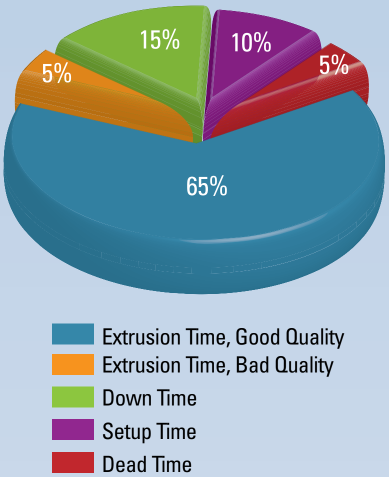
Temperature Process Control System for Aluminum Extrusion

Williamson

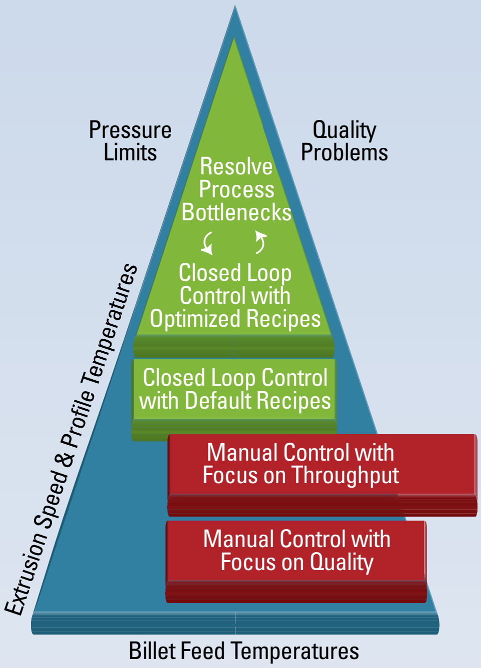
Innovators in Noncontact Temperature Measurement

Optimization of the Aluminum Extrusion Process

Key Elements of the Extrusion Process



Simplified Extrusion Limit Diagram



The goal is to increase quality and productivity by operating to standards and continuously working to raise the standards.

IMPLEMENTING BEST PRACTICES STANDARDS

Imagine a place where Best Practices was not just a philosophy, but a practical, cohesive way of running the press. Imagine an organization where everyone from management to the operators worked together with the same information to run each order. This operation would live by its Best Practices Standards on a day-to-day basis and continuously work to raise the standards to achieve breakthrough results in performance.

Aluminum extrusion plants around the globe are turning to Best Practices programs to improve productivity, quality, and consistency of performance in the key elements of the extrusion process. Unfortunately, the systems and procedures used to implement these standards are often too complex or ineffective. With the innovative design of the Temperature Process Control (TPC) System, it is now possible to implement a Best Practices program that is comprehensive, effective, and simple to use.

TPC Feature	Process Benefit
Automatic Closed Loop Control enables consistent and precise control of process temperatures and press speed.	The TPC System consistently **reduces extrusion times by 10-20%.** Since extrusion time typically represents 65% of the extrusion process, this translates into an overall productivity gain of 7-13%.
The Recipe Database enables each operator to run the press using Best Practices Standards to dramatically improve the consistency of the press performance.	More consistent operation of the press **increases recovery rates and reduces cycle times**. A 50% reduction in scrap rates lowers costs and can free up an additional 2.5% of press capacity.
Advanced Utilities And Reports make it easy for engineering and management to analyze and optimize recipes, identify process bottlenecks, and implement process improvements.	Since downtime, setup time, and dead time represent as much as 35% of the extrusion process, improvements in these areas directly result in **more time to run the press and greater flexibility with scheduling**.

MANAGING PROCESS TEMPERATURES

In most plants, the greatest opportunity for improvement is through better management and control of temperatures throughout the extrusion process. As the extrusion limit diagram illustrates, precise control of billet feed and platen exit temperatures can result in significant improvements in process throughput and product quality. The traditional approach to managing temperatures is to use a subjective set of manual procedures that are highly dependent on the operator's skills. However, with a closed loop temperature control system, the operator no longer needs to be a thermal management expert to achieve optimal results. The difference between manual and automatic systems is significant.

- **Manual Control Systems** typically run at slower speeds to maintain product quality or accept lower recovery rates as operators attempt to increase the speed of the press.
- **Closed Loop Control with the TPC System** automatically optimizes billet feed temperatures and tightly controls profile temperatures to dramatically increase extrusion speeds while assuring high quality. By optimizing the recipes and resolving process bottlenecks, a system of continuous process improvement can be implemented for sustained gains in productivity and quality.

A PROVEN DESIGN THAT DELIVERS BREAKTHROUGH RESULTS

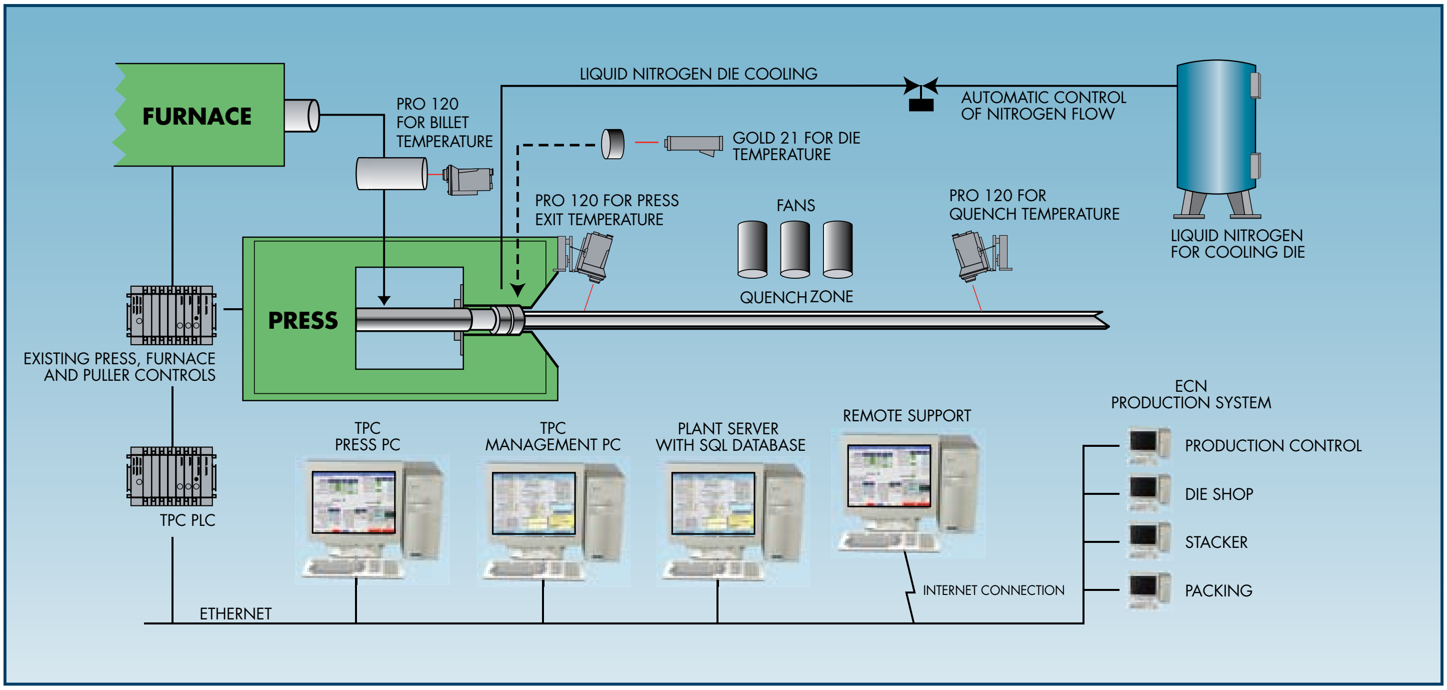
Despite the fact that control systems and infrared thermometers are commonly used in the aluminum extrusion industry, the Temperature Process Control (TPC) System is the first to effectively merge these two technologies to deliver true automatic temperature-based control in a system that is easy to use.

Williamson Corporation and SAI Automation have partnered to develop this innovative system which integrates Best Practices Standards with simple and effective closed loop controls to effectively optimize press performance and enable a process for continuous improvement. Unique TPC features include:

- Real-time temperature-based closed loop control
- Continuous optimization of profile temperatures at the platen exit for isothermal control
- Continuous optimization of billet feed temperatures
- Automatic compensation for varying operating conditions
- Recipe and order management modules that organize and apply Best Practices Standards for each die and each order
- TPC screens in international languages including: English, French, German, Spanish, Italian, Korean, Chinese, Russian, and others
- Advanced Utilities and Reports to automatically capture critical process data
- Flexible design to integrate with existing control systems
- Advanced options to optimize tapered billet heating, nitrogen die cooling, and quench rates
- Installation and training in less than one week with little or no downtime

TPC BENEFITS

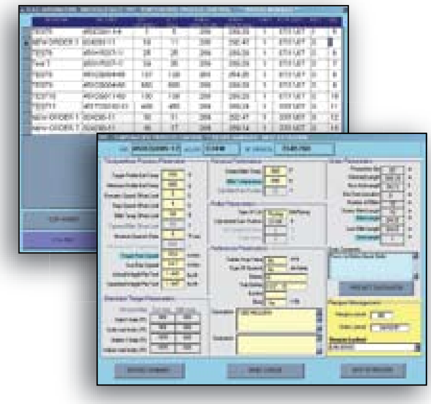
- Increase press speeds by 10 to 20% and more.
- Improve product quality with better surface finish, fewer defects, and reduced scrap rates.
- More consistent press performance as each operator runs the press using the optimized TPC recipes.
- Improve production scheduling with more consistent and efficient performance 24 hours a day, 7 days a week.
- Make informed decisions about process improvements with TPC's detailed process and production data.
- Optional liquid nitrogen cooling module typically increases press speed by 30%, reduces nitrogen consumption by 40%, increases die life by 20%, and improves surface finish.



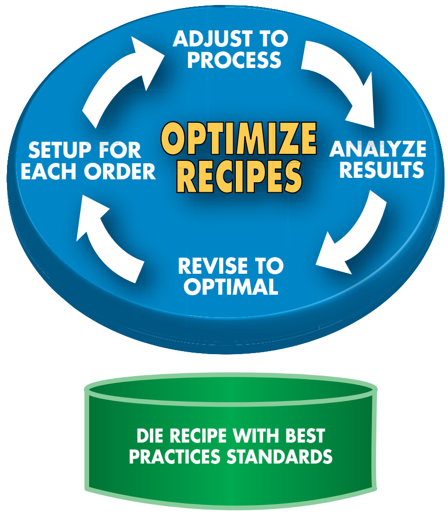
The TPC System uses a combination of infrared temperature sensors, , and PCs to integrate with the existing press controls.

A Simple Solution to Implement Best Practices Standards

Optimizing the Extrusion Process



Efficiently manage the extrusion process with TPC's Recipe Manager, Order Manager, and Control Module



SQL Database

Analyze and optimize performance with TPC's Repeat to Standard (R2S) Monitor, Best Extrusion Analyzer, On-line Graphics, and Reports

SAMPLE RECIPE PARAMETERS

- Profile Temperature at Platen Exit
- Billet Temperature
- Quench Rate
- Die Temperature
- Billet Length
- Finished Length
- Run out Length
- Number of Billets

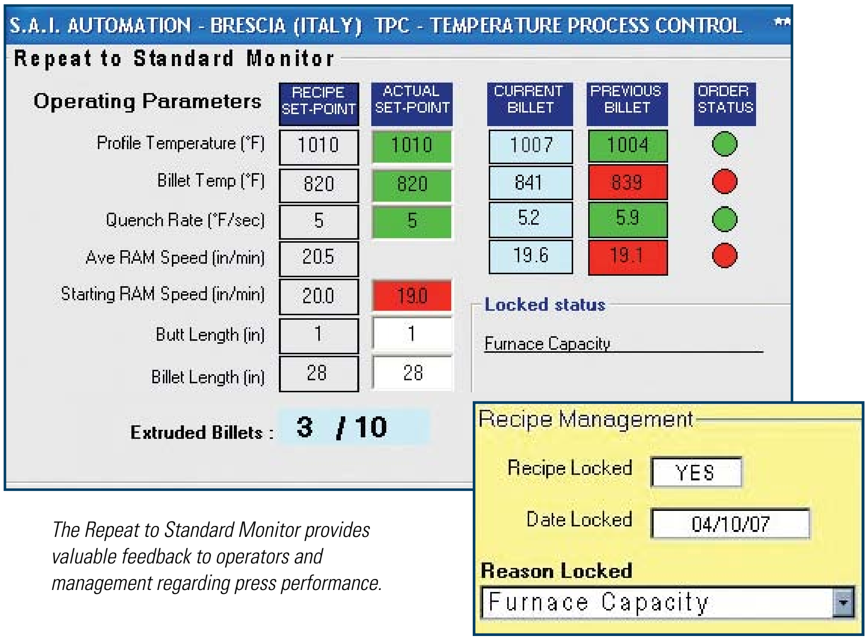
TPC PERFORMANCE INDICATORS

- Average ram Extrusion Speed
- Extrusion Time
- Profile Temperature Compliance
- Repeat to Standard (R2S) Compliance
- Productivity
- Recovery

A SYSTEM FOR CONTINUOUS PROCESS IMPROVEMENT

As the figure above illustrates, the **Temperature Process Control (TPC) System** enables a systematic and scientific approach to define, implement, and evaluate Best Practices Standards for the extrusion process. The foundation of the system is a recipe database that makes it easy to optimize and integrate the Best Practices Standards into the daily operation of the press.

TPC Feature	Process Benefit
The **Recipe Manager** and **Order Manager** make it easy for each operator to setup and use recipes that are optimized for the unique requirements of the press, the profile, and the condition of the die.	With each operator on each shift using the Best Practices Standards, the consistency of the press performance is dramatically improved.
The **Control Module** uses live temperature feedback to enable automatic closed loop control of the billet feed temperatures and the profile temperatures at the platen exit.	These automatic adjustments to the process help to maintain optimal results for each operator, shift, and changing process condition.
The **Best Extrusion Analyzer** uses the average ram speed and recovery rate to automatically capture the recipes used for the top five extrusions of each die.	This utility provides a quick and easy way to analyze and update the optimal values for each recipe.
The **Reporting Module** captures data that can be queried, viewed, and exported by billet, by order, by shift, by die copy, and by date.	Saves and organizes critical process and production data to aid in continuous process improvements.



The Repeat to Standard Monitor provides valuable feedback to operators and management regarding press performance.

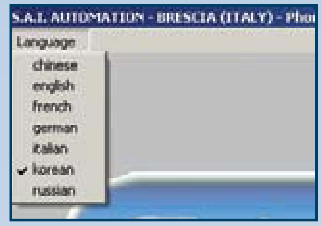
EFFICIENTLY ANALYZE AND OPTIMIZE THE EXTRUSION PROCESS

With the innovative **Repeat to Standard (R2S) Monitor,** the system provides immediate feedback to operators regarding the press performance to Best Practices Standards as well as valuable reports for analysis by management. Important features include:

- The unique **Recipe Locking** feature enables each recipe to be systematically tested until a process constraint limits the system from going any faster without degrading the production quality. The status of this recipe is then changed to 'Locked' and the date and reason for locking the recipe are recorded.
- As each die is run with the system, the **R2S Monitor** clearly displays when recipe values have been optimized, and if the recipe is locked, the system automatically activates status lights and reporting features to track the actual process performance on key recipe values.
    - Green status lights indicate a parameter is within an acceptable range.
    - Red status lights indicate a parameter is outside an acceptable range.
    - For the order status, red, yellow, and green lights are displayed based on the percent of billets that are within an acceptable range for each order.
    - The **R2S Compliance Parameter** provides a summary measurement of the press performance by calculating the percent of green lights out of the total number of lights for all parameters on each respective order and shift.
- Advanced TPC Reports make it easier to quantify and prioritize the extent of problems at the press. This enables more informed decisions about potential investments in the process. For example, if a significant percent of the recipes are locked due to the heating capacity of the furnace, then this can help justify an investment in the furnace to resolve this bottleneck.

SUPPORTS INTERNATIONAL LANGUAGES

With a simple menu selection, it is easy to change TPC screens between different languages.



DIE CHANGE AND DOWNTIME MONITORS

The TPC System includes many advanced utilities and reports that make it easy to analyze and optimize recipes, identify process bottlenecks, and implement process improvements to reach higher levels of performance.

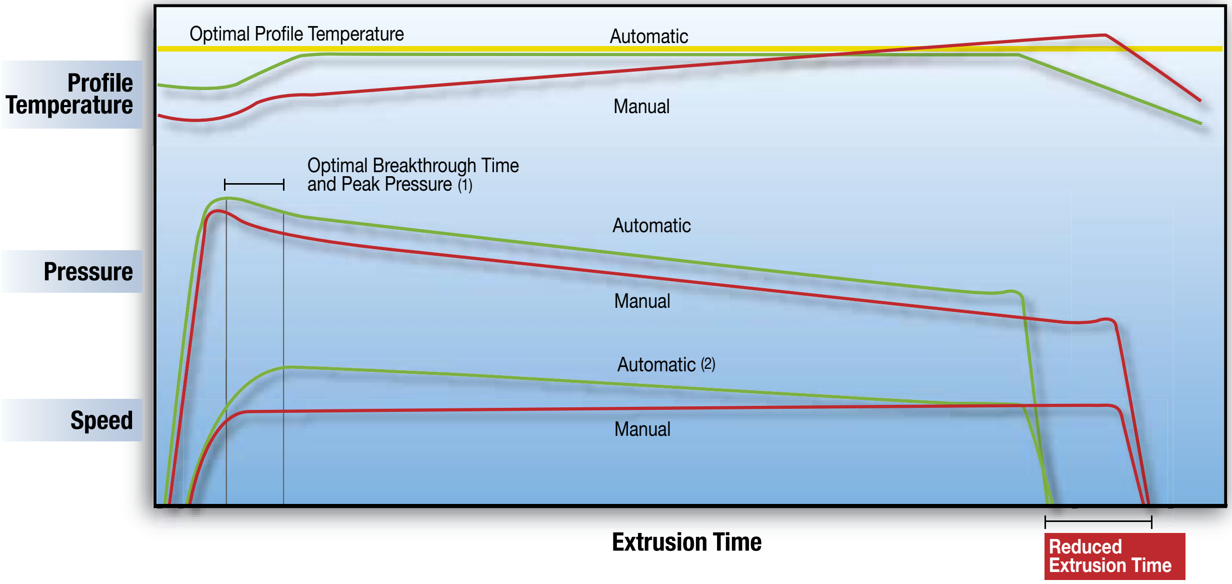
These utilities include a **Die Change Monitor** and a **Downtime Monitor**. Each of these functions automatically triggers a pop up window that prompts the operator to select a descriptive code that documents key process information as it happens at the press. For example, the operator is prompted after each die change to select the reason for the change from a customized drop down list. This information is then saved in a report for future review.

Die Change Monitor

Downtime Monitor

Automatic Closed Loop Control for Improved Quality, Increased

Manual vs. Automatic Control on Each Billet



(1) The Billet Control Module is configured to the unique conditions of each press so billet feed temperatures optimize breakthrough time and peak pressure
(2) With tapered billet heating systems, a constant speed is maintained during each billet

COMPENSATES FOR A WIDE RANGE OF DYNAMIC OPERATING CONDITIONS

The extrusion process is a dynamic thermal forming operation which must be managed to maintain optimal performance on each and every billet. The TPC System accurately and continuously coordinates all of the required adjustments automatically so that the operator does not need to be a thermal management expert to run the press. In addition, the TPC System includes many fail-safe features that maintain quality and safety by automatically recognizing abnormal operating conditions where more extreme adjustments should not be applied. For example:

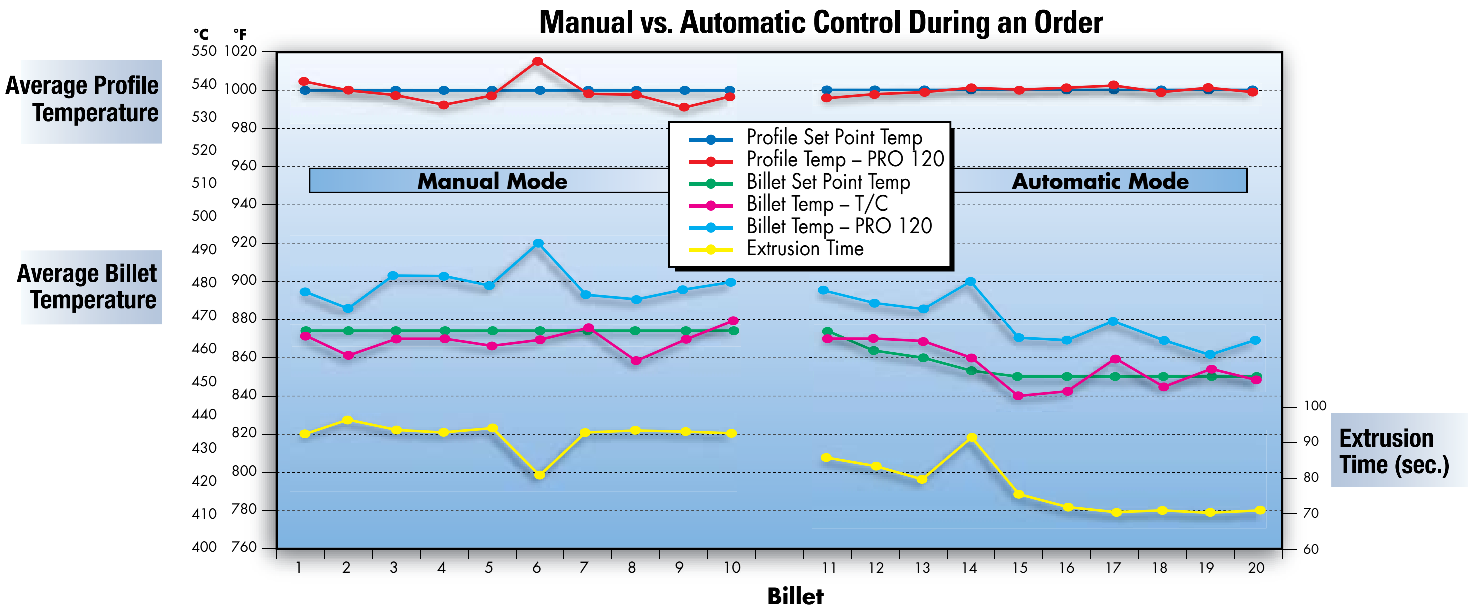
- **Control limits** are used to restrict the adjustments that can be applied by the TPC System. This includes limits to the billet temperature offset and the dynamic and step speed offsets.
- **Emissivity** and **Temperature limits** are used to verify the temperature inputs before control adjustments are applied. If the measured emissivity or temperature are outside acceptable limits, the system automatically stops making adjustments to the process.
- **System Diagnostics** are used to monitor the network and automatically switch the system from automatic to manual control if communication is lost between any of the PLCs or the TPC System.

AN INNOVATIVE TEMPERATURE-BASED CLOSED-LOOP DESIGN

Unlike speed and pressure-based control systems which assume that billet feed temperatures are constant and temperature inputs are simply used to select the appropriate control model, the TPC System uses live temperature inputs and a learning-based architecture to continuously tune the process so that extrusion times are reduced and consistent quality is maintained. Specific controls include:

- **Dynamic Speed Control:** During the extrusion of each billet, the press speed is continuously adjusted with a speed offset to maintain the optimal temperature at the platen exit for each profile.
- **Step Change Speed Control:** A 'learned' speed offset is applied to the starting speed for each successive billet. The total speed offset applied to the process is equal to the Dynamic Offset plus the Step Speed Offset.
- **Billet Temperature Control:** The temperature set-point in the final zone of the billet furnace is automatically adjusted with a temperature offset to optimize the breakthrough time and the peak pressure. For example:
  - If the breakthrough time is too short, then the billet temperature is automatically decreased to increase the pressure.
  - If the breakthrough time is too long, then the billet temperature is automatically increased to reduce the breakthrough time (the typical breakthrough time is between 4 to 8 seconds).
- **Tapered Billet Control:** If required, two temperature set point adjustments are provided to control the billet temperature gradient so that the optimal temperature at the platen exit is achieved while pushing with a constant speed.
- Advanced options to automate the control of **quench rates** and **nitrogen die cooling** are also available.

Productivity, and Better Consistency



Total Extrusion Time is reduced 17%, and with an average dead time of 25 seconds, this translates into a 13% reduction in the cycle time.

UNEQUALLED PERFORMANCE WITH THE TPC SYSTEM

To illustrate the benefits of the TPC System, the figure above compares the following parameters on 10 billets run manually versus 10 billets run with automatic TPC control.

- **The Profile Temperature:** Both the set point and the actual profile temperature are compared to verify that the optimal press speed and quality are achieved.
- **The Billet Temperature:** The final zone set point and the actual billet temperatures from the furnace thermocouple and the infrared thermometer are all compared to illustrate the challenge of optimizing billet feed temperatures.
- **The Actual Extrusion Time** is recorded for each billet to measure performance.

TPC Feature	Process Benefit
On billets 11-13, the system automatically adjusts the press speed to maintain the optimal temperature throughout the entire length of the profile.	By maintaining the optimal profile temperature, the extrusion time is reduced by 8 to 10 seconds as compared to billets 1 - 10 that were run manually.
On billets 15-20, the billet furnace temperature set-point is automatically lowered to optimize the break-through time and maximize the press pressure.	Lower billet temperatures maximize press pressure. This reduces the extrusion time by an additional 13 seconds or 20 seconds overall.
Billets 6 and 13 illustrate how the system adjusts to variations in billet temperatures. On billet 6, the operator does not adjust the press speed to compensate for the hotter billet, while on billet 13, the system automatically reduces the speed to maintain optimal temperatures and quality.	On billet 6, the quality may be compromised because the profile temperature is higher than the optimal target temperature. Frequently, operators run at lower temperatures and speeds to avoid quality problems which significantly reduces press production.

OPTIMIZING BILLET FEED TEMPERATURES

Inconsistent billet feed temperatures, like those above, frequently represent a significant opportunity for improvement.

Optimize the Billet Temperature Set-Point: The optimal billet set-point maximizes the peak pressure while maintaining the optimal breakthrough times and the metallurgical properties of the billet.

Deliver Accurate & Repeatable Billet Feed Temperatures: Actual billet feed temperatures vary significantly due to the inaccuracy of billet furnace contact probes. Dull probes read low causing actual billet temperatures to be high, while probes that are exposed to furnace flames can measure high causing actual billet temperatures to be below set-point.

Uniformly Heat the Billets: While applied heat is distributed rapidly throughout the billet, process conditions can often result in uneven heating of billets. In the worst case, when there are mechanical issues in the furnace or when the billet length does not match the length of the heating zone, it is possible to get a reverse taper. With this reverse taper condition, the operator struggles to run the press consistently because the leading end of the billet is too cool and requires excessive time at the start of the profile, while the trailing end of the billet is to hot and requires the press to slow down in order to maintain the optimal profile temperature at the exit of the press.

An Innovative Design for Temperature Process Control

FLEXIBLE AND SCALABLE TPC DESIGN

The **Essentials Module** is the foundation of the TPC System which can be used with either the **Basic or Advanced Configurations**. This module features:

- An Essentials Recipe Database
- An Essentials Report Module
- Profile Temperature Control
- Billet Temperature Control
- Optional Modules for Die Temperature, Quench Rate, and Nitrogen Cooling

The following modules require the **Advanced Configuration** to enable remote user access to these advanced recipe and reporting functions.

- The **TPC Management Module** expands the Essentials Recipe Database and Reports to include more detailed information. In addition, the **Order Manager** enables detailed recipes to be used with each order, and the **Product Calculator** automatically calculates key parameters such as the billet length, number of billets, and run out length. The **Best Extrusion Analyzer** simplifies analysis and optimization of recipes by using the average ram speed and recovery rate to automatically save the recipes used for the top 5 orders of each die.

- The **Best Practices Module** features innovative functions to manage and track performance relative to Best Practices Standards. A **Repeat to Standard (R2S) Monitor** enables systematic management of recipe values and advanced tracking of performance with status lights, detailed reports, a unique lock recipe function, and the ability to track performance by order and shift. **Die Change and Downtime Tracking Utilities** automatically trigger popup windows to track each process condition for management reports.

- The TPC System can be customized to **automatically exchange data** with other plant applications to eliminate data entry tasks and make it easier to share information. For example, order details can be transferred directly into the TPC System while TPC production data can be automatically shared with other plant applications.

- For a complete integrated extrusion manufacturing system, **SAI's ECN System** works with the TPC System to enable greater automation and management capabilities with Modules for Order Entry, the Die Shop, the Stretcher, and Packaging.

EASY TO INTEGRATE WITH EXISTING CONTROLS

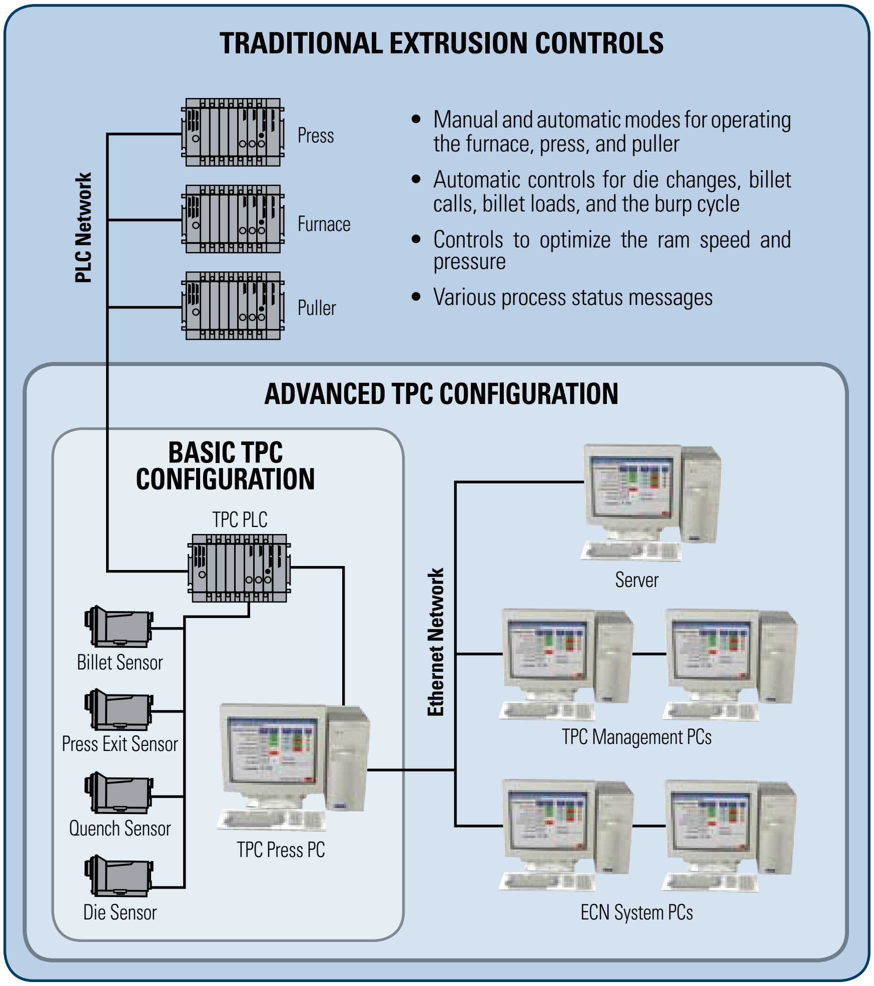
The TPC System features an innovative design that is easy to implement and operate because it works with, instead of replaces, the traditional extrusion controls. Important features include:

- Flexibility to **integrate with traditional control systems** ranging from manually operated relay logic systems to fully automated PLC based systems from a variety of manufacturers.

- A **Basic Configuration** that only requires the TPC PLC, press PC, and temperature sensors to enable the powerful features of the Essentials Module and the optional Essentials Control Modules.

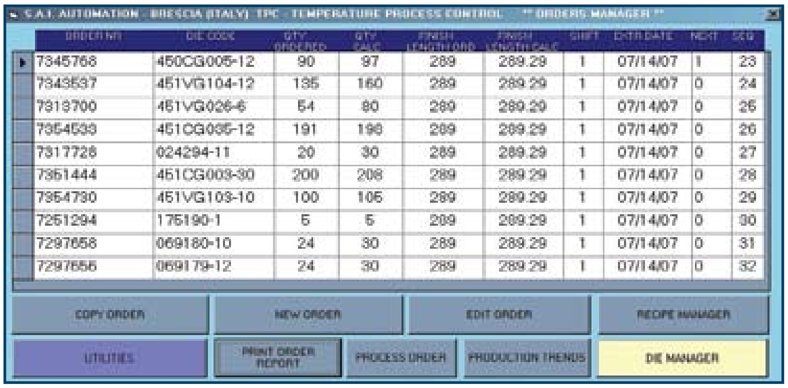
- An **Advanced Configuration** which enables the addition of the Management and Best Practices Modules, or the Remote Essentials Module. With this configuration, the TPC database is setup on a server in the plant, so the operator can run the Essentials Module from the press PC while other users access the order, recipe, and report information from other management PCs on the network.

- It is possible to start with the **Basic TPC Configuration** and then upgrade to the **Advanced TPC Configuration** as more functions are added to the system.

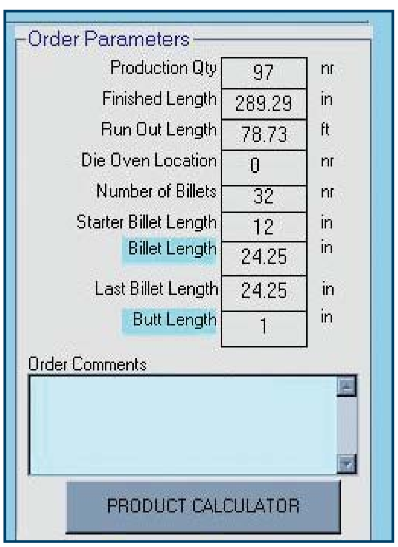


AN INNOVATIVE SYSTEM THAT IS EASY TO USE

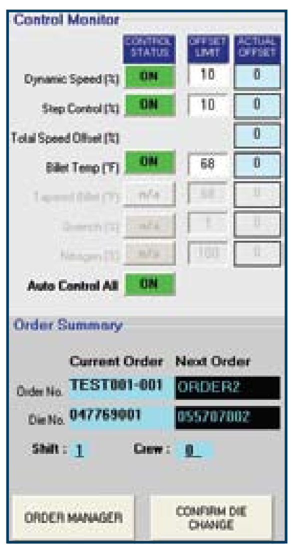
The graphical design of the TPC System makes it easy for the operator to setup and use the prescribed recipes for each order. Simply setup the order, verify the recipe values, and turn on the automatic controls.



STEP 1 – Using the Order Manager, setup the order by entering the order number, order quantity, and the specified profile length. Then select the die copy from the recipe database to automatically load in the specified recipe values.



STEP 2 - Using the Recipe Manager and Product Calculator, confirm the billet length, number of billets, and run out length which are automatically calculated by the system.



STEP 3 – From the Operator Console, confirm the die change to load all of the order and recipe values for the next order and with the push of one button enable the automatic controls. The R2S Monitor, the Process Trends Graph, and the Performance Summary statistics are then used to verify press performance.

IMPLEMENTING THE TPC SYSTEM

The unique design of the TPC system enables it to be implemented in one week with little or no down time at the press. The typical TPC Project is a follows:

System Specification

The tasks to complete this phase are:

- Complete the TPC Questionnaire to define the requirements of the installation
- Define the exact TPC System Configuration which will integrate with the existing controls
- Confirm which TPC Modules to include

System Installation

With the specifications clearly defined, it is then a simple process to deliver, install, and test the system. The tasks to complete this phase are:

- Customize the TPC Recipe Database to the plant's Best Practices Standards
- Create the recipe database with default values for each die copy
- Receive and install the components of the TPC system per the supplied wiring documentation
- In one week of on-site work, complete the programing and commissioning of the system, as well as operator training

Optimizing the Recipes

The systematic optimization of the recipe values is as follows:

- The default recipe values produce a dramatic improvement in the productivity and consistency of the press performance as each operator uses the same settings to run the press.
- Greater improvements in process throughput and quality are achieved as the default recipe values are optimized using the TPC System feedback
- Once a recipe has been optimized, the recipe is locked and tracked by the Repeat to Standard (R2S) Monitor to verify that these proven standards are maintained.
- If the limiting constraint is removed, then the recipe is unlocked and optimized for the new conditions at the press.

Improving Product Quality and Process Productivity Through

ADVANTAGES OF PRO 120 FOR ALUMINUM EXTRUSION

Accurate

- Selectable ESP algorithms for Billet, Press Exit, and Quench measurements eliminates the need for field calibration on different alloys and shapes
- Advanced design enables broad temperature ranges for extrusion applications with greater accuracy and stability

Reliable

- Industry-leading signal dilution factor ensures easy alignment to small and wandering extruded profiles
- Accurate measurements are made with as little as 15% of the targeted area filled
- Tolerates more than 85% optical obstruction due to dirty optics, smoke, steam or a partial filling of the field of view
- A rugged NEMA 4X enclosure for hostile operating environments

Easy to Use

- Text-based menu system assures easy setup and operation
- Integrated laser aiming for quick and easy alignment verification at all distances, and assures long laser life
- Built-in signal strength/emissivity measurement provides information for process verification and optimization
- Versatility – a universal design which enables one sensor model to be used for all applications

GREATER ACCURACY FOR IMPROVED TEMPERATURE CONTROL

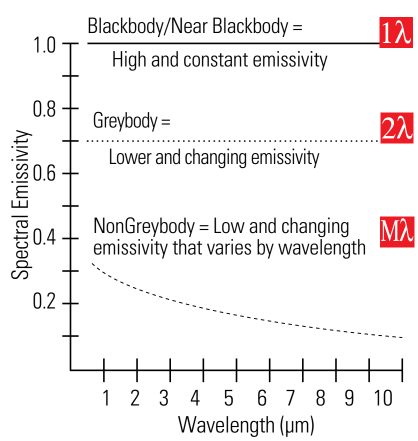
Infrared thermometers measure the amount of infrared energy emitted by an object's surface, and then convert this signal into a temperature value. While many factors affect the measurement accuracy, the most important consideration is the selection of the sensor that most effectively compensates for the emissivity characteristics of the measured surface.

Emissivity is a measure of the amount of infrared energy emitted from a surface relative to its theoretical maximum for a given temperature. As the figure below illustrates, single- and dual-wavelength infrared thermometers are used for traditional applications that exhibit 'near blackbody or 'greybody' conditions, while multi-wavelength sensors are required to compensate for the complex emissivity characteristics of 'non-greybody' materials such as aluminum.

In order to optimize the extrusion process, the TPC System must have accurate and reliable temperature values to precisely control the process. Traditionally, aluminum extrusion applications present many unique challenges for infrared thermometers as the emissivity of aluminum varies with changes in alloy, surface oxidation, surface texture, surface contamination, and crystal structure. However, with the powerful advances in microprocessor and infrared technology, Williamson's Pro 120 multi-wavelength design out performs all others by accurately measuring aluminum temperatures under diverse industrial conditions without any manual calibration adjustments.

The Pro 120 sensors use ESP algorithms to calculate the accurate temperature and emissivity of aluminum by considering infrared energy, emissivity, and the measured wavelengths. These algorithms are computer-based empirical models that have been developed from extensive on-line trials and off-line process simulations for each application. Each sensor includes up to four algorithms for the different measurement locations in the process.

Surface Emissivity Characteristics



The multiwavelength Mλ sensors are required for the complex characteristics of aluminum.

Sample Multi-Wavelength Field Data

Alloy Set	Average Emissivity	Average Variation(1)	Standard Deviation(2)
Billet Face Measurements			
2024	0.043	5°F	4°F
6061	0.065	-3°F	3°F
7075	0.051	4°F	5°F
Profile Measurements			
2024	0.032	6°F	4°F
6061	0.059	5°F	3°F
7075	0.027	-4°F	7°F

Note 1: The sample data represents a wide range of surface and operating conditions, including data from several extrusion plants on a wide range of shapes.

Note 2: As illustrated by the standard deviation values, an ESP algorithm is assigned to each measurement location to provide accurate and repeatable readings regardless of alloy type.

Temperature Process Control

INFRARED TEMPERATURE SENSORS FOR ALUMINUM EXTRUSION

TPC Function	PRO Temperature Sensor
Profile Temperatures at the Platen Exit	
The profile temperature is the most important process parameter in the TPC System as it is the primary value used to optimize the speed and quality of the extrusion operation.	The PRO 120 is mounted on an automated panning bracket at the exit of the press to ensure that the sensor is properly aligned and that accurate profile temperatures are provided to the TPC System.
Billet Feed Temperatures	
Billet feed temperatures are optimized as the TPC System automatically adjusts the billet furnace set point.	The PRO 120 is aligned to view the face or side of the billet between the billet furnace and the container to ensure accurate billet temperatures are provided to the TPC System.
When applicable, the TPC System can automatically adjust the temperature set points to optimize the tapered heating of billets	The PRO 120 is typically aligned to the face of the billet to provide real-time closed-loop control of the induction heating system.
Quench Temperatures and Quench Rates	
The TPC System offers a complete quench management system by calculating and saving the quench rates to ensure proper tensile properties are achieved.	The PRO 120 is mounted on an automated panning bracket in the quench zone to ensure that the sensor is properly aligned and that accurate quench temperatures are provided to the TPC System.
Die Temperatures	
The TPC System can automatically measure and save the die temperatures as the die is loaded into the press.	This measurement location uses a short wavelength, single-wavelength sensor to accurately measure the dies temperatures.

Billet Temperatures

Profile Temperatures

Die Temperatures

A COMPLETE SYSTEM FOR OPTIMIZING THE EXTRUSION PROCESS

The flexibility of the TPC System allows it to be easily configured for the requirements of each installation. Many customers start with the Basic TPC Configuration and then migrate to the Advanced TPC Configuration as they add in more advanced TPC capabilities.

Temperature Process Control (TPC) Functions

TPC ESSENTIALS MODULE (available with the Basic or Advanced Configurations)

- The Essentials Recipe Database enables key parameters to be saved and used with each die copy
- The Profile Temperature Control feature automatically optimizes temperatures at the exit of the press
- The Billet Temperature Control feature automatically optimizes billet feed temperatures
- Live Graphical Trends and Reports provide detailed information to the operator and management

System Components
- The TPC PLC supports Allen Bradley, Siemens, GE, and other PLC platforms
- A cabinet, a Windows® based PC, monitor, and SQL Server license
- PRO 120 Platen Exit Temperature Sensor
- PRO 120 Billet Temperature Sensor
- Automatic Panning Bracket for Platen Exit Sensor

OPTIONAL TPC CONTROL MODULES (available with the Basic or Advanced Configurations)

- The **Die Temperature Module** monitors and alarms on the die feed temperature
- The **Quench Rate Module** monitors and alarms on the profile quench rate
- The **Nitrogen Control Module** automatically adjusts the flow of liquid nitrogen to the die by providing an analog output for proportional control of the nitrogen valve

System Components
- PRO 120 Quench Temperature Sensor
- Gold 21 Die Temperature Sensor
- Automatic Panning Bracket for Quench Sensor

TPC MANAGEMENT MODULE (available with the Advanced Configuration only)

- The Advanced Recipe Database expands the essentials recipe database to enable remote user access as well as a complete set of parameters to enable a comprehensive system of Best Practices Standards
- The Order Manager enables detailed recipes to be used with each order, and the Product Calculator automatically calculates key parameters such as the billet length, number of billets, and run out length
- The Best Extrusion Analyzer simplifies analysis and optimization of recipes by using the average ram speed and recovery rate to automatically save the recipes used for the top 5 orders of each die
- Reports by Billet, Die, and Order make it easy to query and export detailed process and production data

TPC BEST PRACTICES MODULE (available with the Advanced Configuration only)

- A Repeat to Standard (R2S) Monitor enables systematic management of recipe values and advanced tracking of performance with status lights, detailed reports, a unique lock recipe function, and the ability to track performance by order and shift. The Management Module is required to implement this module.
- Die Change and Downtime Tracking Utilities automatically trigger popup windows to track each process condition for management reports

TPC REMOTE ESSENTIALS MODULE (available with the Advanced Configuration only)

For installations that do not include the TPC Management Module, the Remote Essentials Module provides remote access to the essentials recipe database and reports

TPC SERVICES

- Plan, configure, integrate, test, and train on the modules implemented
- Develop, install, and test PLC auto update functions to PLCs for custom process parameters
- Develop, install, and test automated exchange of recipe and report data with other plant applications
- Periodic Remote Training and Support via internet connection

TPC PRESS CONSOLE

The system can be delivered in a stand alone cabinet or mounted in the existing press console.

AUTOMATIC PANNING BRACKET

Platen Exit and Quench Senors are mounted on panning brackets which use sensor inputs to automatically align to the profile.

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