



IES

Isothermal Extrusion SAI
Temperature Process Control

***Isothermal Extrusion and
Liquid nitrogen die cooling***

2019

Main Variables in Extrusion

AIM

- Quality
- Constant Profile Temperature

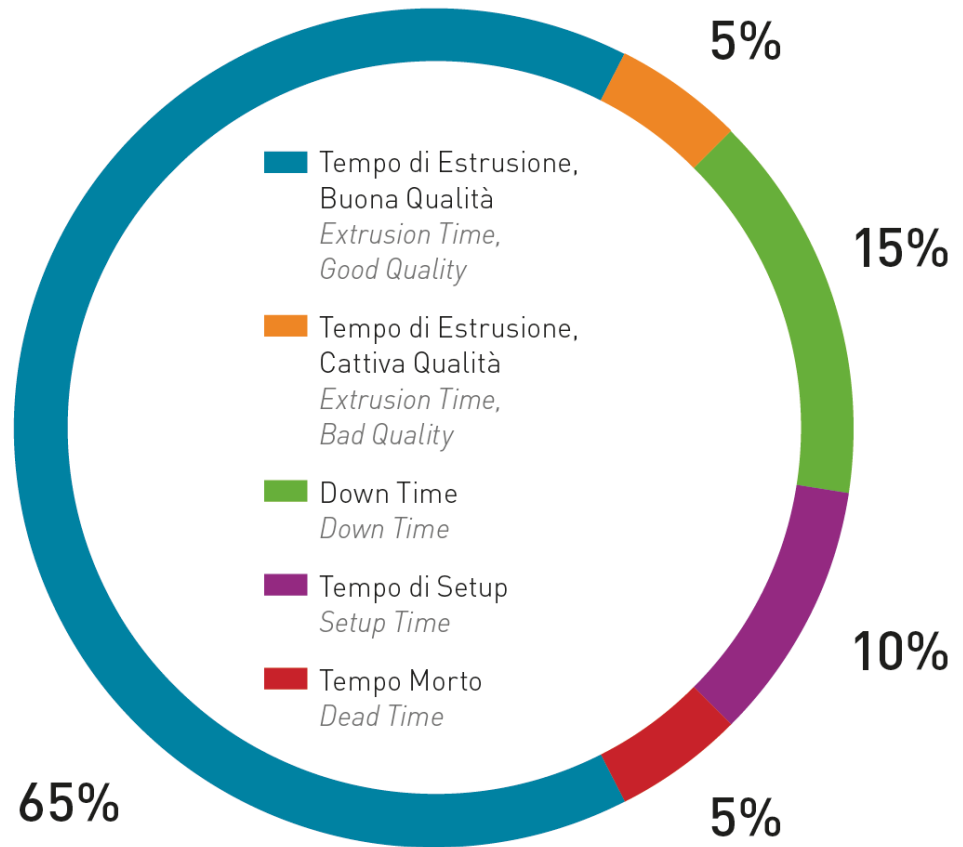
ACTION

- Extrusion Speed
- Billet Temperature

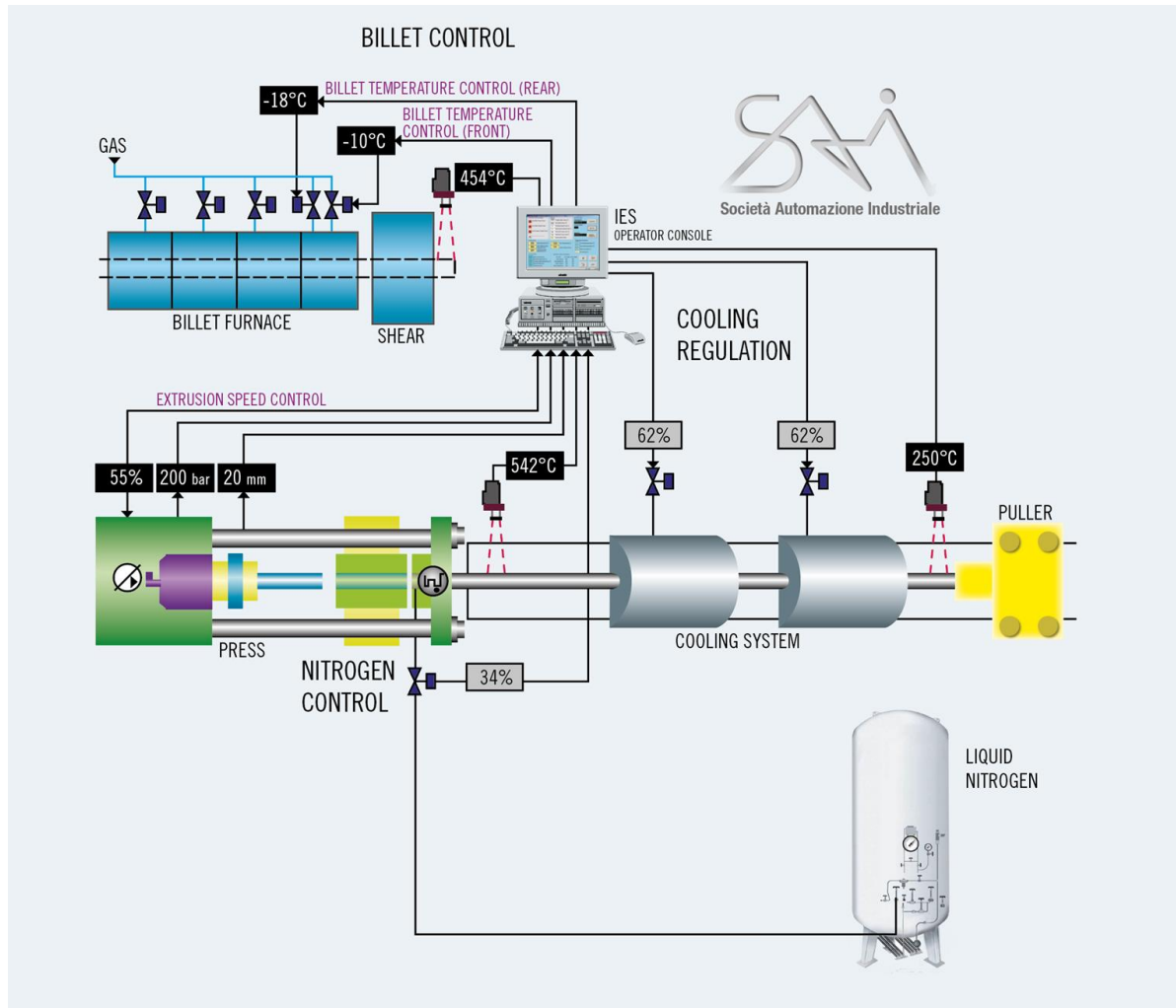
Targeted and effective action

Action on
Good Extrusion Time.

Even
small improvements
gets big results!



IES Configuration



IES Basic Components



INTERFACE PLC



SCANNER



DISPLAY



SENSOR

Scanner & Sensor

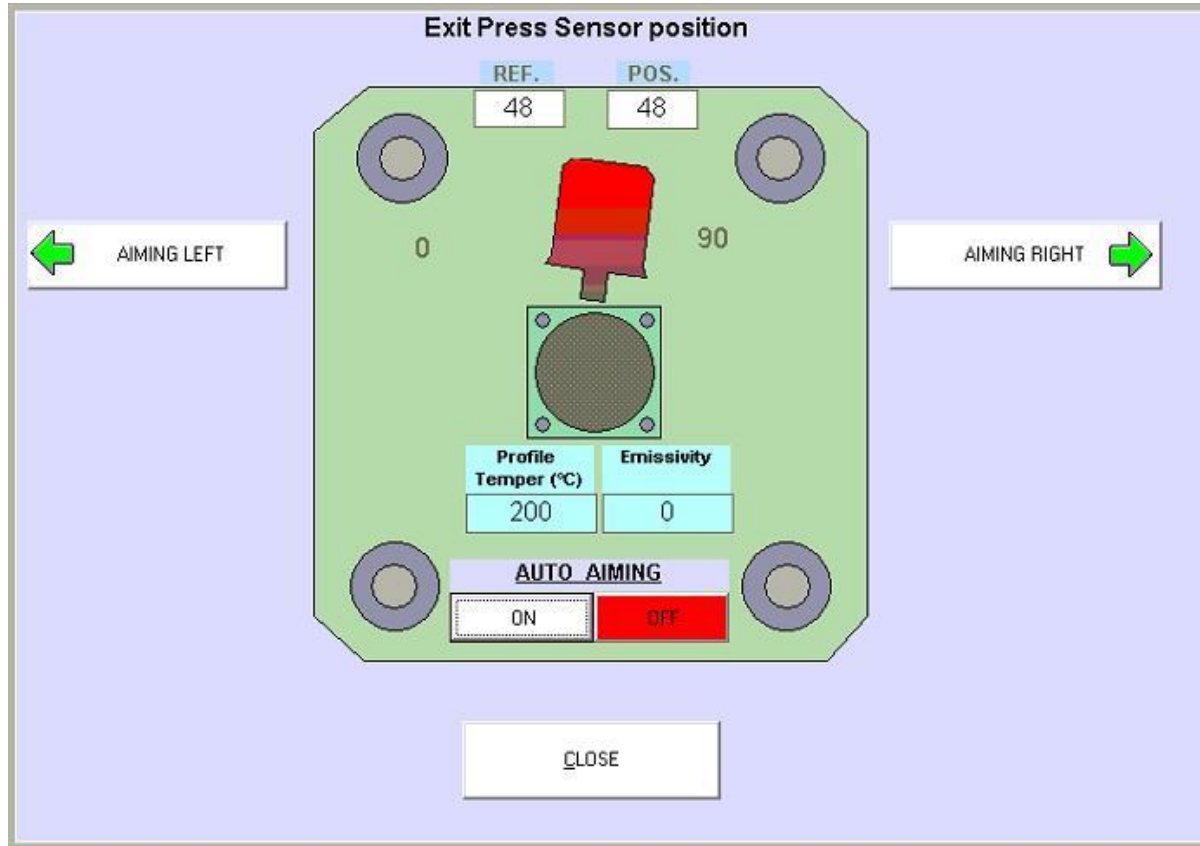


Automatic positioning
during the die change of
using the historic recipe

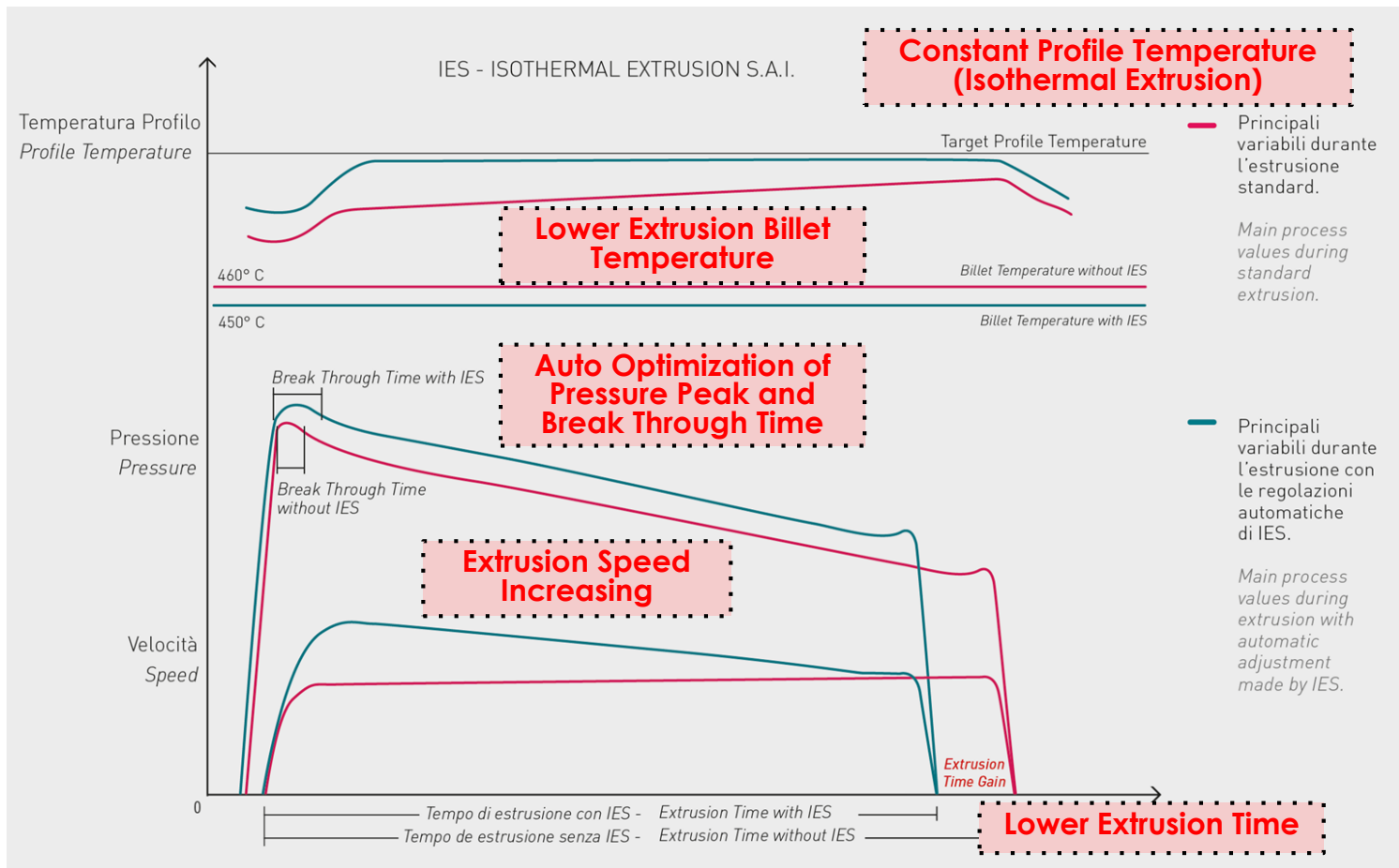
Automatic scan
when the profile is not in the
reading field

Manual positioning
using pushbutton in
dedicated page

IES – Sensor Position



Closed Loop Control and Optimization



Improving Reliability and Productivity of Aluminum Extrusion Process

- Maximize **Throughput, Quality, & Profitability**
 - Increase Press Speed 10-20%
 - Improve product quality with better surface finish, fewer defects, and reduced scrap
 - More consistent press performance with each operator running to Best Practices Standards
- **Closed Loop Control** automatically optimizes billet feed temperatures and profile temperatures at the exit of the press to increase speeds and assure high quality
- Detailed **Process and Production Reports** enable engineering and management to make informed decisions about process improvements

Operator Console

S.A.I. AUTOMATION - BRESCIA (ITALY) IES/TPC ISOTHERMAL EXTRUSION SAI/TEMPERATURE PROCESS CONTROL ** OPERATOR CONSOLE **

Extrusion Data

Running Die
20561-23

Extruded Billets (nr)
28

Next Die
[REDACTED]

NEXT DIE

Operating Parameters

	TARGET	ACTUAL
PRESS EXIT Profile Temp. (°C)	550	539
Billet Temperature (°C)	475	465
QUENCH Profile Temp. (°C)		15
Quench Rate (°C/sec)	1	0
Starting Ram Speed (m/min)	8.8	8.7
Die Temperature (°C)	480	0

Process Data

Peak Pressure (bar)	214
Break Through Time (s)	3.3
Average Profile Temp. (°C)	534
T/C Billet Temp. (°C)	0
Current Extrusion Time (s)	53
Current Dead Time (s)	20

Automatic / Manual settings

- ON Auto Dynamic Speed Control
- ON Auto Step Speed Control
- ON Auto Billet Temp Control
- OFF Auto Nitrogen Cooling
- ON Auto Set Profile Temperature

ING Control Parameters

	LIMIT	ACTUAL
Dynamic Speed Offset (%)	5	3
Step Speed Offset (%)	5	5
Total Speed Offset (%)		8
Front Billet Temp. Offset (°C)	10	-10
Rear Billet Temp. Offset (°C)	0	0
Nitrogen Output (%)	50	0
MIN Flux Nitrogen (%)	50	
MAX Flux Nitrogen (%)	70	

Diagnostic

- Auto Param 1* Bill ●
- Auto Parameters ●
- PC-PLC Communication ●
- Furnace Communication ●
- Press Communication ●
- Comunic. Puller ●
- Extrusion ●
- Die Change ●
- Exit Sensor Aiming ●
- Quench sensor Aiming ●

****ACTUAL EXTRUSION REPORT****

Date	Time	Extr Bill Nr	Profile Temp (°C)	Avg Extrus Speed (mm/s)	Extr Time (s)	Break TTime (s)	Avg Extr Press (bar)	Peak Press (bar)	Billet Temp (°C)	Dead Time (s)	Down Time (s)	Offset Step Speed (%)
12/04/2013	08:13:57	25	549	8.8	97	4.1	162	211	484	19	0	5
12/04/2013	08:15:10	26	543	9.3	54	2.7	147	172	484	19	0	5
12/04/2013	08:17:03	27	543	9.1	94	4.3	163	212	481	19	0	5
12/04/2013	08:18:16	28	540	9.4	53	2.3	147	173	483	19	0	5

MAIN MENU

PRODUCTION SUMMARY

ALERTS

PROCESS IREND

DIES DATABASE VIEW

12/04/2013 08:18

Isothermal Extrusion

How to Use

1 Set Up Die

The 'SETUP DIE' interface shows a dropdown menu for selecting a die and buttons for 'EDIT DIE', 'ADD NEW DIE', 'DELETE DIE', 'COPY DIE', and 'NEXT DIE TO BE EXTRUDED'. The 'ADD NEW DIE' interface shows a 'Die Code' field with 'TESTEGE0011' and a list of parameters to be set, including Target Profile Temp (540), Minimum Profile Temp (520), and various speed and temperature offsets. A 'Standard Target Parameters' table is also displayed.

Die type / Alloy	Exit Temp (°C)	Billet Temp (°C)	Quench rate (°C/sec)	Die temp (°C)	Extr Speed (m/min)
Solid 1 hole (°C)	540	450	5	500	10
Solid multi holes (°C)	580	460	5	510	10
Hollow 1 hole (°C)	560	470	5	520	15
Hollow multi holes (°C)	550	480	5	530	15

3 Set Auto vs Man and Offset

The 'Automatic / Manual settings' section shows toggle switches for 'Auto Dynamic Speed Control', 'Auto Step Speed Control', 'Auto Billet Temp Control', 'Auto N', and 'Auto S'. The 'Control Parameters' table shows the relationship between 'LIMIT' and 'ACTUAL' values for various parameters.

	LIMIT	ACTUAL
Dynamic Speed Offset (%)	5	3
Step Speed Offset (%)	5	5
Total Speed Offset (%)		8
Front Billet Temp. Offset (°C)	10	-10
Rear Billet Temp. Offset (°C)	0	0
Nitrogen Output (%)	50	0
MIN Flux Nitrogen (%)	50	
MAX Flux Nitrogen (%)	70	

2 Set Exit Temperature

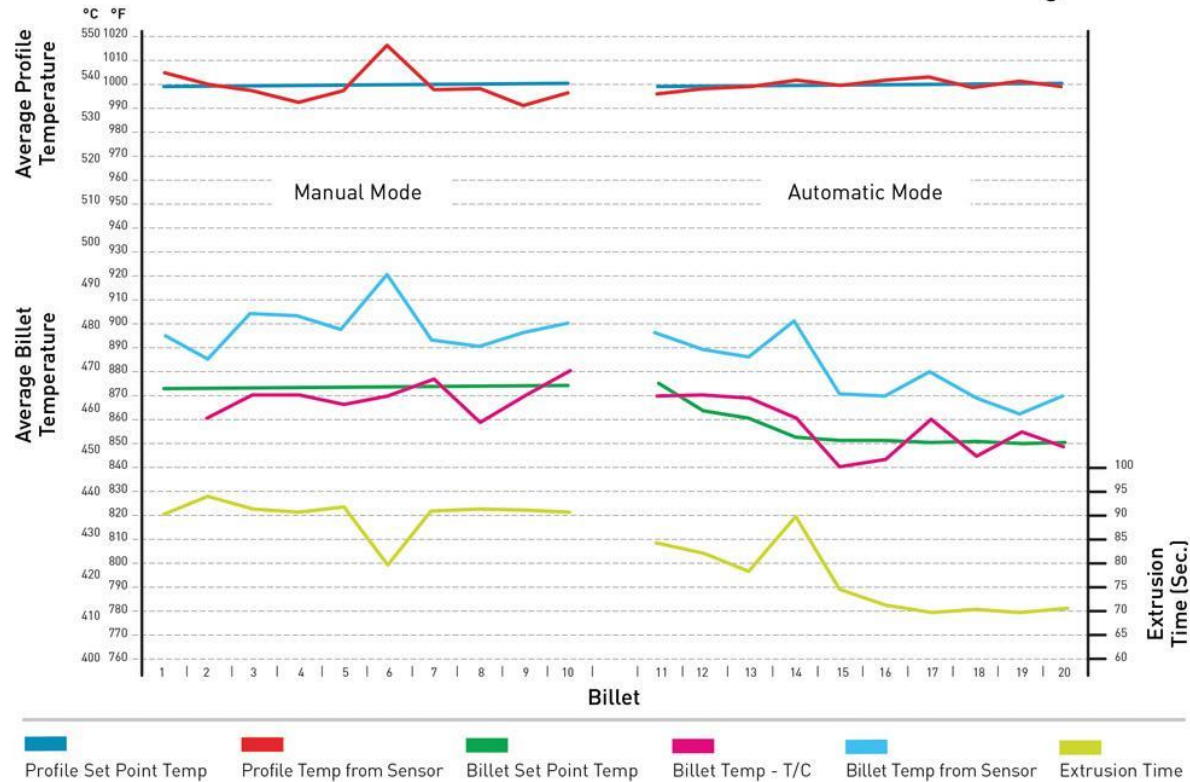
The 'Operating Parameters' section shows 'PRESS EXIT Profile Temp. (°C)' with a target of 550 and an actual of 539. 'Billet Temperature (°C)' is set to 475 with an actual of 465. 'QUENCH Profile Temp. (°C)' is set to 15.

Auto Set Profile Temperature

Manual press works as usually
Automatic
IES applies continuous adjustment

Manual vs Automatic

Manual vs. Automatic During an Order



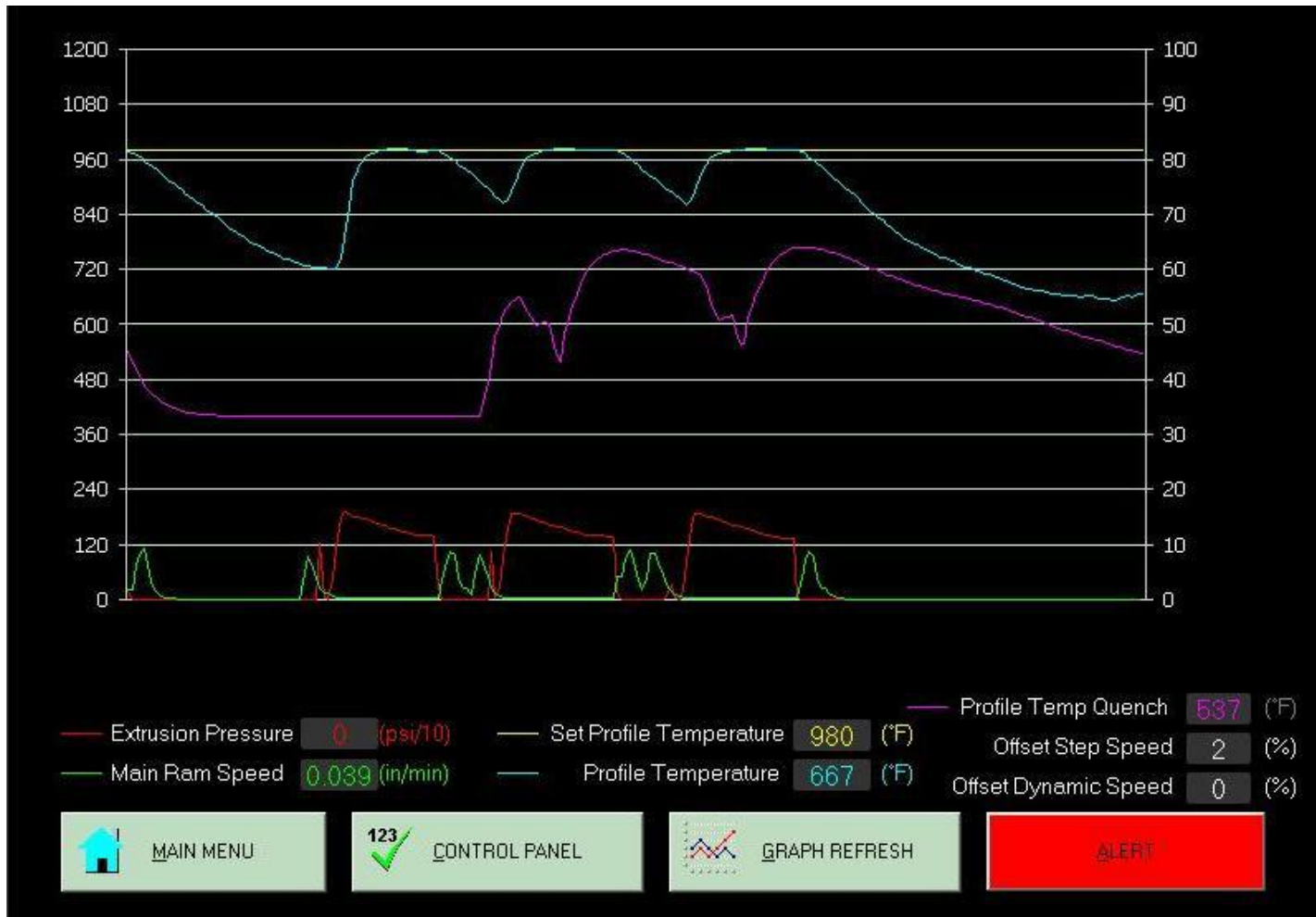
17% Reduction in Extrusion Time with no sacrifice in quality

Automatic Temperature Control with IES

In **manual mode**, the press operates with the same controls that are used today, and in the **automatic mode IES** makes continuous adjustments to maintain best practices standards

- **Billet Temperature Control** applies a temperature offset to the final zone of the Billet Furnace. Two temperature offset adjustments are available for furnaces with tapered heating capabilities (front and rear billet)
- **Dynamic Speed Control** continuously calculates and applies a percent change (offset) to the press speed in order to maintain the optimal press exit temperature during the extrusion of a billet
- **Step Change Speed Control** applies a “learned” percent change (offset) to the starting speed for the next billet on the same die

Process Trend



Data collection & Reports

** CURRENT EXTRUSION REPORT **

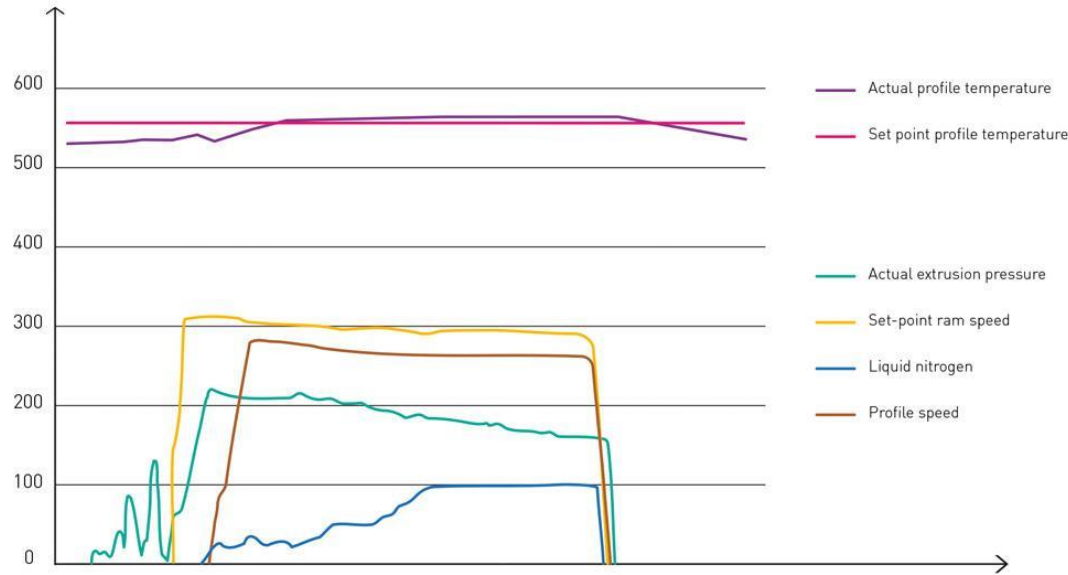
Date	Shift	Time	Order Number	Die Code	Extruded Billet N°	Set Profile Temp (°F)	Average Profile Temp (°F)	Ram Speed Target (in/min)	Ave Ram Speed Target (in/min)	Extr Time (sec)
▶ 06/16/2009	1	09:51:49 AM	ORDER21	027157-100	1	1020	953	12	12	102
06/16/2009	1	09:54:22 AM	ORDER21	027157-100	2	1020	978	12	12	101
06/16/2009	1	09:56:56 AM	ORDER21	027157-100	3	1020	977	12	12	101
06/16/2009	1	09:59:30 AM	ORDER21	027157-100	4	1020	978	12	12	101
06/16/2009	1	10:02:03 AM	ORDER21	027157-100	5	1020	977	12	12	102
06/16/2009	1	10:20:42 AM	ORDER21	027157-100	12	1020	980	12	12	102
06/16/2009	1	10:22:26 AM	ORDER21	027157-100	13	1020	980	12	12	102
06/16/2009	1	10:24:50 AM	ORDER21	027157-100	13	1020	980	12	12	92
06/16/2009	1	10:25:01 AM	ORDER21	027157-100	14	1020	978	12	12	103
06/16/2009	1	11:35:34 AM	ORDER21	027157-100	41	1020	977	12	12	19
06/16/2009	1	11:36:57 AM	ORDER21	027157-100	42	1020	977	12	12	102

#Records: 11

IES collects all production data and they are stored in a database.

Data referred to billet, die, alert and failure is disposable in every moment for internal review, statistics and maintenance.

Liquid Nitrogen Die Cooling



Improved quality surface

- limited profile oxidation at the die exit;
- dimensional quality improved;
- scrap rate reduced;
- optical appearance improved.

Increased die life

- protection of die and backer from overheating and deformation;

Reduced press down time

TEST RESULT

Alloy: 6086L

Profile Type: Tube

35 mm diameter
3 mm thickness

Speed

Standard Value

With Liquid Nitrogen

Managed by IES

from 13 to 15 m/mm
26 m/mm

30% SPEED INCREASING

40% NITROGEN SAVING

20% DIE LIFE EXTENSION

IES Configuration

