OMRON

Digital Temperature Controllers/ NX-series Temperature Control Unit

E5□D/NX-TC

Temperature control is moving into the era of AI.

New

The adjustments made by skilled workers are automated using AI.
The innovation of production sites has begun.

Optimal and automatic temperature control without human intervention easily achieves both productivity and quality.

Previous temperature controllers have not only required a long time for start-up settings and
variation adjustments, it has also been difficult to make the optimal adjustments without having
experience and intuition. There were therefore some effects on quality.
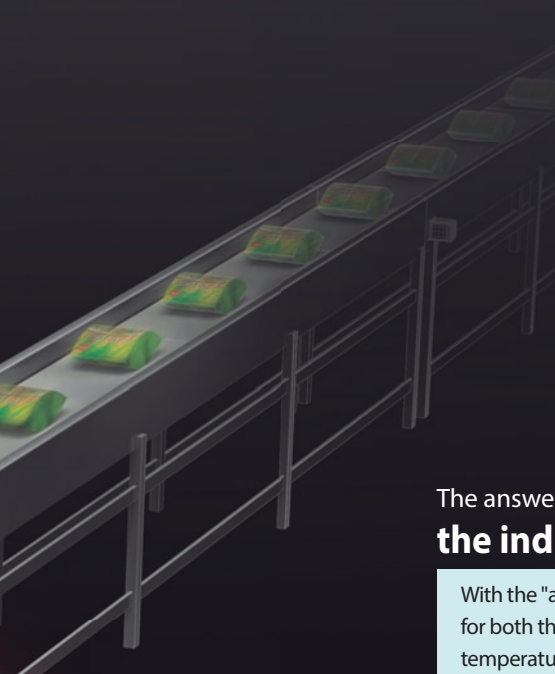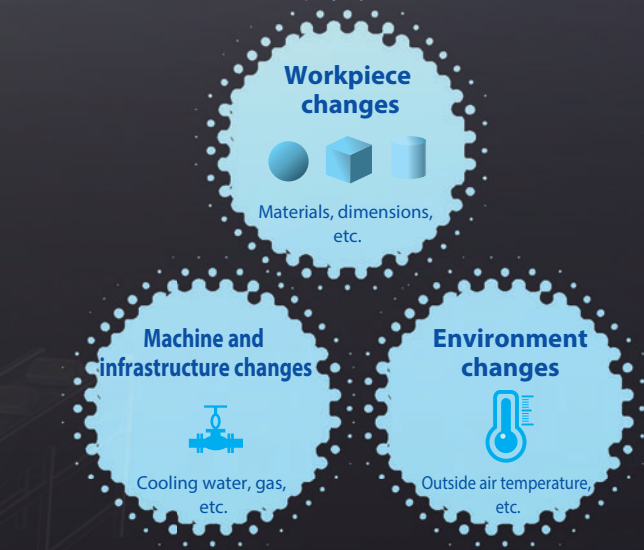In response to this situation, OMRON developed temperature controllers that includes

"adaptive control technology."
This makes it possible to detect the changes in the status which will have an effect on quality and
to automatically control the temperature so that the optimal state is always
maintained, in the same way as a skilled worker would.
This frees production sites from troublesome start-up and adjustment work.

Causes of temperature variations on production lines

Workpiece changes

Materials, dimensions, etc.

Machine and infrastructure changes

Cooling water, gas, etc.

Environment changes

Outside air temperature, etc.

Previously
Production speed: Slow
Failure rate: High
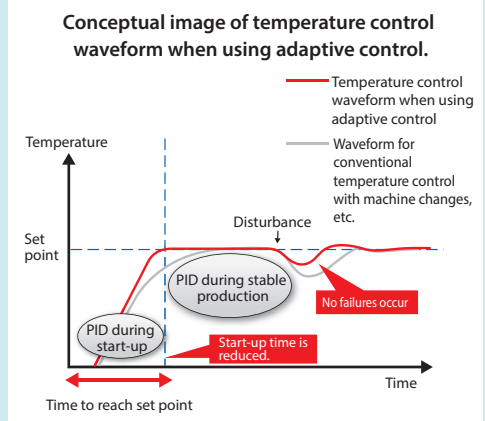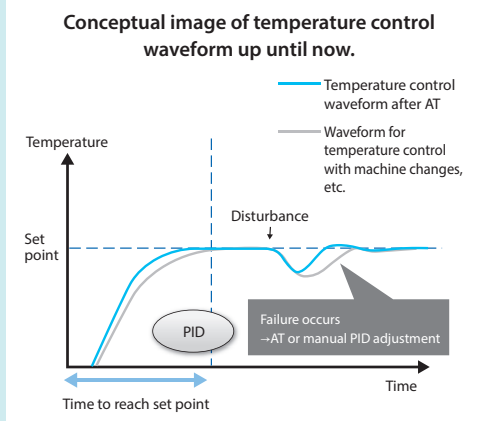Adjustment by workers: Necessary

E5□D/ NX-TC
It is possible to continue producing good products without making set point changes or PID adjustments

The answer was
the industry's first inclusion* of "adaptive control technology"

With the "adaptive control" incorporated into this product, the optimal PID value is calculated automatically for both the time of the start-up and for during stable production. Furthermore, it is possible to monitor the temperature control status of the machine to automatically adjust the PID value to obtain the optimal temperature control in response to changes such as workpiece changes and machine changes.

Previously There is one type of PID and after failures occur due to reasons such as machine changes, PID adjustment is performed with AT or manually.

E5□D/ NX-TC Higher speeds become possible with the PID during start-up and also the optimal temperature control status is maintained with automatic adjustment of the PID value following changes such as machine changes.

Conceptual image of temperature control waveform up until now.

Temperature control waveform after AT

Waveform for temperature control with machine changes, etc.

Temperature
Disturbance
Set point
PID
Failure occurs →AT or manual PID adjustment
Time
Time to reach set point

Conceptual image of temperature control waveform when using adaptive control.

Temperature control waveform when using adaptive control

Waveform for conventional temperature control with machine changes, etc.

Temperature
Disturbance
Set point
PID during stable production
PID during start-up
No failures occur
Start-up time is reduced.
Time
Time to reach set point

* According to an investigation by OMRON of general-purpose temperature controllers for FA as of March 2017.

New value that supports advances in **packaging machines**

The sealing temperature is measured accurately and con maintain quality even at higher speeds.

Issues at production sites

· Faster packaging to respond to the demand for foodstuffs arising due to the population increases in emerging nations

· Increase in speed even when performing multiple-product production using a wide variety of packaging materials

· At higher speeds, the temperature difference between the sealing surface and the control temperature widens, so the failure rate rises…

The temperature difference widens due to higher speeds

High

Failure rate

Low

Low speed   **Packaging speed**   High speed

Failure rate increases.
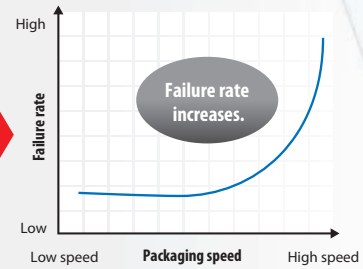
E5□D/NX-TC solve the issues

The temperature of the sealing surface is stably controlled automatically with measurement of the sealing surface temperature and algorithms to suppress variations.

Even if the speed of the packaging process is increased, the difference between the sealing temperature and the control temperature is minimized to perform stable automatic control, so it is possible to realize faster production while maintaining the product quality. This also contributes to the use of thinner packaging materials and to high precision control.
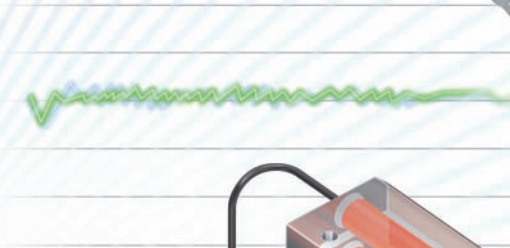
Even with the production of multiple products that require changes to the settings, automatic control reduces the work

Even in the production of multiple products, which hinders faster speeds because a change of packaging materials can mean that time is required to change the settings, the use of automatic control that has a small error in the sealing temperature enables a speedy response at production sites.

trolled automatically for packaging machines that can

Control performance that achieves new value

The temperature error is minimized with a temperature sensor for packaging machines* and an algorithm for packaging machines (automatic filter adjustment function)

*Sold separately

"Temperature sensors for packaging machines" to measure the temperature of the sealing surface

The temperature of the heating bar surface is measured accurately and there is no effect from factors causing temperature variations, such as the speed of the packaging machine and changes to the packaging materials.

From

Sensor

Sensor

140°C

Sealing surface
135°C

To

Temperature error is minimized.

Sensor

Sensor

135°C

Sealing surface
135°C
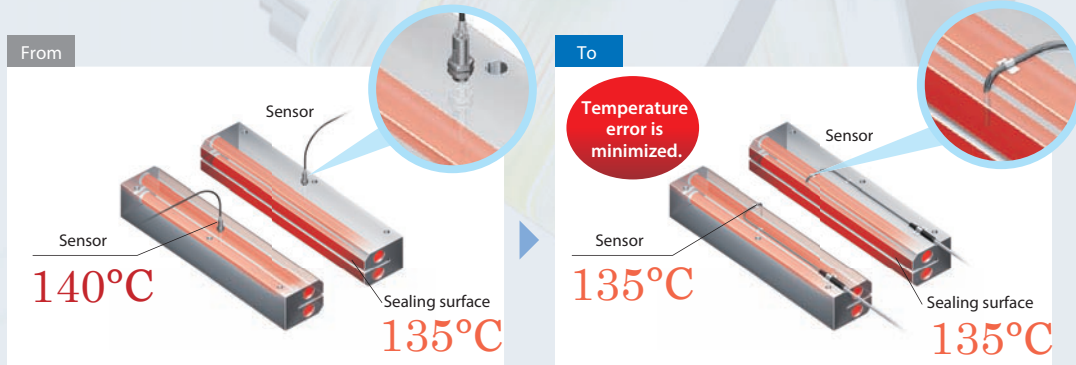
On a conventional machine, the temperature sensor was a little distance away from the sealing surface, so a difference occurred between the temperature of the sealing surface and the temperature that was actually being controlled. The temperature difference and failure rates increased in proportion to the packaging speed.

The installation position of the temperature sensor for packaging machines has been brought closer to the sealing surface to bring the temperature of the sensor closer to the temperature of the sealing surface. This minimizes the effects from variation in the surface temperature of the packaging materials.

"Automatic filter adjustment function" to suppress the instability in surface temperature measurements

By using the temperature sensor for packaging machines and the automatic filter adjustment function, it becomes possible to control the quality with the sealing temperature while also suppressing variation in the temperature with just a temperature controller, without relying on adjustments by workers.

From

(°C)

164
162
160
158
156

0   100   200
(sec)

To

164
162
160
158
156

0   100   200
(sec)
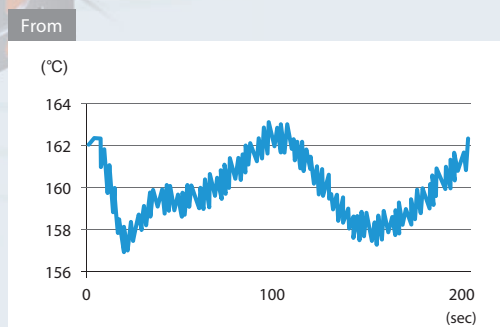
When a temperature sensor for a packaging machines is used, there is sometimes periodic temperature variation generated when there is a marked effect from the heat on the packaging materials side.
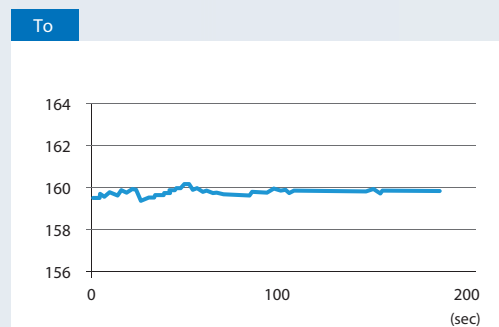
When the automatic filter adjustment function of the E5□D /NX-TC is used, this periodic temperature variation is suppressed automatically. It becomes possible to perform stable temperature control.

* Data measured by OMRON on a vertical flow packer.

New value that supports advances in **molding machines**

Stable control of the temperature changes arising from faster molding machines that can maximize production capacity.

Issues at production sites

· Increased productivity to respond to demand expansion related to infrastructure as a result of the economic development of the emerging nations and the transfer of production bases overseas.

· At higher speeds, adjustments by the workers become necessary to respond to temperature variations arising due to factors such as the materials compounding and cooling water…

· It is difficult to achieve high speed production while also maintaining the quality…

Temperature variation is approx. ±5°C.
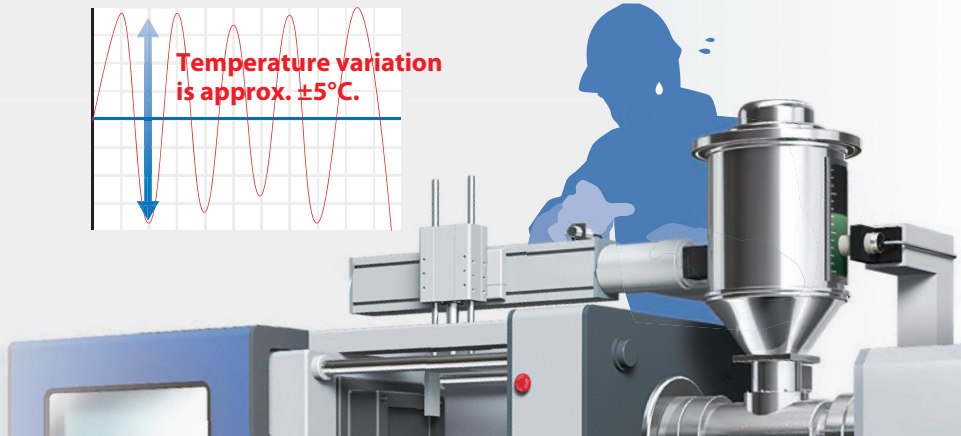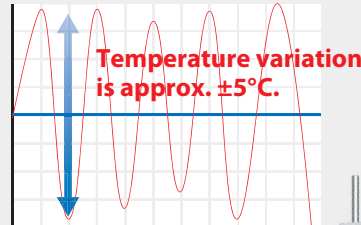
E5□D/NX-TC solve the issues

Temperature variations due to speed changes and changes in the status of machines are suppressed without adjustments by the workers

Stable control is achieved automatically by detecting the temperature variations on the heat generating parts of the material that occur when the speed of the extrusion molding machine is increased and by detecting the temperature variations due to variation in the cooling water. The work required for setting are also greatly reduced.

Also saves energy on the machine

The stable control reduces the wasteful use of energy on the heater by up to 40% compared with conventional machines.

* Data measured by OMRON on a water-cooled twin screw extrusion molding machine.
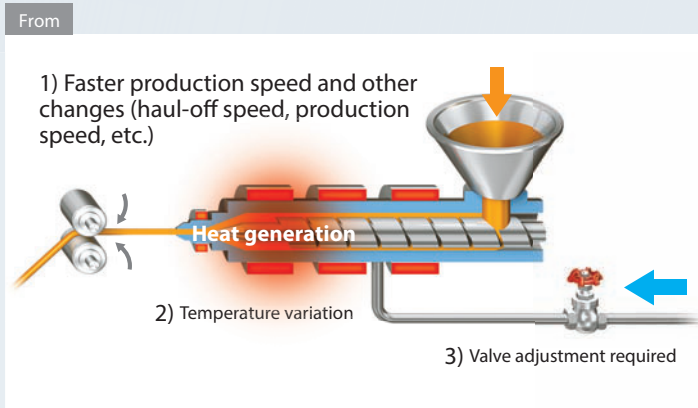
speeds is performed automatically to realize

Control performance that achieves new value

Temperature variations are minimized with an algorithm for molding machines (water-cooling output adjustment function)

On a water-cooled extrusion molding machine, increased speed leads to temperature variations due to various causes and it was previously necessary for the workers to repeatedly make valve adjustments to stabilize the quality.
With the E5□D/NX-TC, the water-cooling output adjustment function suppresses the temperature variations to a minimum and raises the production capacity with the quality maintained.

From

1) Faster production speed and other changes (haul-off speed, production speed, etc.)

Heat generation

2) Temperature variation

3) Valve adjustment required

Causes of temperature variations

Nonlinear characteristics of water cooling

In the type of cooling that uses the heat of evaporation, the cooling performance is nonlinear, so temperature variation occurs.
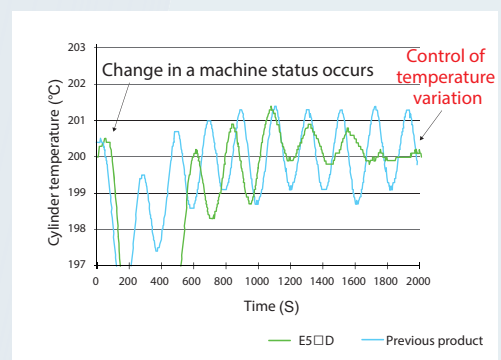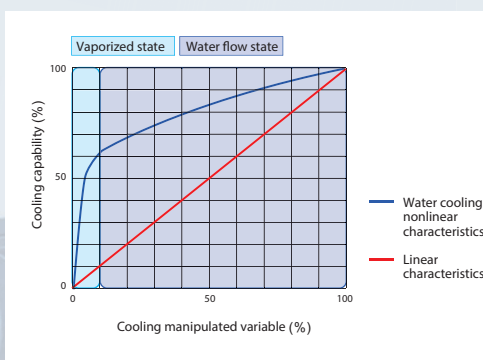
Variations in cooling water

When there are variations in the cooling water system, temperature variations occur with the conventional auto-tuning because it is not possible to respond to changes in the status during operations.

"Water-cooling output adjustment function" to simultaneously suppress the causes of temperature variations and maintain stable performance

To Auto-tuning (Water cooling) **+** Water-cooling output adjustment function

It is possible to suppress the temperature variations that occur due to the cooling output by using the auto-tuning (water cooling) before the materials are input to gain an understanding of the cooling characteristics.

During the production after the materials have been input, the water-cooling output adjustment function constantly detects changes in the temperature and suppresses the temperature variation by automatically adjusting the proportional band (cooling).

Vaporized state | Water flow state

Cooling capability (%)

Cooling manipulated variable (%)

— Water cooling nonlinear characteristics
— Linear characteristics

Change in a machine status occurs

Control of temperature variation

Cylinder temperature (°C)

Time (S)

— E5□D   — Previous product

* Data measured by OMRON on a water-cooled twin screw extrusion molding machine.

Push-In Plus Technology for Easy Wiring

E5□D-B/NX-TC

Just Insert Wires: No Tools Required
Now you can use Push-In Plus technology to reduce
the time and work involved in wiring.

Greatly Reduce Wiring Work

Approx. 60% reduction!
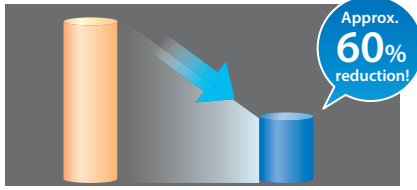
Conventional screw terminal blocks   OMRON Push-In Plus terminal blocks

*Information for Push-In Plus and screw terminal blocks is based on
OMRON's actual measurement value data.

Easy to Insert

OMRON's Push-In Plus technology are as easy
as inserting to an earphone jack. They help reduce
the work load and improve wiring quality.

Value Design for Panel

Our shared Value Design for Panel (herein after referred
to as "Value Design") concept for the specifications of
products used in control panels will create new value to
our customer's control panels.

Main specifications

E5□D/E5□D-B

Model	E5CD	E5CD-B	E5ED	E5ED-B
Size (mm)	Front panel: 48 × 48, Depth: 60	Front panel: 48 × 48, Depth: 67.4	Front panel: 48 × 96, Depth: 60	Front panel: 48 × 96, Depth: 67.4
Sensor input	Thermocouple, platinum resistance thermometer, infrared temperature sensor (ES1B), or analog input (voltage/current).			
Indication accuracy (at the ambient temperature of 23℃)	Thermocouple: (±0.3% of indication value or ±1℃, whichever is greater) ±1 digit max. Platinum resistance thermometer: (±0.2% of indication value or ±0.8℃, whichever is greater) ±1 digit max. Analog input: ±0.2% FS ±1 digit max. CT input: ±5% FS ±1 digit max.			
Input sampling period	50 ms			
Control output	Relay output, voltage output (for driving SSR), Linear current output			
Terminal type	M3 screw terminal block	Push-In Plus terminal block	M3 screw terminal block	Push-In Plus terminal block
Approved standards	UL, KC, CE			

NX-TC

Model	NX-TC24□□	NX-TC34□□
Size (mm)	Front panel: 12 × 100, Depth: 71	Front panel: 24 × 100, Depth: 71
Sensor input	Thermocouple, platinum resistance thermometer	
Reference Accuracy	For details, refer to the "NX-series Temperature Control Units User's Manual (Man.No. H228)".	
Input sampling period	50ms	
Control output	Voltageoutput (for driving SSR), Linear current outpu	
Terminal type	Push-In Plus terminal block（Screwless clamping terminal block）	
Approved standards	cULus、CE、RCM、KC、EAC、NK、LR、BV、DNV-GL	

Temperature Sensors for Packaging Machines

Model	E52-CA□AY S□
Type	Lead wire type
Element type	K
Temperature range (Temperature range of sleeve)	0 to 650℃ (0 to 260℃)
Protective tubing length (mm)	60/120
Protective tubing diameter (mm)	1 dia.
Compensating conductor	7 core/30 core
Temperature measuring junction	Grounded type
Terminal type	Y(Y terminal), F(Ferrule terminal)

Main functions of E5□D/NX-TC

- **Adaptive Control**
- **Automatic Filter Adjustment**
- **Water-cooling Output Adjustment**
- **Indication Data**

  Power ON Time*

  Ambient Temperature

  Output ON/OFF Count*

  *Only E5□D Series

* For details of the specifications, refer to "E5CD/E5ED Digital Temperature Controllers and Temperature Sensors for Packaging Machines Datasheet (Cat. No. H223)" and
"NX - TC NX Series Temperature Control Unit Datasheet" on our website (www.fa.omron.co.jp)