BETTER CONTROL OF THERMAL PROCESS UNITS

ACCURATE, FAST AND SMART

Honeywell

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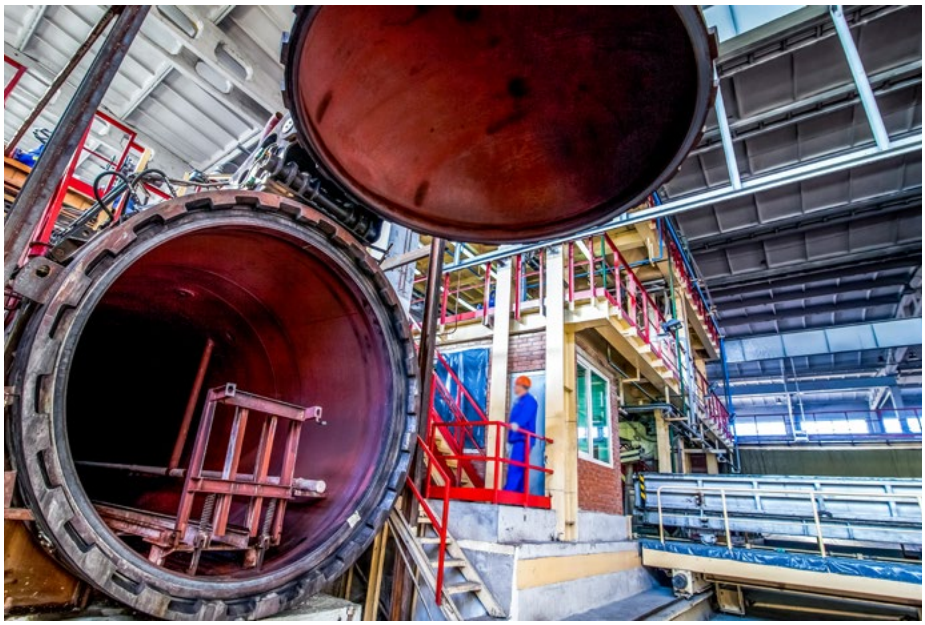
BACKGROUND

Heat-treaters, whether it is a quench furnace, cupellation furnace, atmosphere box furnace, industrial walk-in oven, or laboratory temperature chamber, always want to obtain tighter control of the process to improve process efficiency, product quality, and reduce scrap. And quick and easy start-up on configuration is also critical to them.

CHALLENGES ON THERMAL DEVICE

Customer's challenges around accuracy, configuration, reliability and tuning are increasing with rigor demand. It is worth examining each of these in turn and check out Honeywell's solution to them: UDC2800.

- The Next Step in Accuracy: AMS2750F
- Gain efficiency: Bluetooth Configuration
- Smart device: Thermocouple Health
- Automatic Tuning



AMS2750F THE NEXT STEP IN ACCURACY

1

Aerospace Material Specification 2750 (AMS 2750) is the main pyrometry specification for the calibration and testing of thermal-processing equipment. But now, AMS2750F has arrived.

Once thought of as only the specification for aerospace heat treaters and raw-material producers, AMS 2750 has crossed over to a wide range of industries. Chemical processing and coatings, medical-device manufacturers, castings and forging are just some of the applications in which AMS 2750 is the standard for testing thermal-processing equipment. Now it's had an update.

With AMS 2750F, published in June 2020 and replacing AMS 2750E, the standard's document expanded from 43 to 54 pages, added eight more definitions to bring the total to 87 and created more than double the number of tables from 11 to 25. These provided significant clarification of the requirements.

Some changes to tables have also been made. The maximum permitted offsets are now in the tables associated with the TUSs and not the tables associated with SATs as previously, for example. Numeric values are now expressed to a tenth of a degree, rather than as whole numbers, to enable heat treaters to express numeric resolution with the same precision.

The standard's requirements for calibration accuracy for controlling, monitoring or recording are found in Table 7, which sets the following limits:

- Digital instruments accuracy of +/- 2°F (+/- 1.1°C) or 0.2% of the maximum survey temperature of the equipment, whichever is greater
- Calibration interval based upon furnace class.

Temperature display increments for control, recording and over-temperature Instruments are found in 3.2.3 / 3.2.3.1 / 3.2.3.2:

- All control, recording and over-temperature instruments shall be digital.
- Digital recording instruments will have a minimum readability of 0.1°F or C.

Many furnace operators may find their existing monitoring solutions do not measure up to these new requirements.

BLUETOOTH CONFIGURATION

2

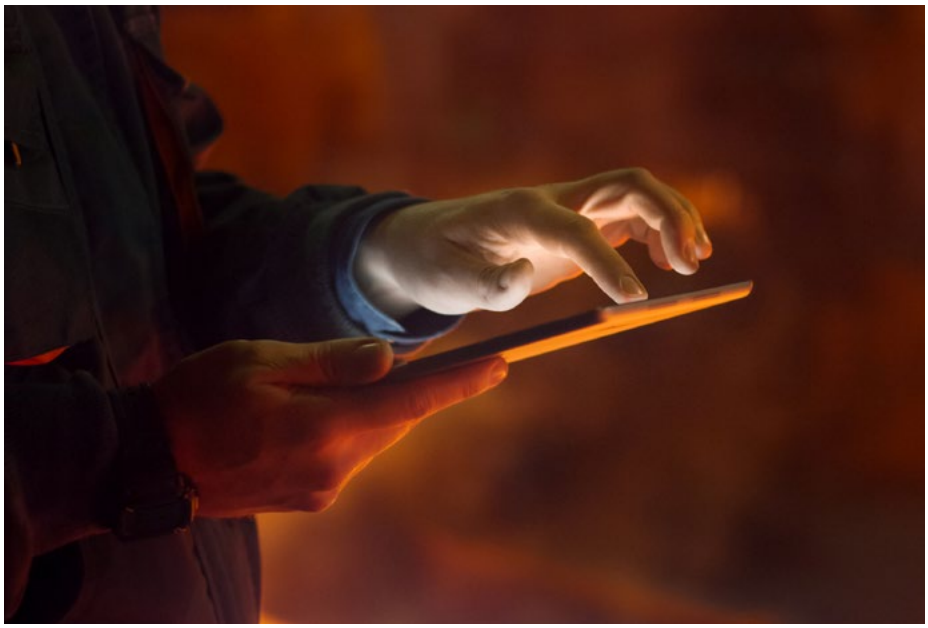
Configuration is the most important step for the controller user – and the most time-consuming.

Traditionally, configuration requires access to the back of the controller. A connection with the instrument is achieved through wiring the communication cable and then configuration from a computer using Ethernet TCP/IP or RS485 Modbus. A wiring mistake, in this case, can mean replacing the communication board.

An alternative is connecting the controller via infrared. That requires close proximity, with the configuration device having a direct line of sight with the controller. Any substantial obstruction will prevent the connection. Neither solutions is very efficient or straightforward.

Bluetooth provides a better alternative: A non-intrusive, wireless connection with the i nstrument that maintains NEMA4X and IP66 integrity. It does not require access to the back of the controller, nor any wiring, eliminating the scope for human error. It is, meanwhile, robust with substantial range and no requirement to maintain a line of sight, simplifying the task.

The technology provides a simple, modern, and secure method for quick, accurate control. Combined with modern mobile devices, it enables users to duplicate an instruments' configuration, copy and paste, upload or download new configuration in a matter of seconds, without any errors.



THERMOCOUPLE HEALTH: SMART DEVICE

3

Many operators rightly worry about the condition of the process thermocouple. They are right to do so. Repeated abuse from measuring the process variable day in and day out means thermocouples wear out. Failure can lead to costly reworks, defective products or process shutdowns.

A thermocouple comprises two metallic wires forming a junction, which generates a small voltage when heated or cooled. From the size of this voltage, the temperature is calculated.

The thermocouple is critical for monitoring thermal processes and for safe operations. The critical problem operators face is that an external examination of a thermocouple tells little about its health and how much additional life can be expected from the device. It is not unusual to run to failure.

Continuous health monitoring of the thermocouple addresses this weakness, alerting operators to potential problems before they materialize. It is done by testing the resistance of the connected thermocouple and using diagnostics firmware of to determine the condition of the thermocouple based on this.

To facilitate this, the instrument can be preset with levels relating to the health of the thermocouple, which can be used to alert the user if the thermocouple shows signs of degrading

AUTOMATIC TUNING

4

Industry surveys show that nearly half of all processes are not accurately tuned. A poorly tuned process can result in bad readings, wasted materials and downtime.

Manually tuning processes is both time-consuming and complex, however. The process may require retuning after every setpoint step change is implemented or whenever a process variable disturbance occurs. Even where it can be done, it requires time, skills and resources often in short supply.

Using a tuning algorithm and fuzzy logic in the controller, however, furnace operators can automatically and continuously retune the process whenever required. This accurately identifies and tunes any process, accelerates and simplifies start-ups, saves energy and improves throughput.

Fuzzy logic is used to suppress process variable overshoot due to setpoint changes or externally induced process disturbances. It does not change PID constants, but temporarily modifies the internal controller response to suppress overshoot to allow more aggressive tuning to co-exist with smooth process variable responses.

HONEYWELL UDC2800

5

Honeywell's Universal Digital Controller 2800 is the new generation of panel-based temperature controller. With AMS2750F compliance, Bluetooth configuration, Thermocouple Health Monitoring and Accutune III automated tuning, it's a more connected, more accurate, faster and more efficient solution to thermo process control.

UDC2800 meets all of the key challenges for thermal control. Providing remote connectivity and full-color TFT screen, it provides a range of features to accurate temperature control to meet regulatory requirements, optimize performance, ensure product quality and minimize waste.

AMS2750F READY

The UDC2800 fully meets the requirements of the new AMS2750 standard. It has two analog inputs with a typical accuracy of ±0.15% of full-scale input and a typical resolution of 16 bits. Inputs can be field calibrated to ± 0.05% of full scale. Both analog inputs are sampled ten times per second (every 100 ms).

The first, or process variable input, can be one of the various thermocouple, RTD, or linear actuations. Linear actuations have thermocouple, RTD characterization capability as a standard feature. Linear actuations also have square root capability. The optional second input is isolated and accepts the same actuations as input one.

A TFT LCD screen is dedicated to display the process variable, setpoint, output and alarm. Key selected operating parameters can be shown in the lower area of the screen. Alternate information is displayed during configuration mode. All control, recording and over-temperature instruments is digital, and the controller has a minimum readability of 0.1°F or °C.

With the necessary calibration, the UDC2800 meets both the calibration accuracy requirements of the standard in table 7, and the temperature display increments defined by clause 3.2.3 / 3.2.3.1 / 3.2.3.2.

BLUETOOTH CONNECTIVITY

Using Bluetooth, it takes less than 2 seconds with UDC2800 to upload a configuration from an instrument. This configuration file can be saved on to a mobile device for review, modification, or archiving.

The software and app included also provides important maintenance information on the controller. Users can instantly access information on the current operating parameters, digital inputs and alarm status and identify internal or analog input problems

Honeywell's EasySet configuration app provides an intuitive HMI and dashboards to quickly connect, calibrate and monitor controllers to minimize effort and errors. All connectivity are Honeywell Cyber Security Qualified.

THERMOCOUPLE HEALTH MONITORING

The UDC2800's Thermocouple Health Monitoring is a unique feature built into the instrument measurements and diagnostics. It constantly monitors the health of connected thermocouples and alerts users to potential problems before they escalate.

Checking the loop resistance at 30 seconds intervals, the controller uses this information to determine thermocouple degradation. Using preset thresholds, the thermocouple health is then categorized at one of four levels:

- Good
- Failing
- Failure Imminent
- Failed (Burn-out)

The early warning stage is designed to give the user time to change the thermocouple before it fails. During this time, the system may be working as expected, but the degradation of the thermocouple results in a rising risk of unscheduled downtime.

With continual monitoring of thermocouple health, users not avoid this, and also maximize the life of the thermocouple and minimize unnecessary replacement.

ACCUTUNE III

Honyewell's Accutune III is a plug-and-play tuning algorithm included with UDC2800. It accurately and automatically identifies and tunes any process, including integrating processes and those with dead-time. It also continually retunes in response to setpoint

step changes or process disturbance. It accelerates start-up by automatically tuning the process, boosts quality and saves energy.

Accutune III provides for two types of tuning. The first uses the setpoint (SP) value according to one of two settings:

- Cycle Tuning, which derives tuning parameter values from the process response to causing the parameter value (PV) to oscillate about an SP value. This method uses the measured ultimate gain and period to produce tuning parameter values using the relationship developed by the Ziegler-Nichols equations. It does not require an initial stable process.
- SP Tuning, based on the process response to an SP change. When initiated, a target SP value is calculated. The tuning algorithm then estimates the final output value needed to move the PV to the target value. That output value is held until the process is identified. When identification is complete, new tuning parameter values are calculated, and control is again automated based on the pre-tuning SP value.

The PV Adaptive Tuning method, meanwhile, adapts a tuned process to changing system characteristics over time. It operates by monitoring a previously tuned process for variations in the system, such as changes to the deadtime, as well as other process characteristics that can make a tuned process become unstable, unresponsive or over-responsive. In doing so it ensures tuning is maintained and drifts to variables are rapidly addressed.

Accutune III is ideal for tuning furnaces, ovens and boilers, including combustion fired as well as electrically heated processes. It can also be used to tune flow and level loops such as those found in the food & beverage, pharmaceutical and chemical industries.

CONCLUSION

Honeywell's UDC2800 provides an efficient, effective solution to monitor and control of thermal process units. It provides the connectivity required to allow easier configuration remote access, as well as the functions to ensure accuracy, reduce errors and effort and improve quality.

Thermal control for too long has either relied on basic panel-based controllers or local data acquisition systems that provide their own challenges to maintain. Local control remains a valuable tool in ensuring safe, efficient processes. However, many furnace applications could benefit from improved accuracy, quicker calibration, better diagnostics and automated tuning – as well as easier configuration remote connectivity.

To market pressures, regulatory requirements and business goals, the features of the UDC2800 are likely to become increasingly essential.

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