control but tends to overshoot the setpoint temperature at startup before stabilizing at the correct value. This is particularly important to consider if the furnace workload is sensitive to temperatures slightly above the setpoint. Temperature control in furnaces with either type of control is the most precise above 260°C. Temperature accuracy is largely determined by the position of the load within the chamber. Generally speaking the temperature is most uniform within the inner 2/3 of the chamber, therefore, we recommend keeping the load within this area when high accuracy is needed. Other factors to consider with regard to accuracy include the size and density of the material being heated and the thermal lag of the material relative to the chamber temperature. Large, dense materials will obviously require more time to reach the set temperature.

OVER-TEMPERATURE PROTECTION (OTP)

Digital controllers are designed with two types of OTP. A "full-scale high" alarm will be in effect when the furnace chamber exceeds its maximum allowable temperature. The controller will cut power to the heating elements until the chamber cools to a value below this limit. This value is defined by the heating capacity of the elements, the thermocouple, and the insulation and cannot be modified by the operator. The second type of OTP, the "deviation high" alarm is designed to protect the furnace workload and can be changed by the operator. We recommend setting this value to 20°C above the working temperature of the load.

SENSOR BREAK PROTECTION

All Thermolyne controllers provide for a safe response should there be a loss of input signal because of a broken thermocouple or an open circuit. Power to the heating elements is terminated and a message flashes on the display.

TUNING

The digital controllers can be automatically tuned to improve product or process quality. Self-tuning is a built-in software package for automatically determining the PID and other control parameter values. For maximum performance, this feature should be used the first time the furnace is used and each time the setpoint or the type of load is changed. Some controllers offer adaptive tuning for processes that frequently change due to load or setpoint changes. Adaptive tuning continuously evaluates tuning parameters and automatically installs new values if better accuracy is possible.

PROGRAMMING

Many processes require the temperature to vary according to a precise profile with time. The digital controllers allow a programmed function which is stored in non-volatile memory. Programs consist of functions and associated settings called segments. These segments can be assembled into a program in a fixed format, such as a succession of ramp/dwell pairs (Figure 2). Segments include:

Ramp: The setpoint temperature increases or decreases at a linear ramping rate until a specified target level is reached.

Step: A step is a specialized type of ramp segment where the setpoint jumps to the specified target level. It is used when the most rapid change in measured value, limited by the heating elements, is desired.

Dwell: The length of time required at a target temperature.

COMMUNICATIONS

Bi-directional digital communications via an RS-232 port is an option with select digital controllers. Eurotherm Controls has available a free demonstration program called the Communications Sampler. This program enables an IBM compatible computer to communicate with a single controller. The controller's parameters can be displayed on the screen and the value of the parameters can be changed with the computer keyboard. Two off-the-shelf software packages, Instrument Programming System (IPS) and Eurovis 3, allow the user to supervise groups of controllers, as well as retrieve data for logging and trend plots.

HOLDBACK

If the measured value lags behind the setpoint by an undesirable amount during ramp or dwell, the holdback feature can be used to freeze the program at its current state. The program will resume when the error comes within the holdback value.

GAIN SCHEDULING

Gain scheduling is the automatic transfer of control between two sets of PID values. Select digital controllers do this at a presettable measured temperature. Gain scheduling is used for difficult to control processes which show large changes in their response time or sensitivity at high or low temperatures.

Group A

Group B

Group C & D

TEMPERATURE CONTROLLER SPECIFICATIONS

Feature	Group A Single Setpoint Analog	Group B Single Setpoint Digital	Group C 8 Segment	Group D 16 Segment 4 Stored Programs
Temperature Display	Toggles between set and actual	Toggles between set and actual	Dual Display	Dual Display
Over Temperature Protection	No	Yes	Yes	Yes
Sensor Break Protection	Yes	Yes	Yes	Yes
Self Tuning	No	Yes	Yes	Yes
Adaptive Tuning	No	No	Yes	Yes
Holdback	No	No	Yes	Yes
Gain Scheduling	No	No	Yes	Yes
Communications	No	No	No	Yes

Figure 1

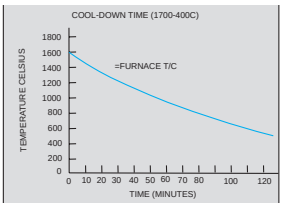
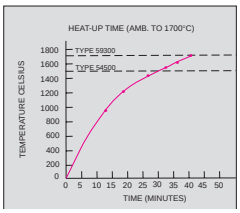


Figure 2



Furnace Controllers

TEMPERATURE CONTROLLERS

Thermolyne

Type CP3600 &
Type CP53700

ESSENTIAL CONTROLS FOR YOUR HEAVY DUTY FURNACE!

- *— Digital display of chamber temperature and set point*
- *— Adjustable programmable over temperature protection (OTP)*
- *— Thermocouple break protection*

PRODUCT DESCRIPTION

Three Control Models:

- **Group B)** Single set point digital control allows simultaneous monitoring of set point and actual chamber temperatures. Includes OTP alarm.
- **Group C)** 8 segment programmable control permits programming the rate of temperature increase and decrease (**ramp**), and length of time the temperature holds at specific levels (**dwell**).
- **Group D)** Multi-programmable 4-stored programs with 16 segments each; includes a RS232 communications port for connecting to printer or computer.
- Output power adjustment can be set from 1% to 100% for furnace operation below 260°C (500°F).
- No battery backup is required for date retention up to one year with instrument unpowered.
- Controllers can be operated in ambient temperatures of 0–50°C (32°–122°F) and field adjusted to change input type, ramp rates and dwell times.
- Group C & D controllers are self-tuning and automatically install optimum tuning parameters.
- Solid state relay to control power to furnace.
- All hardware for mounting, plus conduit and wiring to connect controller to a Thermolyne muffle furnace.

48 Hour or Sooner Express Shipping Guaranteed!*

RUSH

see inside front cover for details

PRODUCT SPECIFICATIONS

Type	Overall Dimensions Inches (cm) W	H	D	Calibrated for Thermocouple Type (Supplied with Controller)	Shipping Weight Lb. (kg)
CP53600	5.5 (13.9)	10.5 (26.6)	13.5 (34.2)	F (Plantinel II)	20.5 (9.2)
CP53700	5.5 (13.9)	10.5 (26.6)	11.5 (29.2)	F (Plantinel II)	18.3 (8.3)

ORDERING INFORMATION

Model #	Control Group	Control Circuit Voltage	Volts Load Circuit	Max Load Current	Scale Phase	Operating Temperature Range °C	US List Price
CP53610	B	208/240	208/240	35	1	0–1200	$2145.00
CP53615	B	120	120	35	1	0–1200	$2145.00
CP53610-70	C	208/240	208/240	35	1	0–1200	$2617.00
CP53615-70	C	120	120	35	1	0–1200	$2617.00
CP53640	D	208/240	208/240	35	1	0–1200	$3548.00
CP53645	D	120	120	35	1	0–1200	$3548.00
CP53710	B	208/240	100–500	50	3	0–1300	$2145.00
CP53715	B	120	100–500	50	3	0–1300	$2145.00
CP53710-70	C	208/240	100–500	50	3	0–1300	$2617.00
CP53715-70	C	120	100–500	50	3	0–1300	$2617.00
CP53740	D	208/240	100–500	50	3	0–1300	$3548.00
CP53745	D	120	100–500	50	3	0–1300	$3548.00
CP53750	B	208/240	100–500	30 + 30	1	0–1300	$2145.00
CP53750-70	C	208/240	100–500	30 + 30	1	0–1300	$2617.00
CP53780	D	208/240	100–500	30 + 30	1	0–1300	$3548.00