

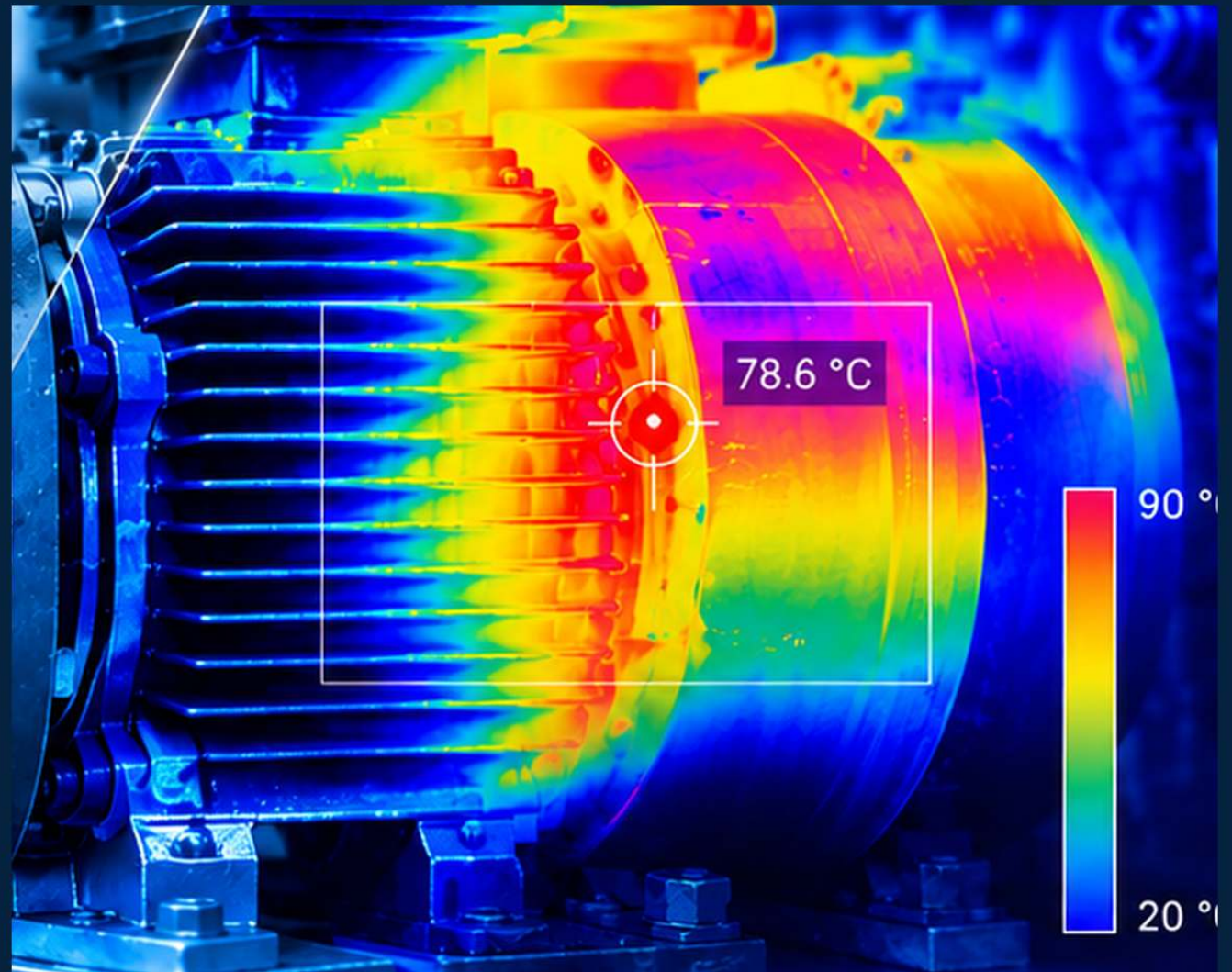
PREDICTIVE ANALYSIS

SEE IT COMING.

FROM DATA
TO DECISIONS.

FOR A MORE RELIABLE
TOMORROW.

- **EARLY DETECTION**
Spot changes before failure.
- **PLANNED ACTION**
Create time to intervene.
- **GREATER RELIABILITY**
Protect production continuity.



1 PROTECT

Predictive Maintenance

2 IMPROVE

Performance & Efficiency

3 OPTIMIZE

Process & Quality



TORNATI PROJECT
IDEAS INTO SOLUTIONS

PREDICTIVE ANALYSIS • TEMPERING FURNACES

WHAT IS PREDICTIVE ANALYSIS?

From data to decisions — before a problem becomes production downtime.

Predictive analysis monitors how equipment behaves over time, identifies significant changes and enables action before an anomaly develops into a production problem.



NOT JUST "SEEING A FAILURE".

TURN A WEAK SIGNAL INTO A USEFUL DECISION.

THREE LEVELS. ONE PREDICTIVE LOGIC.

1 PROTECT

2 IMPROVE

3 OPTIMIZE



THREE LEVELS OF PREDICTIVE ANALYSIS

From production continuity to process improvement.

The same predictive approach can be applied to different objectives.

The first level is the most immediate: preventing failures and unplanned downtime.

01 PROTECT

PREDICTIVE MAINTENANCE

Anticipate anomalies and potential failures in critical components.

- SSR / Solid-State Relays
- Resistors / Heating Elements
- Inverters
- Fans / Motors
- Sensors / Thermocouples

02 IMPROVE

PERFORMANCE & EFFICIENCY

Identify conditions that can reduce efficiency and reliability.

- Abnormal vibrations
- Mechanical components
- Furnace insulation
- Heat losses

03 OPTIMIZE

PROCESS & QUALITY

Correlate equipment behaviour with final product quality.

- Process stability
- Thermal uniformity
- Production trends
- Glass quality

OPERATIONAL PRIORITY

LEVEL 1 — Turn abnormal thermal signals into planned maintenance.

LEVEL 1

PROTECT

PREDICTIVE MAINTENANCE

Detect anomalies early,
prevent unexpected stops
and extend the lifetime
of your equipment.



SSR

Solid-State Relays



RESISTORS

Heating Elements



INVERTERS

Drives and Controls



FANS / MOTORS

Cooling and Ventilation



SENSORS

Thermocouples



MONITOR

Continuously collect
process and equipment data.



TREND

Analyze data to identify
deviations and critical conditions.



ALERT

Detect potential issues
before they cause failures.



PLAN

Schedule maintenance
and optimize interventions.

LESS UNPLANNED DOWNTIME. LONGER EQUIPMENT LIFE. HIGHER PRODUCTION RELIABILITY.



TORNATI PROJECT
IDEAS INTO SOLUTIONS

MONITOR. IMPROVE. GROW.
YOUR PRODUCTION, OUR COMMITMENT.

IMPROVE PERFORMANCE & EFFICIENCY

Use condition data to identify losses, instability and inefficient operation.

Predictive analysis is not limited to failure prevention: the same data can reveal conditions that reduce equipment performance, energy efficiency and process stability.

WHAT TO OBSERVE

- **ABNORMAL VIBRATIONS**
Changes in rotating equipment behaviour.
- **MECHANICAL COMPONENTS**
Friction, wear and local overheating.
- **FURNACE INSULATION**
Thermal discontinuities and weak areas.
- **HEAT LOSSES**
Unexpected dispersion and inefficient zones.

FROM CONDITION TO IMPROVEMENT

- 01 COMPARE** Compare behaviour across time or similar zones.
- 02 IDENTIFY** Locate deviations, losses and unstable conditions.
- 03 EVALUATE** Assess impact on efficiency and reliability.
- 04 IMPROVE** Target maintenance or process adjustments.

OBJECTIVE

Reduce losses. Improve stability. Increase efficiency.

LEVEL 3

OPTIMIZE

PROCESS & QUALITY

Turn process data into valuable insights to optimize production, ensure consistent quality and reduce waste.



PROCESS
STABILITY



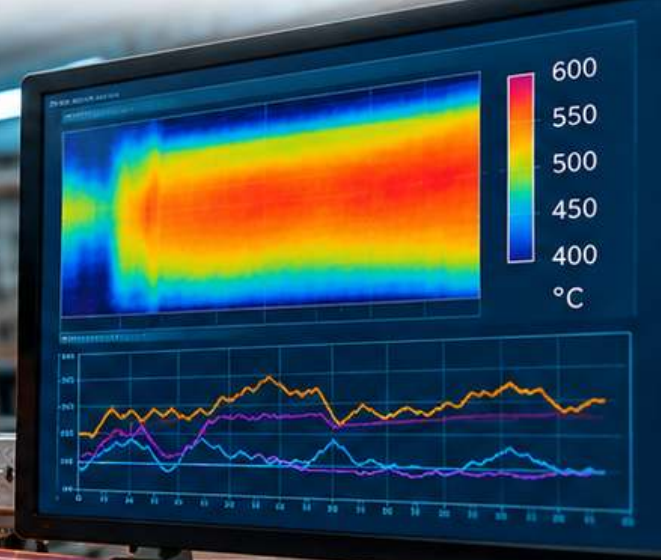
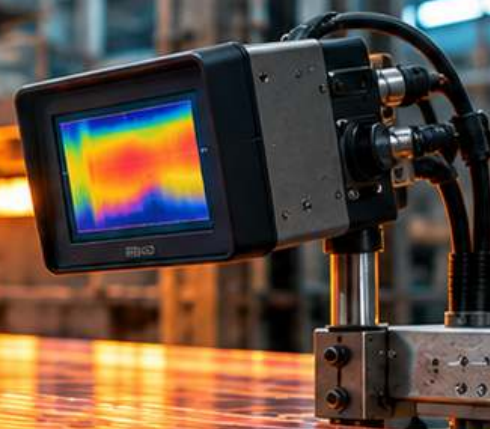
THERMAL
UNIFORMITY



PRODUCTION
TRENDS



GLASS
QUALITY



CORRELATE

Combine thermal and process data with quality results



COMPARE

Analyze batches, shifts or product types to identify the best operating conditions



UNDERSTAND

Identify the real causes of variations and defects.



OPTIMIZE

Stabilize the process, improve product quality and increase overall performance

A MORE STABLE PROCESS. A HIGHER QUALITY PRODUCT. A STRONGER COMPETITIVE ADVANTAGE.



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BEYOND THERMOGRAPHY

Temperature is the main continuous signal; complementary checks increase diagnostic capability.

CONTINUOUS MONITORING

Component temperature

- Trends over time
- Comparison of equivalent components
- Deviation from baseline
- Automatic early warning

SPOT VIBRATION ANALYSIS

Recommended twice a year by an operator.

- Fans and motors
- Mechanical components
- Vibration variations
- Targeted anomaly verification

OPERATING CONTEXT

Interpretation must consider actual furnace conditions.

- Load
- Operating status
- Historical comparison
- Maintenance events

KEY PRINCIPLE

The strength of the system is not a single measurement, but data continuity and the ability to recognize a significant change.

REAL TIME DATA

FOR SMARTER DECISIONS



MONITOR

Collect and analyse key parameters in real time

- Temperature
- Vibrations
- Electrical parameters
- Process data



ANALYSE

Turn data into useful information

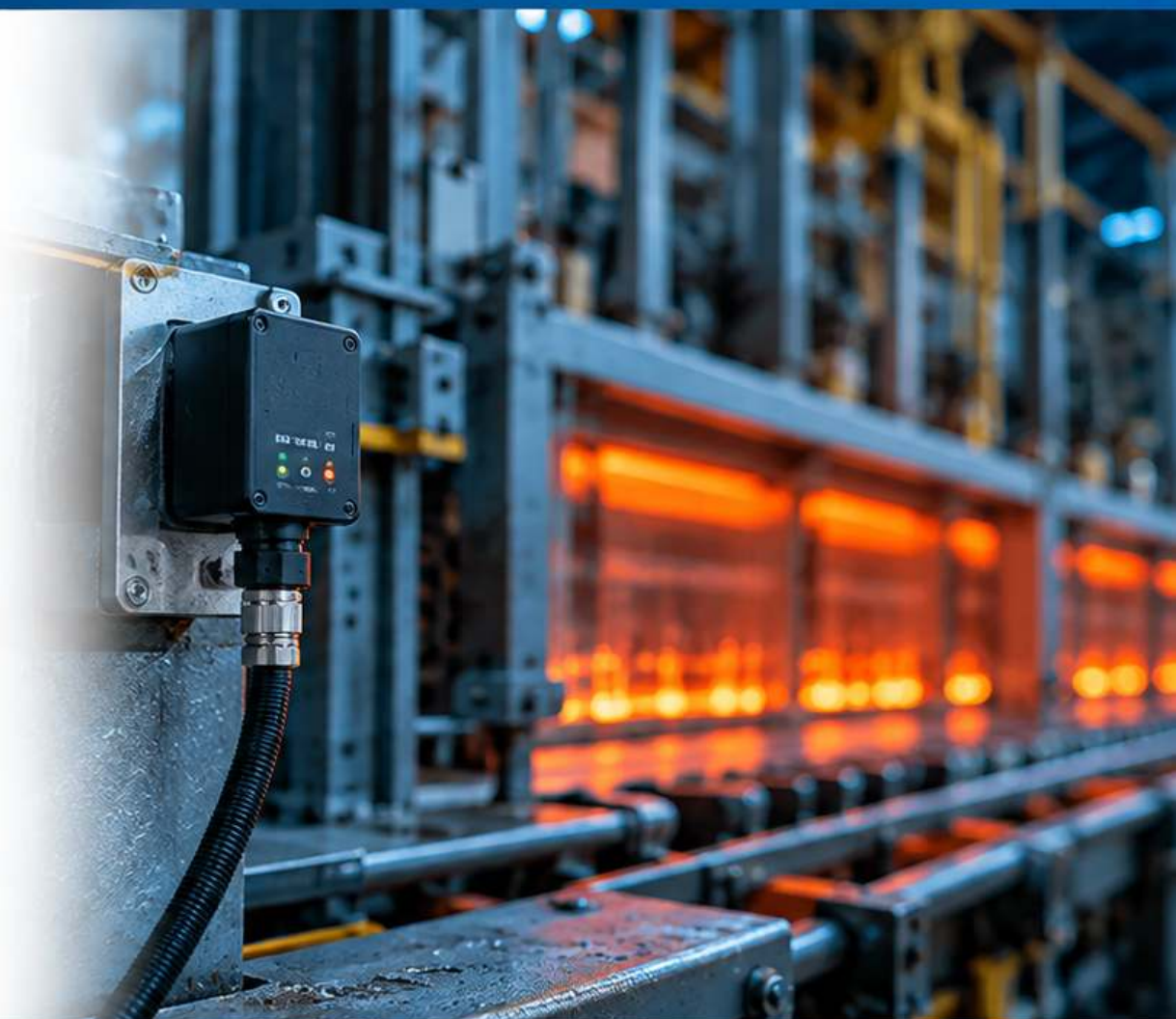
- Trend analysis
- Anomaly detection
- Correlation between parameters
- Customised reports



ACT

Support operational and strategic decisions

- Predictive maintenance
- Process optimisation
- Reduced downtime
- Greater efficiency and productivity



DATA TODAY.

A MORE RELIABLE TOMORROW.



INCREASE
EFFICIENCY



REDUCE
RISKS



IMPROVE
PERFORMANCE



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