

Technical News Bulletin

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Temperature Control System - TCS

- Automatic temperature measurement reduces workload to control process.
- Multiple measurement points per section reduce downtime.
- Automatic re-measuring when measurement is out of range.

Introduction

The Temperature Control System (TCS) uses a highspeed pyrometer mounted on an automatic positioning system on the blank side. It measures blank mold, plunger and neck ring temperature. The different temperature readings are displayed and recorded. These temperature readings give the process the transparency needed to reduce blank mold, plunger and neck ring temperature variations and lead to improved process stability.

The Temperature Control System (TCS) has evolved through three versions to address growing industry needs, offering improvements in reliability and connectivity at each stage.

System description

By means of three axes, the pyrometer is accurately positioned to measure all blank mold and plunger temperatures. The collected data are plotted on various graphs and a warning is activated if any of the temperatures fall outside of the pre-set limits.

The system includes:

a) A three-axis positioning system

The first “X” axis, is composed of a linear rail, a stepper motor which drives a tooth belt and, in turn, moves a carriage along the linear rail that covers the full span of the IS machine. An encoder is employed to monitor the exact position of the carriage.

The second and third “Horizontal” and “Vertical” axes include two precision stepper motors with integrated gearing. The two motors are mounted together onto the X axis carriage. This particular arrangement provides a pan and tilt movement.

b) High speed infrared pyrometer

The high-speed pyrometer measures temperature using an infrared wavelength of 1.45 μm , in a range of 350°C to 1800°C. The pyrometer is housed in a small enclosure which has purge air continuously running through it to clean the lens and cooling the pyrometer.

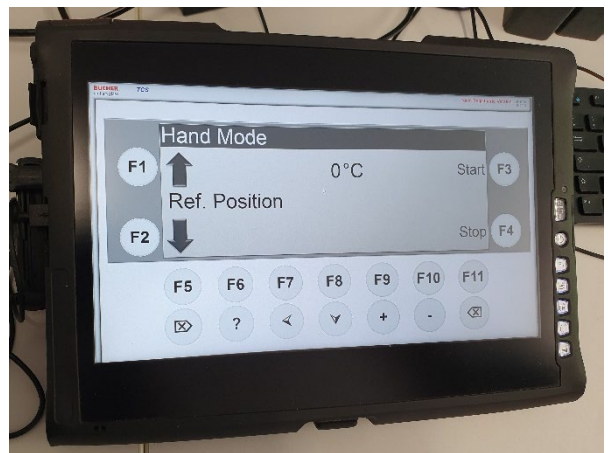


c) Ethernet Bus and PLC interface

The Ethernet Bus system controls the horizontal and vertical motors and transfers the pyrometer signals to the PLC (programmable logic controller) interface. The PLC commands the positioning of all axes, handles the temperature signal in real time, activates the TCS alarm, processes the cycle trigger signal received from FlexIS for each independent section.

d) Hand-Held unit

The operator, standing in front of the machine, uses the hand-held terminal or FlexPad depending on TCS version to move the three axes to position the pyrometer to a given measurement location and to save its coordinates. A laser pointer, which is internally fitted to the pyrometer, is used to verify the viewing location of the pyrometer and to set up the measurement locations.



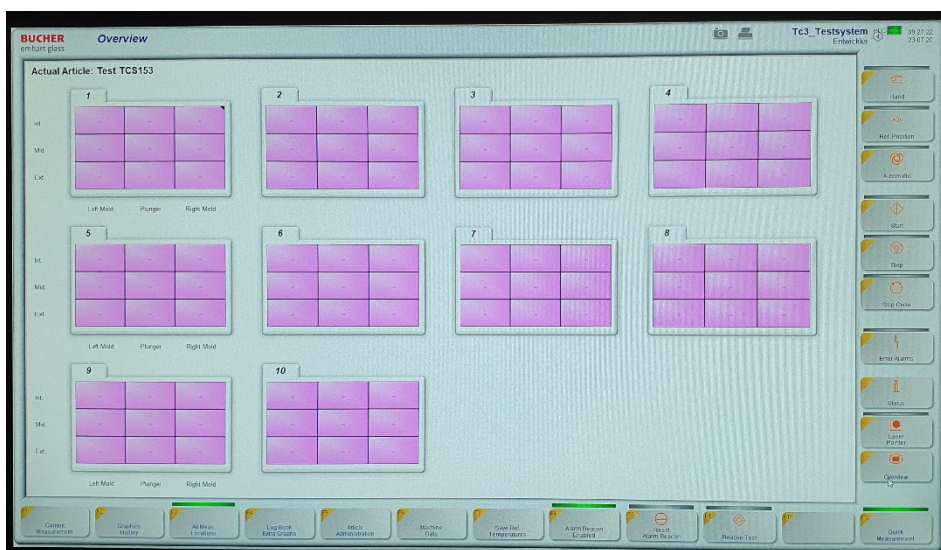
From the hand-held terminal the user can switch on/off the laser pointer and display the temperature received by the pyrometer.

e) User interface

The user interface provides the operator with a variety of software features that automatically analyze and present the temperatures acquired on different easy-to-understand screens.

The “Overview” display provides for all the sections the temperatures of the various cavities and a warning/alarm is activated if any of the temperatures fall outside of the predetermined set limits.

The “History” is a graphical display of the collected data over time. Additionally, the minimum and maximum alarm limits are shown using two horizontal red lines.



Version description

V1 (603-1-XX): The Original System

The original TCS provided automated temperature monitoring and control using real-time Ethernet communication and physical handheld terminals.

Key Features:

- Three-axis positioning system
- High-speed infrared pyrometer
- Handheld Terminal (HHT)
- Real-time Ethernet connectivity

Limitations:

- Moderate robustness in axis motors and X-axis belt.
- Real-time Ethernet with copper cables limited future scalability.

V2 (603-101-XX): Hardware Upgrades for Better Reliability

V2 improved hardware robustness and ease of installation, addressing key limitations of the original TCS system.

Key Improvements:

- Computer Upgrade:
 - Replaced with a Beckhoff industrial-grade computer for enhanced reliability.
- More Robust X-Axis Motor:
 - Increased durability and lifespan.
- Easier-to-Install Y & Z Axis Motors:
 - Streamlined installation and maintenance processes.
- High-Temperature Belt for X-Axis Movement:
 - Designed to withstand extreme conditions, reducing wear and tear.
- Generation 2 Linear Rail:

Benefits:

- Increased reliability and operational lifespan.
- Improved maintenance efficiency.
- Better resistance to harsh production environments.

V3 (603-102-XX): EtherCAT Integration and Connectivity Overhaul

V3 introduced a new communication protocol (EtherCAT) and upgraded several system components to future-proof the TCS and enhance diagnostic capabilities.

Key Upgrades:

- EtherCAT Communication Protocol:
 - Replaced real-time Ethernet with EtherCAT for improved analysis and diagnostics.
 - Standardized fiber optic cables, replacing copper Ethernet cables.
- Control Cabinet:
 - Bus Coupler BK9050 replaced with EtherCAT Bus Coupler EK1100.
 - Older systems can be upgraded with minimal changes.
- Junction Box:
 - Fiber optic connectivity integrated using the EtherCAT branch terminal BK1561.
 - Eliminated the need for switches and media converters.
- Measurement Head:
 - Integrated Bus Coupler EK1541 for fiber optic communication.
- Handheld Terminal (HHT):
 - Replaced with the FlexPad, offering a wireless and software-based interface.
- Switch and Media Converter:
 - Completely removed, simplifying the system architecture.

Benefits:

- Future-proof diagnostics and analysis capabilities.
- Improved reliability with fiber optic cables.
- Wireless operator interface simplifies setup and usage.
- Seamless upgrade path for V2 systems.

Features and Benefits Across Versions

Core Features (All Versions):

- Automatic temperature measurement:
 - Reduces worker involvement.
- Real-time alarms and re-measurement:
 - Alerts for temperature violations and automatic re-measuring.
- Multiple measurement points per section:
 - Enhances process stability and reduces downtime.

Enhancements in versions V2 and V3:

- V2:
 - Improved hardware robustness (motors, belt, linear rail).
 - Easier installation and maintenance.
- V3:
 - Advanced diagnostics and wireless communication.
 - Fiber optic cables for improved performance.

Identifying the TCS Version of an Installed System

To determine which version of the TCS system is installed, use the serial number assigned to the system. Each TCS version corresponds to a specific range of serial numbers:

- **TCS V1 (Part Number: 603-1-XX):**
 - Serial numbers **TCS00001** to **TCS00128** (inclusive).
- **TCS V2 (Part Number: 603-101-XX):**
 - Serial numbers **TCS00129** to **TCS00156** (inclusive),
 - except for **TCS00148** and **TCS00150**, which belong to V3.
- **TCS V3 (Part Number: 603-102-XX):**
 - Serial numbers **TCS00157** and higher.
 - Serial numbers **TCS00148** and **TCS00150**.

Locate the system's serial number on its label on the Measurement Head. Once identified, refer to the ranges above to determine the corresponding version.

Components Specification – TCS System Requirements 603-10015.

User Console

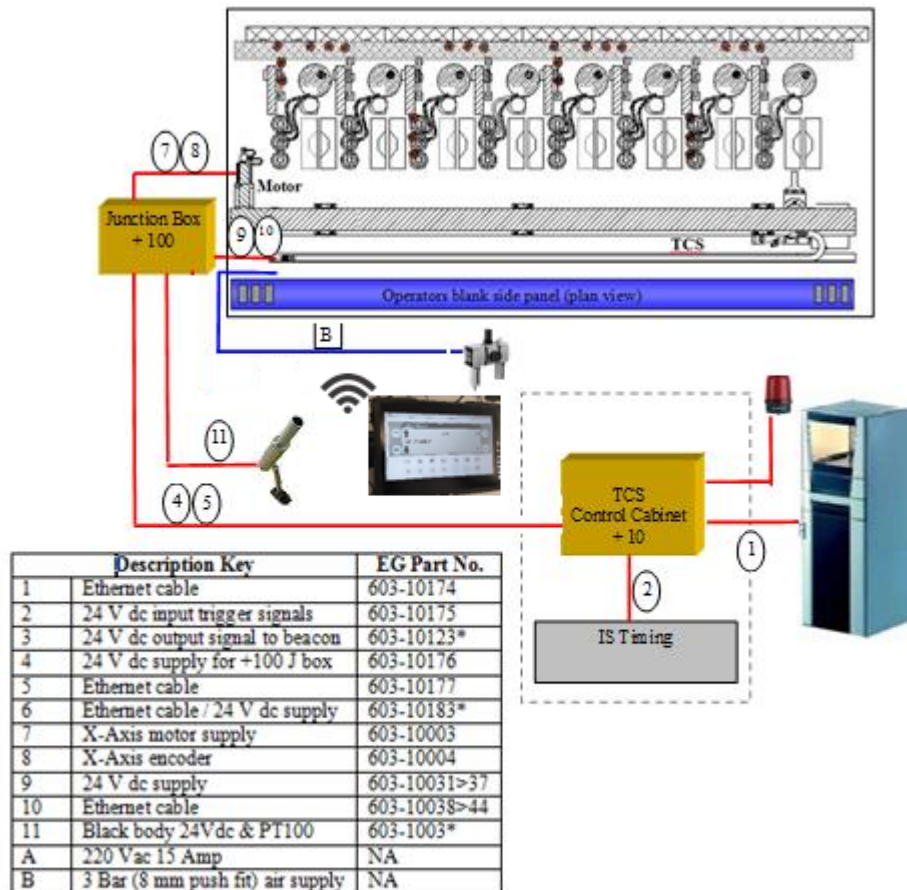
Temperature:	without air conditioner	0-40°C
	with air conditioner	0-55°C
Humidity:	without air conditioner	10-80% non-condensing
	with air conditioner	10-100%
Power consumption/supply	110 - 240V AC single phase, 1kVA; 48-62Hz	
	Line voltage tolerance	-10%/+15%
Protection grade:	IP65	

Control Cabinet

Temperature:	max. 60 °C housing cover surface
	max. 55 °C inside cabinet
Humidity:	relative 20 – 95 % non-condensing
Power consumption/supply:	110 - 240V AC single phase, 0.5 kW, 50 Hz
Protection grade	IP 66

Handheld Terminal (only V1 & V2)

Temperature:	max. 60 °C housing cover surface
Humidity:	relative 20 – 95 % non-condensing
Power consumption/supply:	24 V DC supplied through Control Cabinet
Vibration and mechanical shock:	5-100Hz 19,6m/s ² or 1,5mm amplitude,
Diskless design, but limitation by TFT display & internal ventilation:	10-55Hz 539m/s ² 11ms (whatever applies first)
Protection grade	IP 66



Linear Module

Temperature: max. 60 °C
 Humidity: relative 20 – 95 % non-condensing (<70g/m³)
 Power consumption/supply: 24 V DC supplied through Control Cabinet
 Protection grade: IP65 (all connectors/covers properly attached)

Measuring Head, including Pyrometer and Terminal Box

Temperature:	max. 60 °C cable track chain
Humidity:	relative 20 – 95 % non-condensing
Power consumption/supply:	24 V DC supplied through Control Cabinet
Protection grade:	IP65 (all connectors/covers properly attached)
Pneumatic supply	
pressure/consumption	3.2 bar 280 NI/min
Air requirement	ISO Class 4 (ISO-8573-1) Air temperature max 40°C VORTEX Cooler KIT is required if the Air temperature at the TCS head is >50°C
Temp. Measurement range:	350 to 1800 deg. Celsius

Control Interface

Input Per Section

Timing signal (trigger)	24V DC (>10ms)
Delivery depending signal	24V DC (>10ms)
Swab depending signal	24V DC (>10ms)

Output

Cooling Fan control	4-20mA
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Master Spare Parts List

The master spare parts list for all three versions of the TCS system is available under **Part Number: 603-1013-00**. This list provides comprehensive details of the components used across all TCS versions, based on its version as determined by the serial number.

Availability / Application

The drawings 603-2-00 (V1) & 603-3-00 (V2 & V3) TCS Master Assembly shows the list of the components needed to install TCS, for each group, under the voice “TCS Mounting parts”, is indicated the TCS installation drawing for that specific machine:

Machine Bk panel	Machine type	Mounting parts
400-849	IS	200-2114-00
400-849	AIS	210-2043-00
400-849	NIS	400-5329-00
200-1952-00	Any	200-1954-00
200-1964-00		
200-1957-00		

During the preparation of the machine installation layout, to design the gob distributor platform and the cullet chute, need to consider the position of the TCS and BK panel, indicated in the above installation drawings

Upgrade paths

The following table summarizes the differences and upgrades available for all 3 TCS versions:

New Technologies	TCS V1 (603-1-XX)	TCS V2 (603-101-XX)	TCS V3 (603-102-XX)
Robust X-axis motor	Upgradable	✓	✓
Plug & play Y/Z axis motors	Upgradable	✓	✓
High temperature belt	Upgradable	✓	✓
Beckhoff computer (Twincat3)	✗	✓	✓
EtherCAT protocol	✗	Upgradable	✓
Standard fiber optic	✗	Upgradable	✓
Handheld terminal (HHT) in FlexPad	✗	Upgradable	✓

V1 upgrade

V1 can only be upgraded to have more robust components

qty	name	Comment	V1 motors
1	x axis motor supply cable	W7	603-10205
1	x axis encoder cable	W8	603-10206
1	stepper motor incl. encoder	x axis stepper motor	603-10204
1	gearbox x-axis		603-10212
2	y/z axis stepper motor		603-10191
2	y/z axis motor cable	Cable straight M12, 4-pin - 0,6m	603-10210

V2 to V3 upgrade

V2 can be completely converted into V3

qty	Name	Comment	V2 to V3
2	EK1100 (bus coupler)	Control Cabinet & Junction box	603-10217
2	BK1250 (k-bus expansion card)	Control Cabinet & Measurement Head	603-10218
1	EK1561 (EtherCAT branch terminal)	Junction box	603-10220
1	EK1541 (bus coupler)	Measurement head	603-10219
1	fiber optic transducer cable	W10	603-10221
x	electrical schematics		603-10222