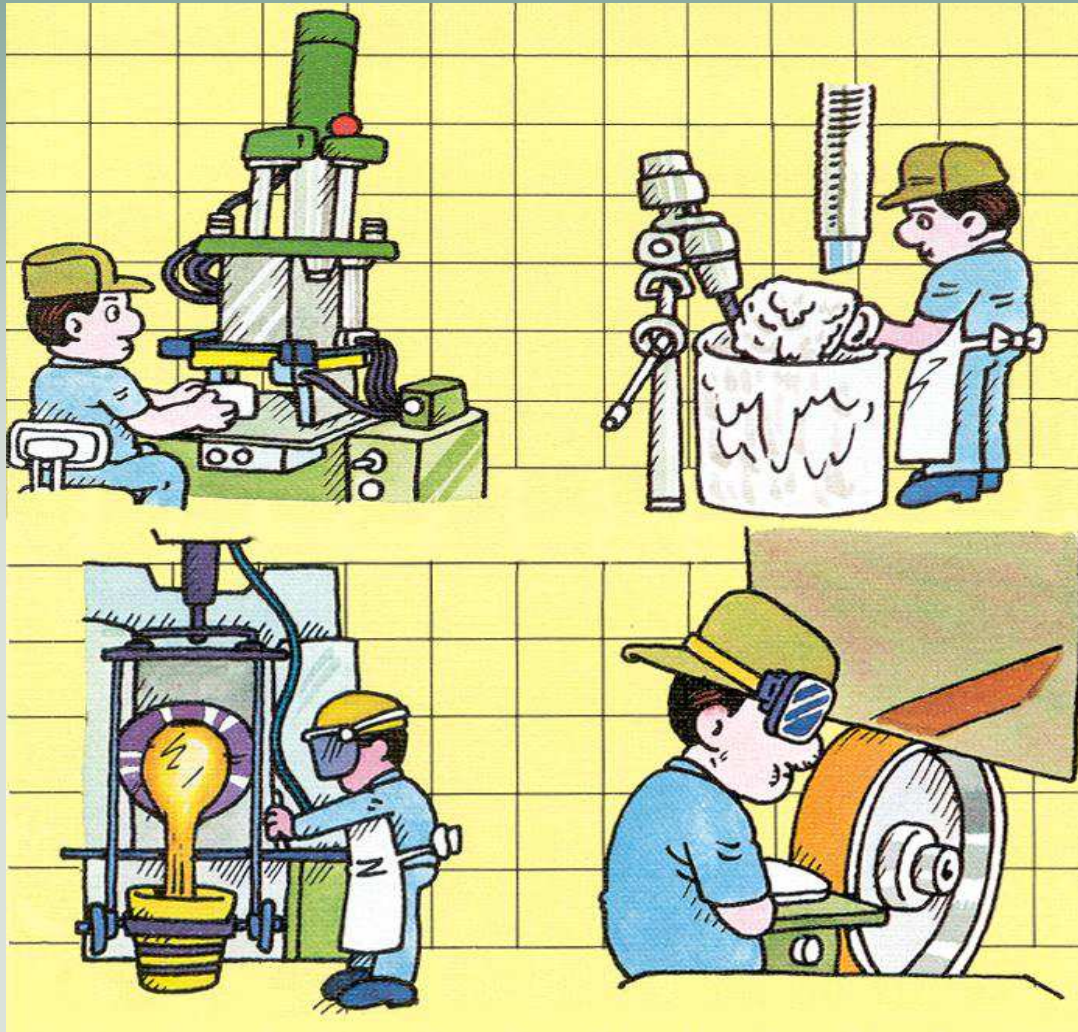


Investment Casting Institute Technical Conference & Expo Milwaukee Oct. 22-25

Knowing Your Investment Casting Process



Knowing Your Investment Casting Process

Losing business on price or quality will continue until your customers know that by using your castings it will allow them to produce their products for less money than those supplied by your competition.

Knowing Your Investment Casting Process

Losing business on price or quality will continue until your customers know that using your castings will allow them to produce their products for less money than those supplied by your competition.

This is a common thread in any business. Unless you adjust to the market your business will not survive. Now many of the foundries here today have done a fantastic job competing in the world market. You are supplying castings with added value by performing secondary operations such as machining, painting, and assembly.

Knowing Your Investment Casting Process

To remain competitive you continually ask yourself, what else can I do to stay ahead?

Knowing Your Investment Casting Process



Where else in my process can I make improvements that will result in gains to my bottom line?

Knowing Your Investment Casting Process

Today I want to talk to you about how you can increase your profitability with your existing process.
First let me tell you a little bit about MPI and how we developed what I will present.

Knowing Your Investment Casting Process

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MPI has been a part of the investment casting industry for 34 years, we have focused entirely on wax preparation and wax injection equipment. This long-term commitment to a narrow niche of the investment casting process has enabled us to become the acknowledged expert in the wax room.

Knowing Your Investment Casting Process



Six years ago, we began developing the MPI Automated Pattern Assembly System, APAS.

Knowing Your Investment Casting Process



Six years ago, we began developing the MPI Automated Pattern Assembly System, APAS.

As of today we have installed six operating systems in four major sectors of the industry:

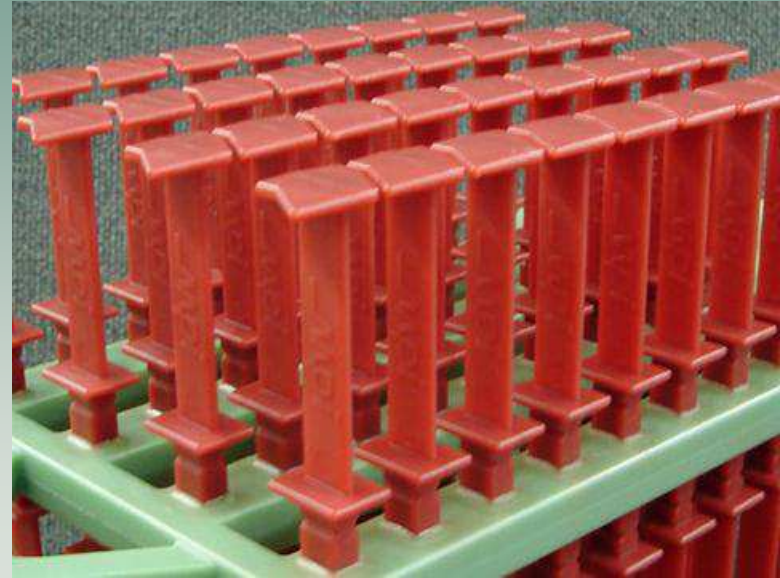
Knowing Your Investment Casting Process



Fire Arms

Knowing Your Investment Casting Process

Aerospace



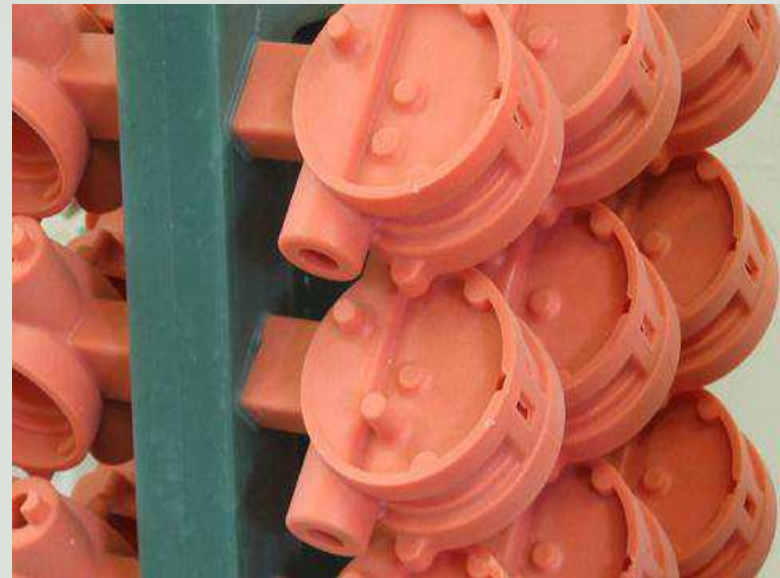
Knowing Your Investment Casting Process



Golf

Knowing Your Investment Casting Process

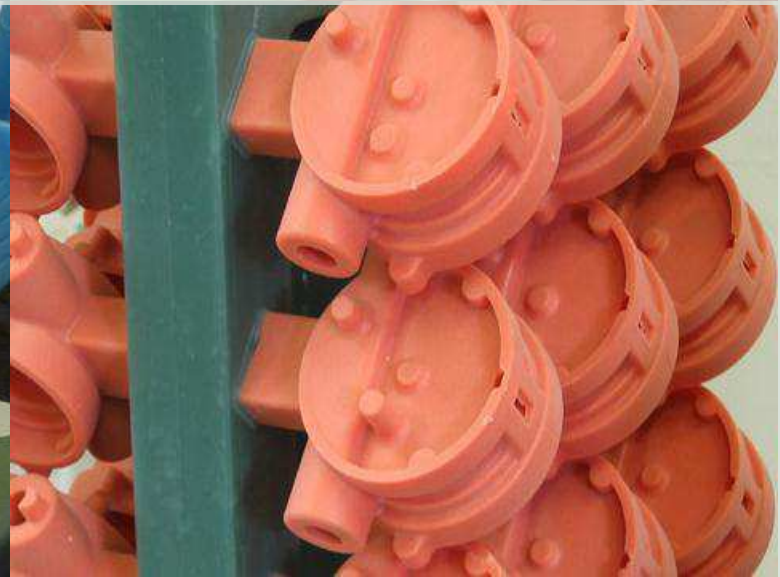
Commercial



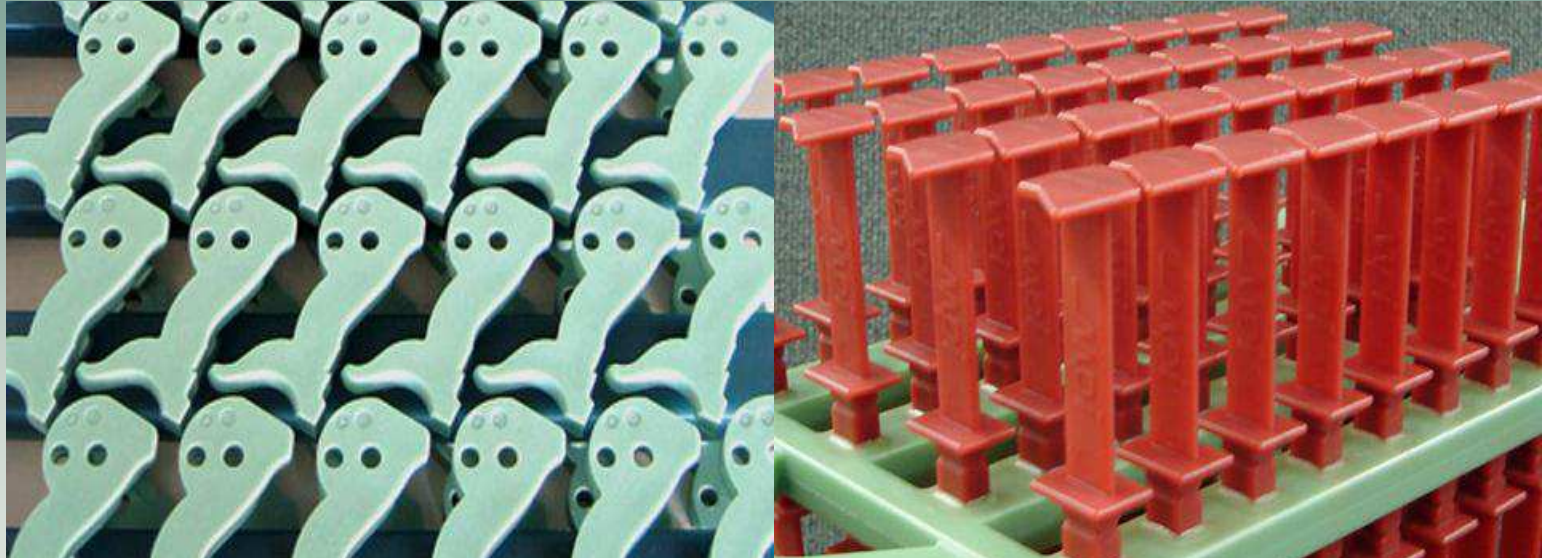
Knowing Your Investment Casting Process



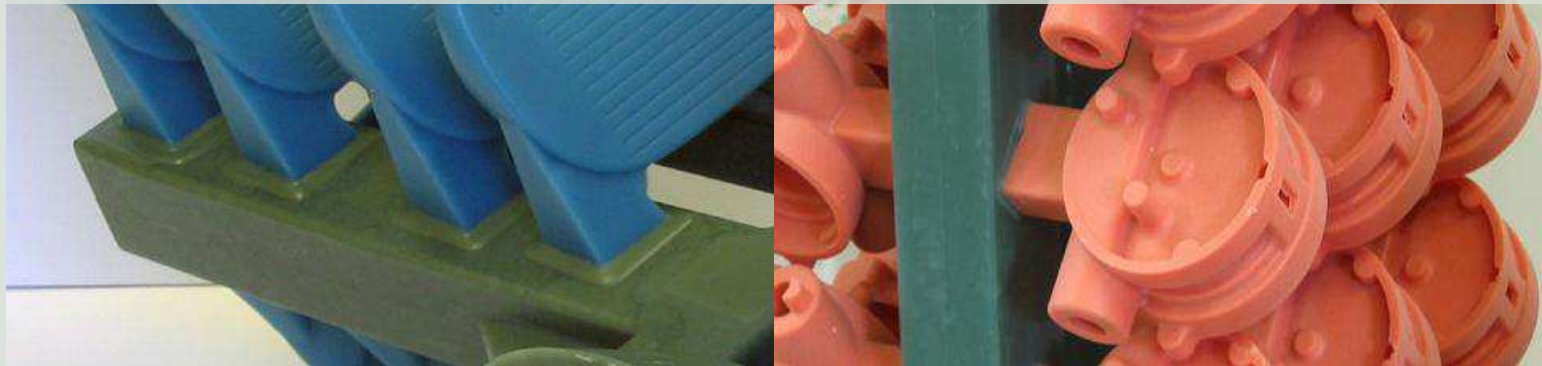
Our customers purchased the systems mainly based on labor savings but have been pleasantly surprised by additional savings they did not anticipate.



Knowing Your Investment Casting Process



They are finding that they are increasing the number of castings shipped without increasing the number of assemblies going into the shell room.



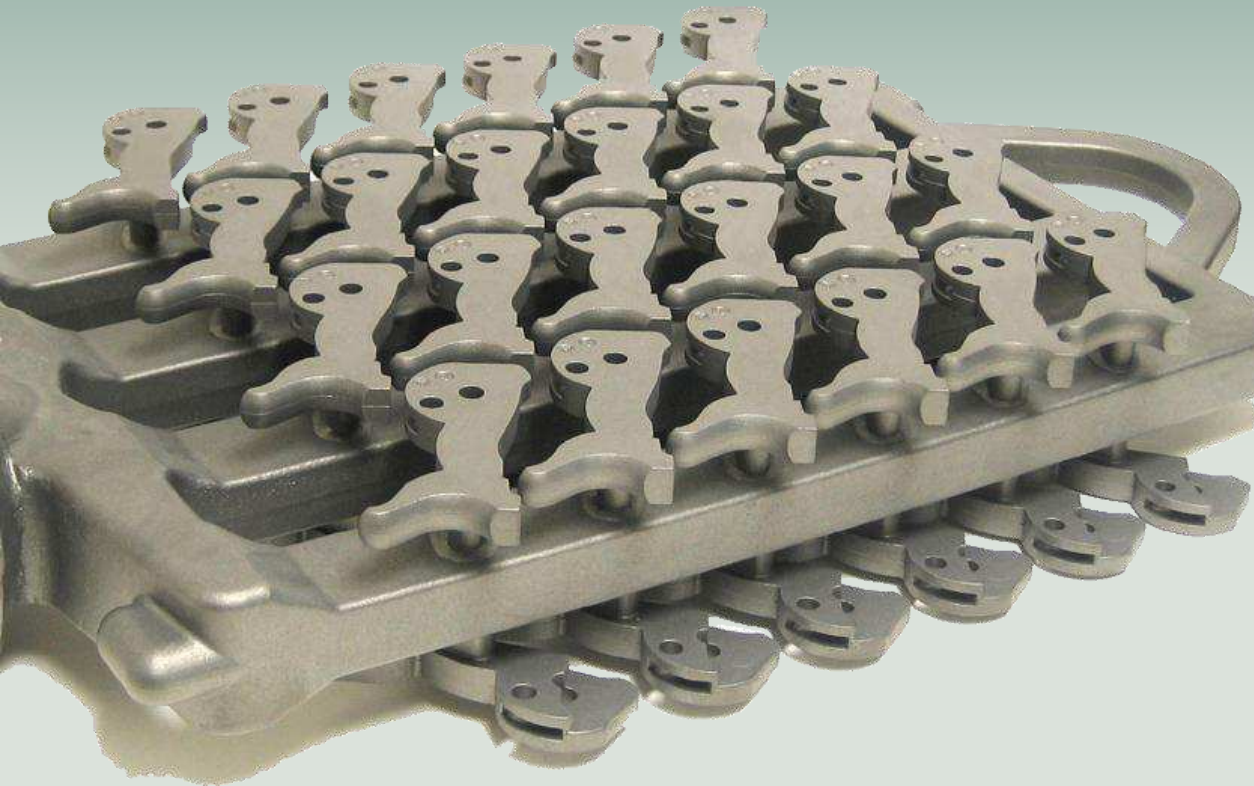
Knowing Your Investment Casting Process



The unanticipated down stream savings are contributing to a better bottom line.

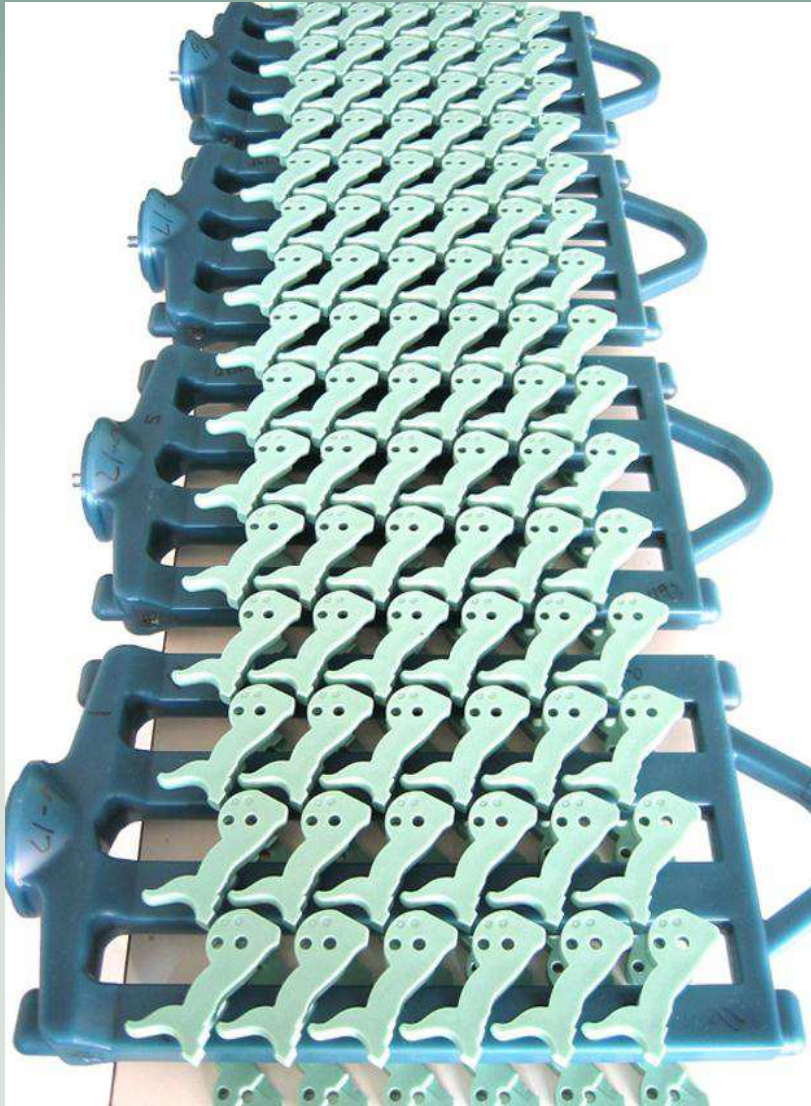
The reason for the downstream savings is that every assembly is being produced as a single perfect casting.

Knowing Your Investment Casting Process



That's right; every assembly is being produced as a single perfect casting. Think about it. An entire assembly that is a perfect casting, not just castings on a runner.

Knowing Your Investment Casting Process



Each assembly is identical to the next.

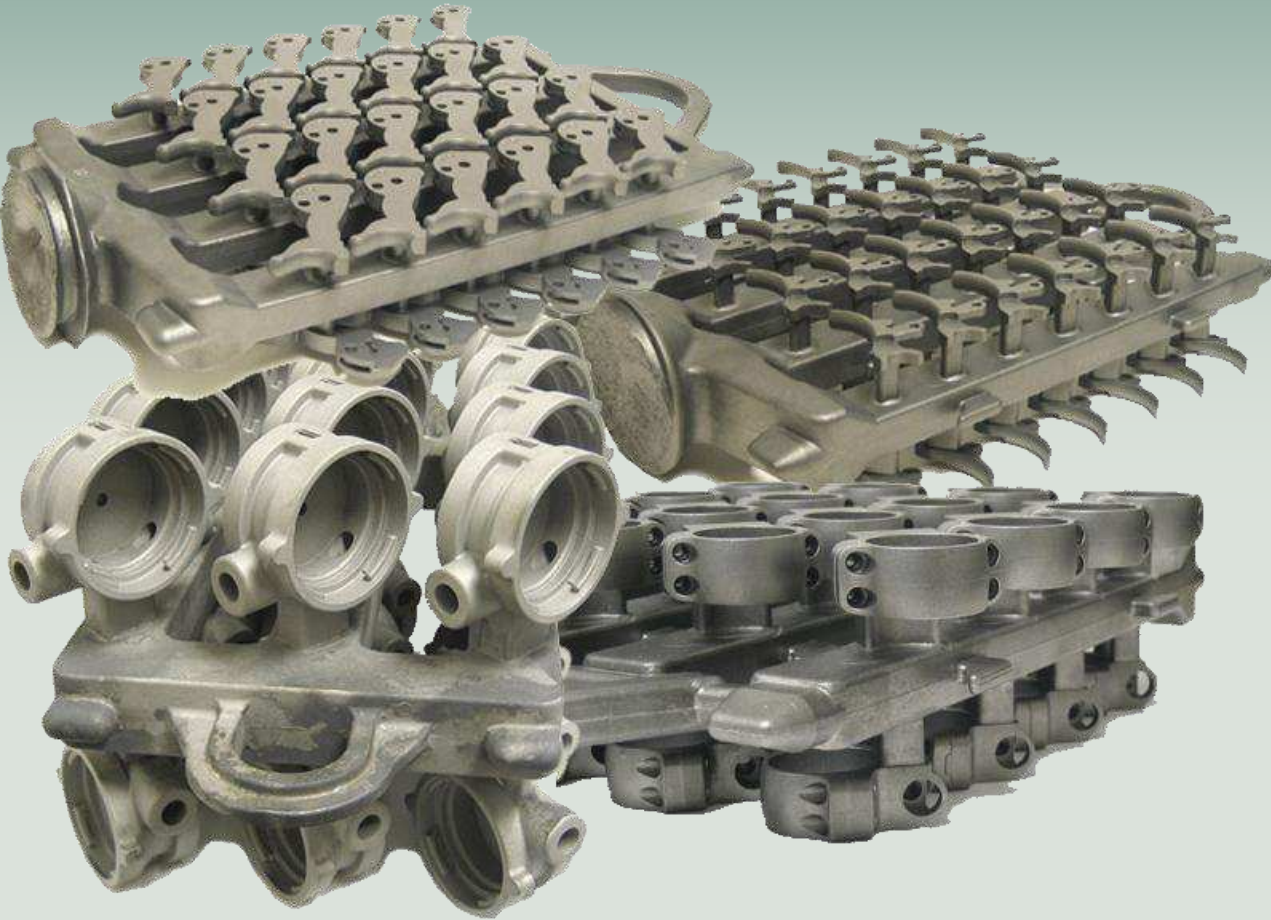
Because there are no variations in the wax assembly there are fewer variations in the downstream foundry process.

Knowing Your Investment Casting Process



Each and every time the Automated Pattern Assembly System is installed, it results in casting yields that far exceed the company's prior results.

Knowing Your Investment Casting Process



What our APAS customers have recognized and proven, is that consistency at the front end creates higher casting yields and therefore a better bottom line.

Knowing Your Investment Casting Process

Working together, our customers and MPI have learned a lot about the impact of each element in the assembly process. The experience has been quite rewarding.



Knowing Your Investment Casting Process



Automating the pattern assembly process has forced us to carefully evaluate the impact of each element of the assembly.

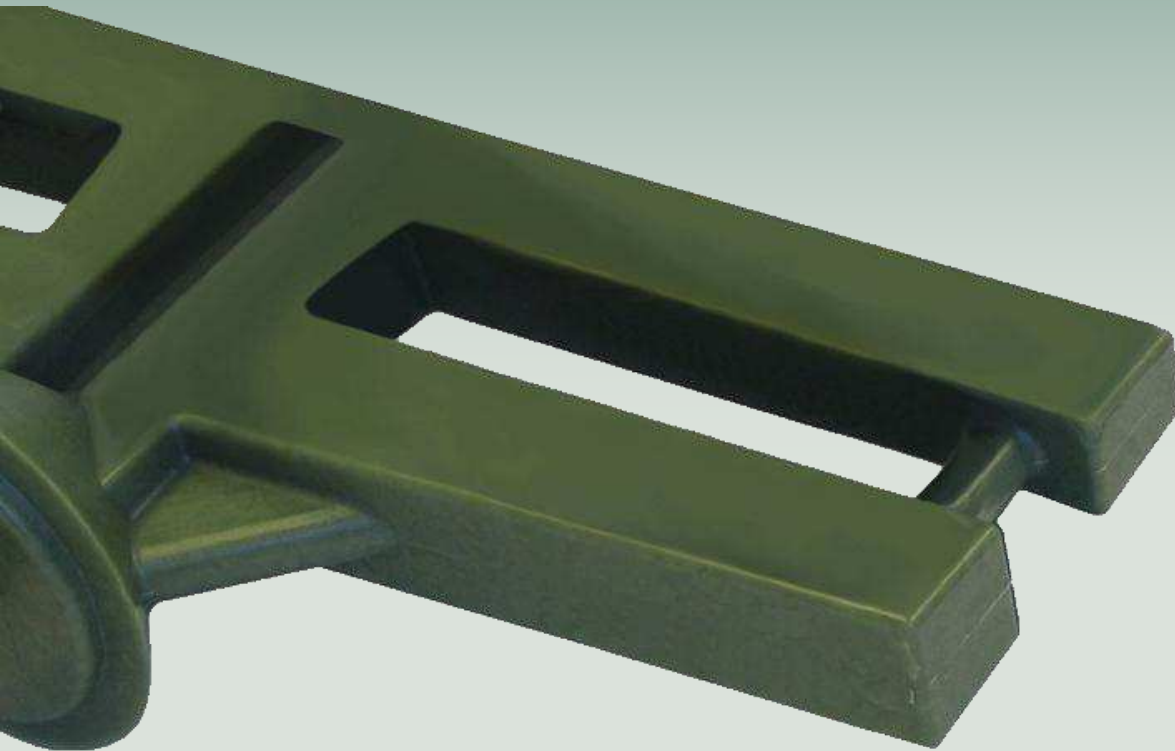
Knowing Your Investment Casting Process

The quality of the wax pattern,



Knowing Your Investment Casting Process

the quality of the wax runner,



Knowing Your Investment Casting Process

and the quality of their weld have an impact on the final result.



Knowing Your Investment Casting Process

Automating the assembly process has shown that the TOTAL is greater than the sum of the parts.
Quality Wax Patterns + Quality Runners + Quality Welds = Perfect Assemblies. And a Perfect Assembly equals MORE and BETTER CASTINGS and a BETTER BOTTOM LINE.

Knowing Your Investment Casting Process

We all know that a quality wax pattern is required to make a quality casting, but is it hard to quantify the definition of pattern quality.



Knowing Your Investment Casting Process

You all make judgments each and every day as to what your foundry process can and cannot produce. You know which features you can cast in and which features must be machined. You all know what your process is capable of producing and you quote accordingly.



Knowing Your Investment Casting Process

Now ask yourself:

Knowing Your Investment Casting Process

Now ask yourself:

What if I could cast a part to a tighter finished tolerance?

Knowing Your Investment Casting Process

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What if I could eliminate some of the secondary operations?

Knowing Your Investment Casting Process

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The fact is you can cast to a tighter tolerance and you can eliminate secondary operations, and in order to remain competitive in the world market you must.

Knowing Your Investment Casting Process

Now ask yourself:

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The fact is you can cast to a tighter tolerance and you can eliminate secondary operations, and in order to remain competitive in the world market you must.

This is not an option!

Knowing Your Investment Casting Process

As I said, the experience in automating pattern assembly has been rewarding.

Knowing Your Investment Casting Process

As I said, the experience in automating pattern assembly has been rewarding.

But it was also a lot of fun, and extremely beneficial to our customers.

Knowing Your Investment Casting Process

To gain the maximum benefits of automating the pattern assembly process requires patterns of consistent quality. To produce patterns of consistent quality, regardless of what injector is used, led MPI to develop the technology to control the process of producing wax patterns from any injector.

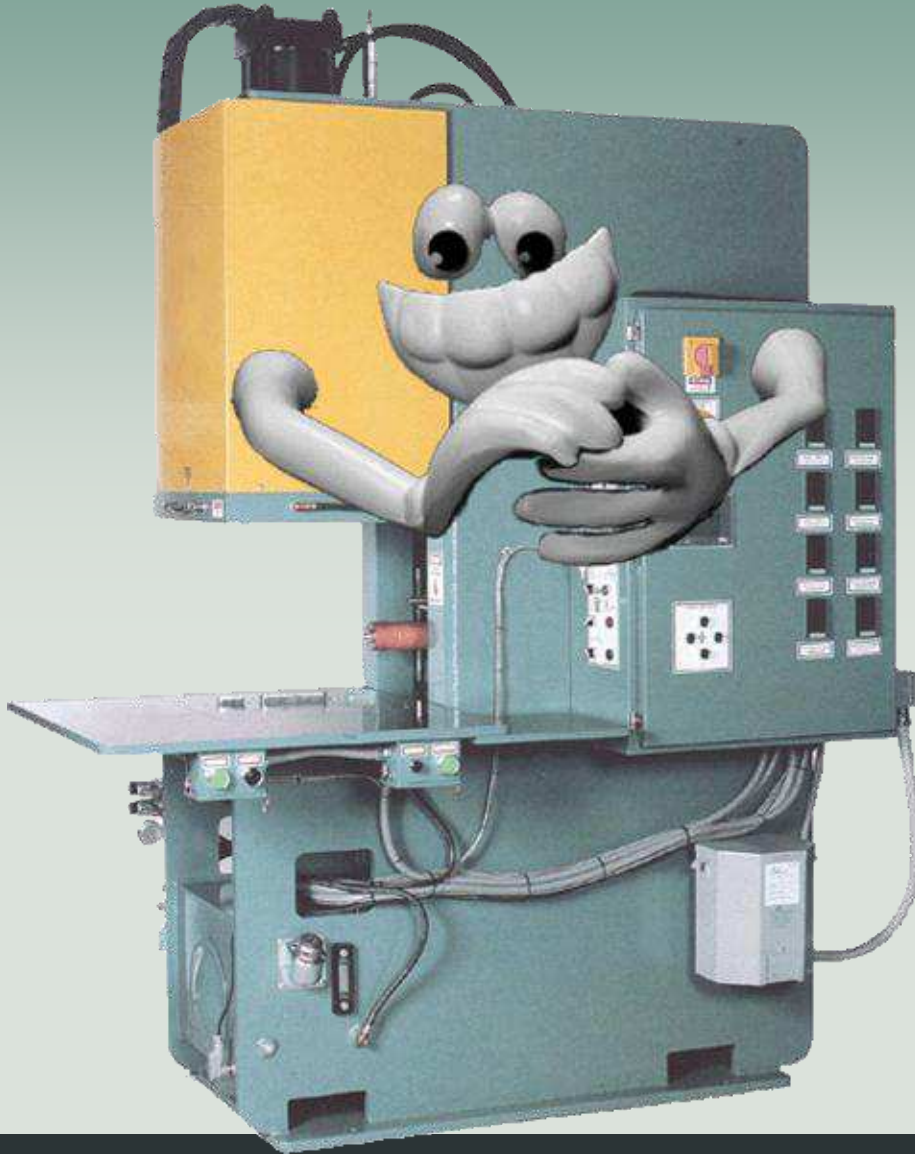
Knowing Your Investment Casting Process

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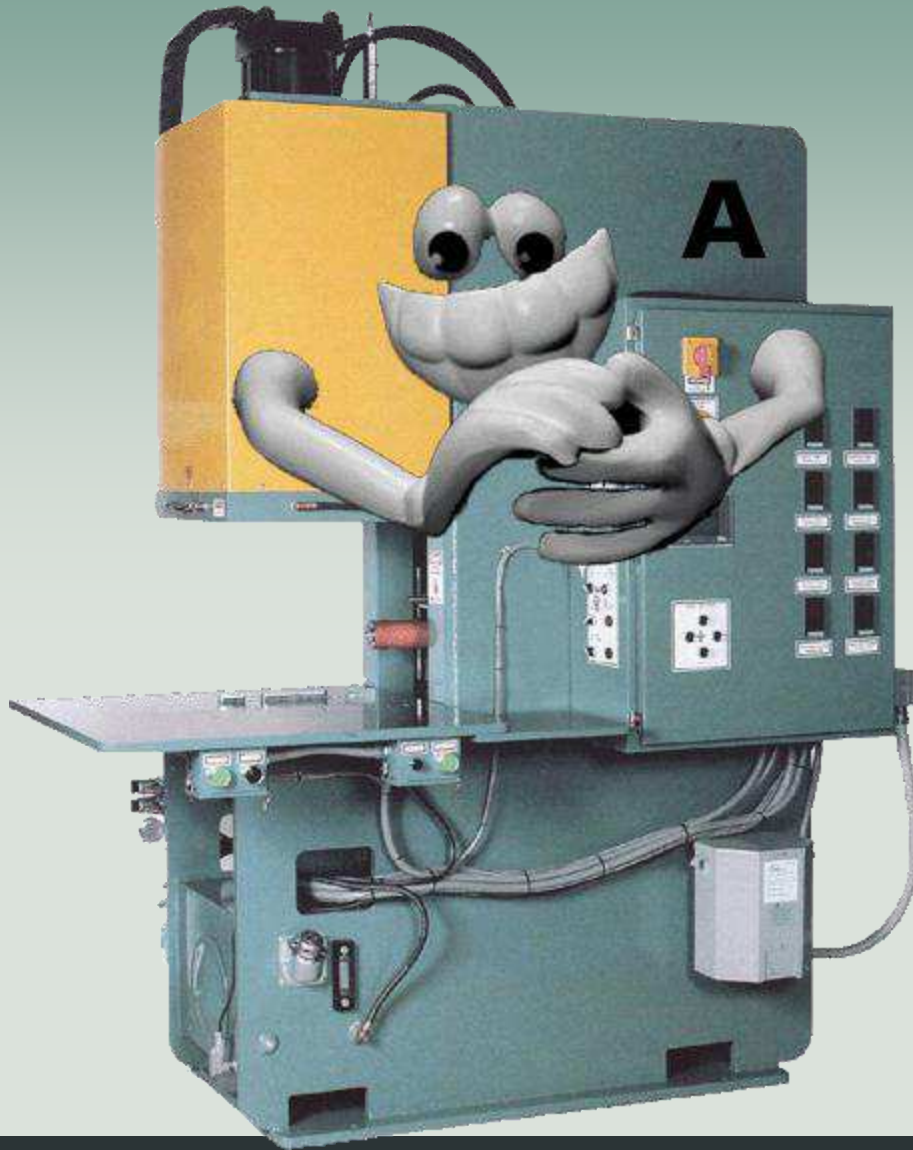
Note that I said any wax injector. Now let's get into some specifics.

Knowing Your Investment Casting Process

How many of you have wax injection machines with “personalities”?



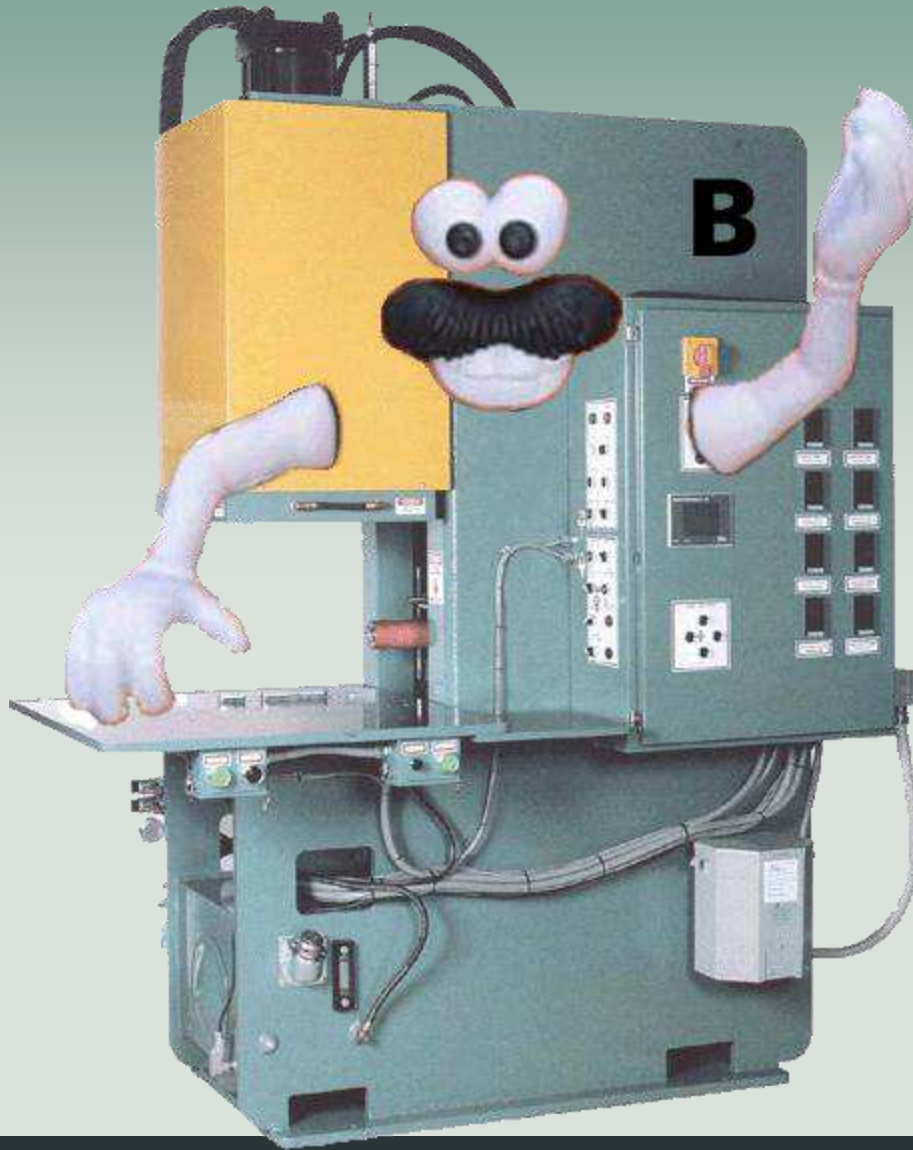
Knowing Your Investment Casting Process



How many of you have wax injection machines with “personalities”?

You have a die that will run well on a particular machine (Machine A), and produce quality patterns.

Knowing Your Investment Casting Process

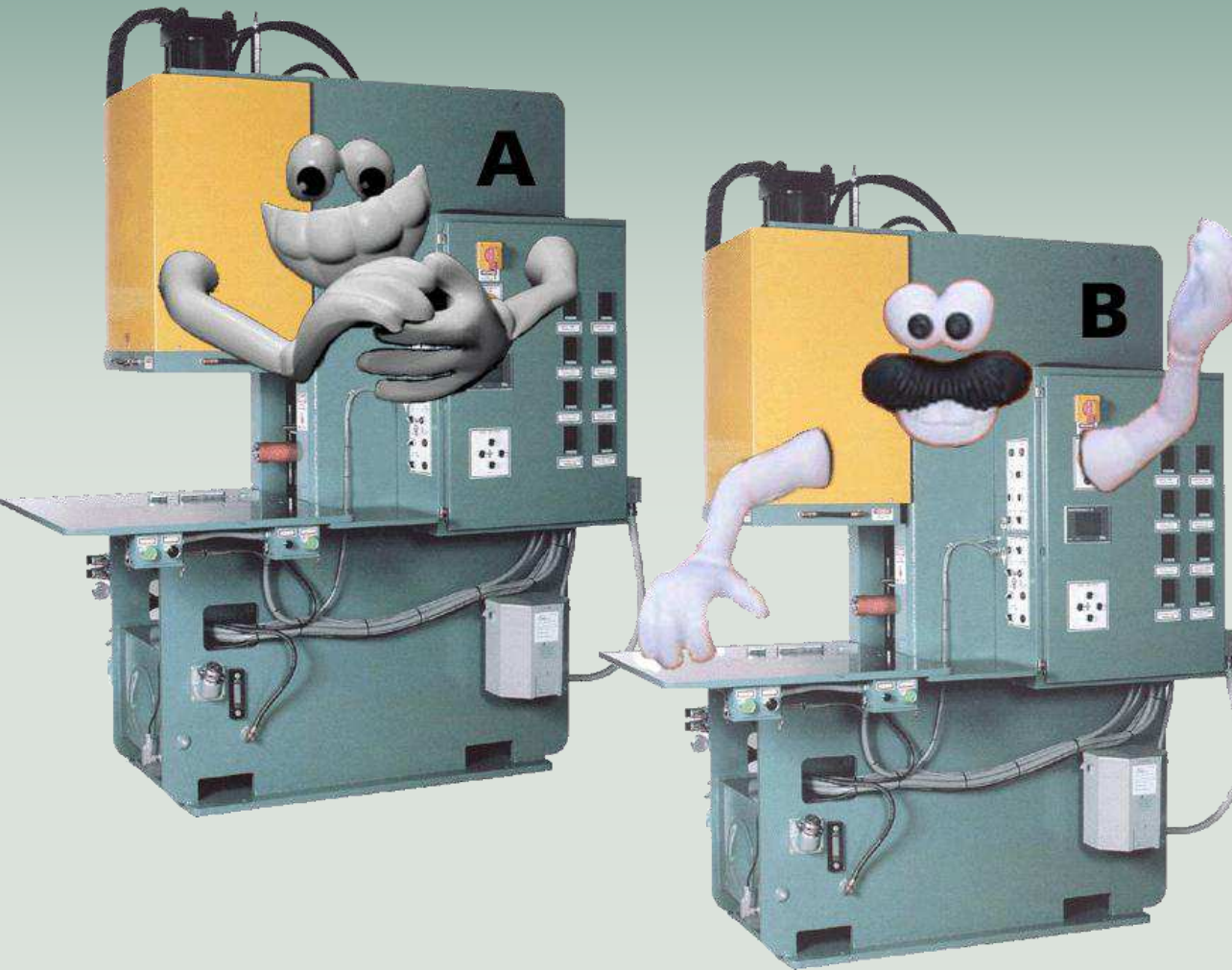


How many of you have wax injection machines with “personalities”?

Then because of production bottlenecks you are forced to run the die on a different machine (Machine B), now you are unable to replicate the same quality pattern.

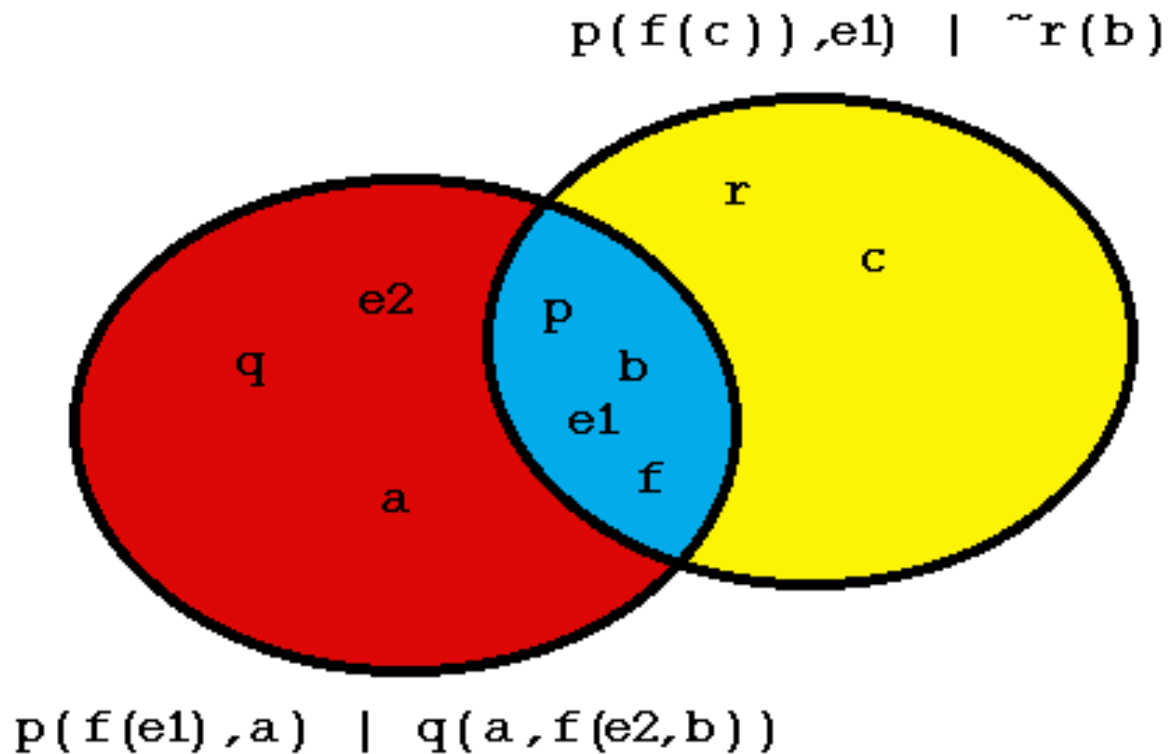
Knowing Your Investment Casting Process

This can happen even when both machines are from the same manufacture.

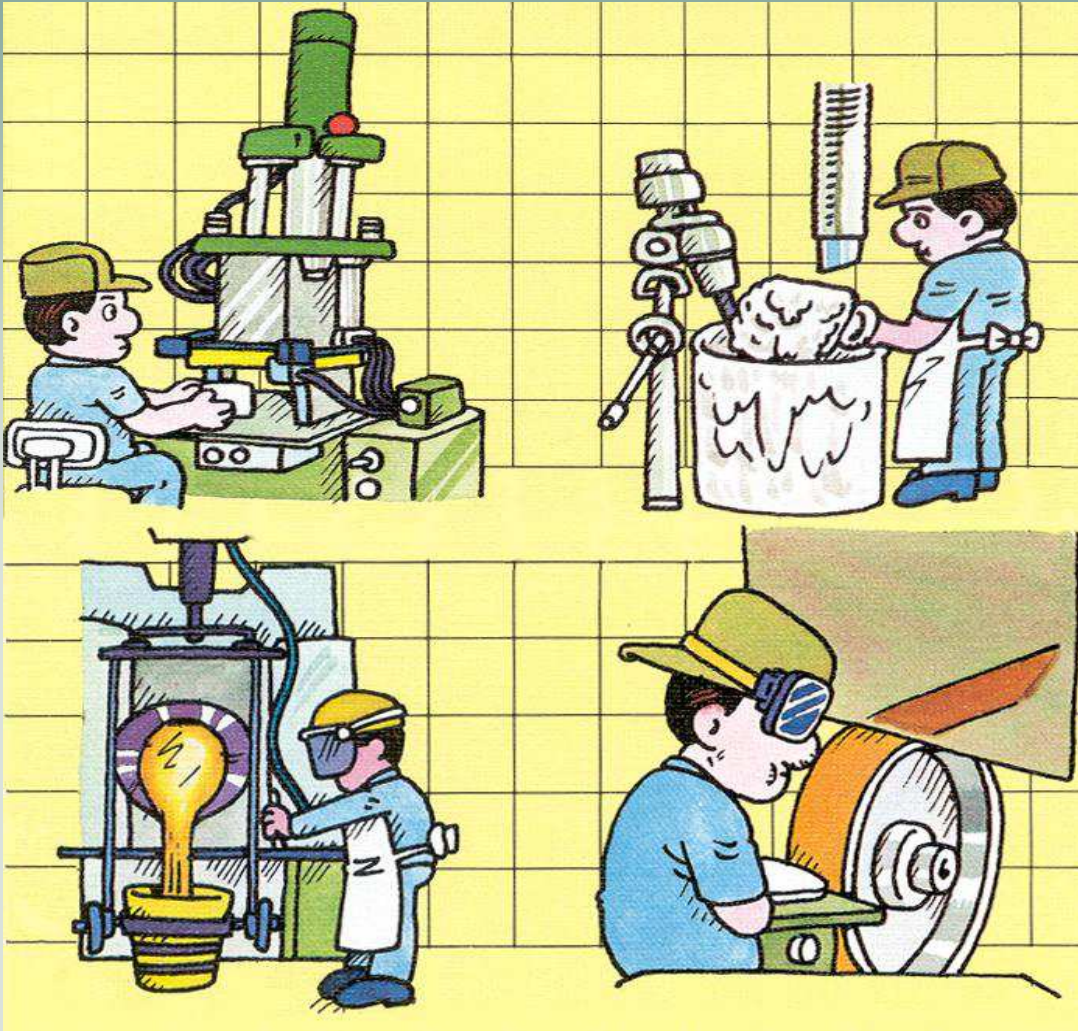


Knowing Your Investment Casting Process

So what is causing this inconsistency of patterns from the same die on different machines?

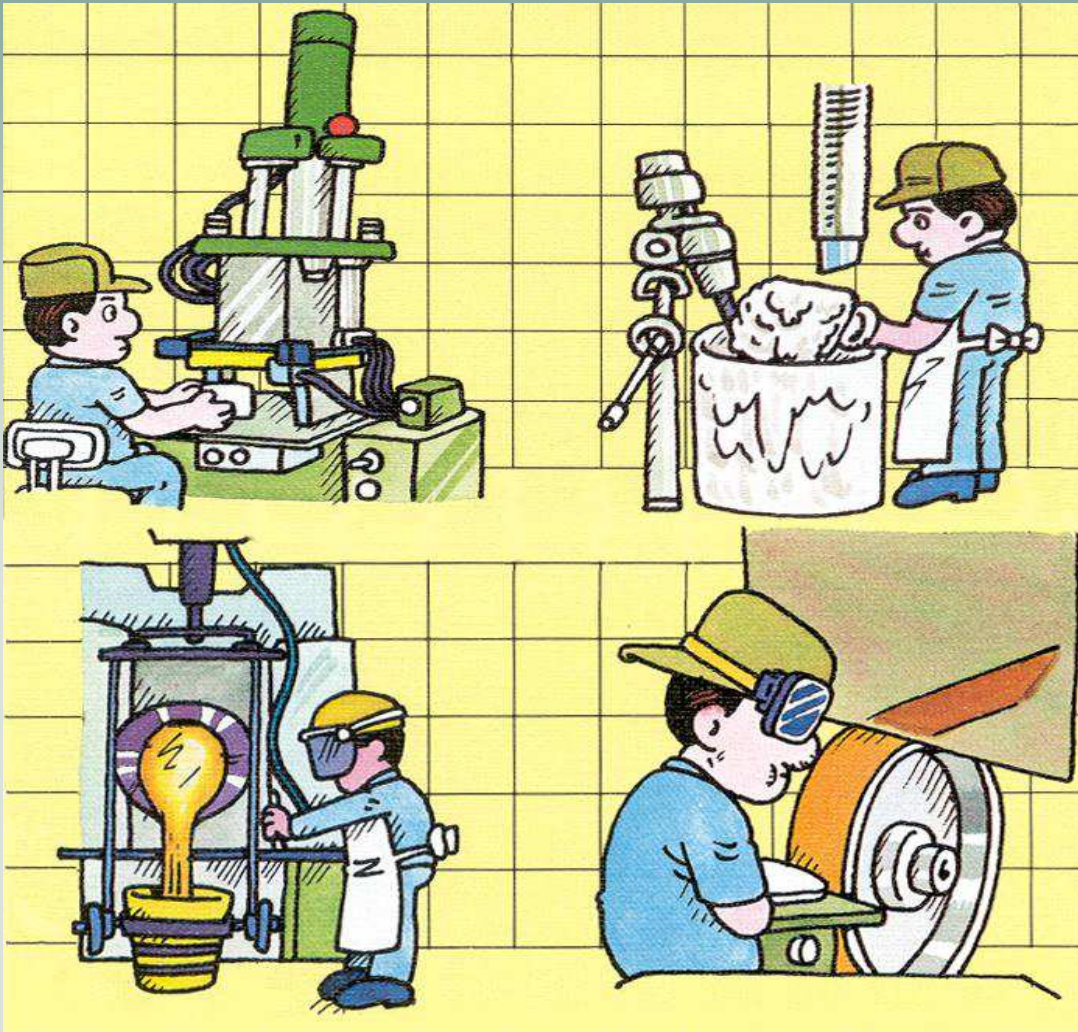


Knowing Your Investment Casting Process



There are a number of variables, but today the time constraint will not allow me to go deep into the details.

Knowing Your Investment Casting Process



If you really want to know, go back to the ICI Bibliography and look at all my previous papers that I have given over the last 25 years. The Bibliography shows I have spent my professional career testing and documenting the causes of pattern defects.

Knowing Your Investment Casting Process

Now I can show you how to virtually eliminate defective patterns simply and cost effectively:

Knowing Your Investment Casting Process

Now I can show you how to virtually eliminate defective patterns simply and cost effectively:

Through process control of your wax injectors.

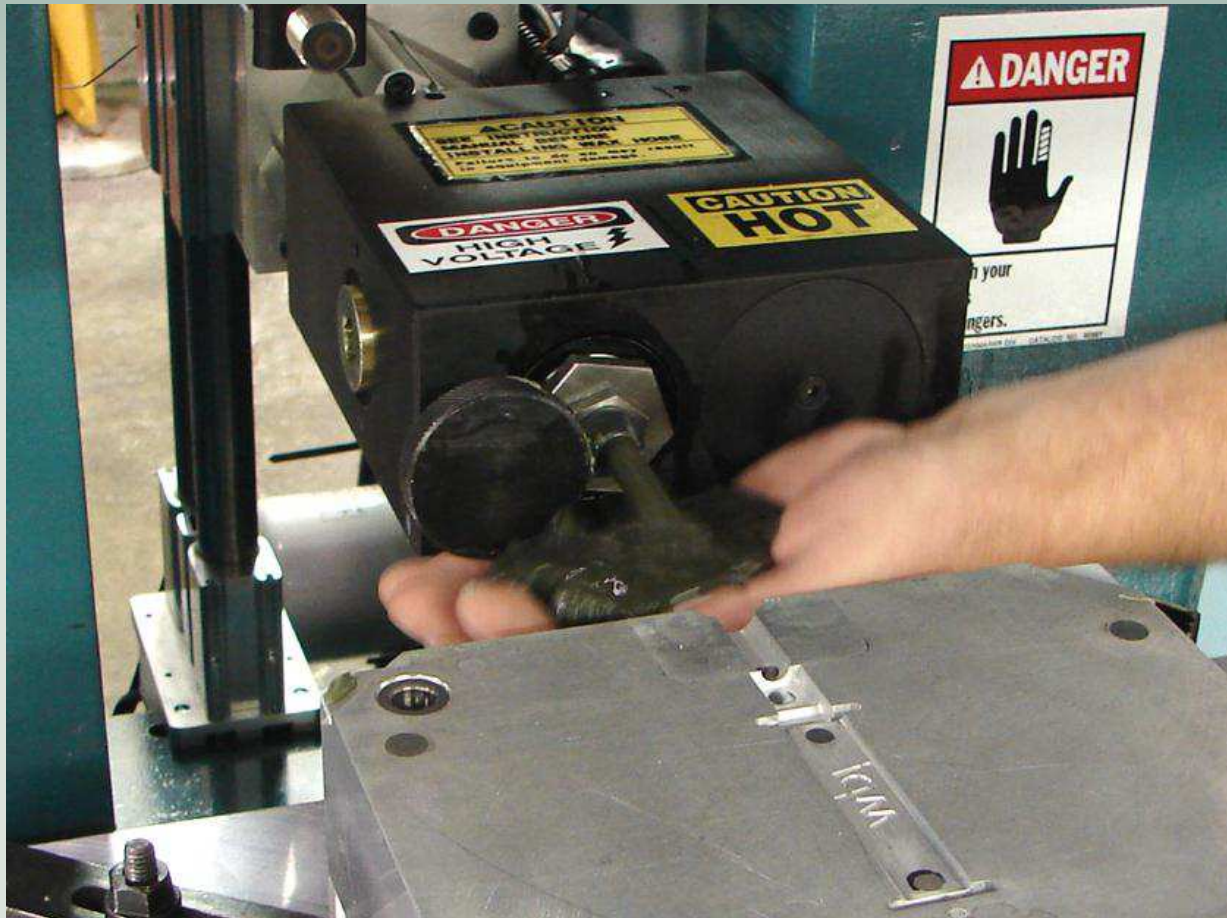
Knowing Your Investment Casting Process

Here are some simple checks that you can do that will tell you if your wax equipment is out of control:



Knowing Your Investment Casting Process

1. Do you see your operators purging wax out of the nozzle or throwing patterns away as they purge the machine prior to an injection?



Knowing Your Investment Casting Process

Often times after breaks, lunch, or long injection cycles, operators purge wax out of the nozzle to remove any temperature variations before they start production. If you see this being done it is a clear indication that the machine has a temperature variation.



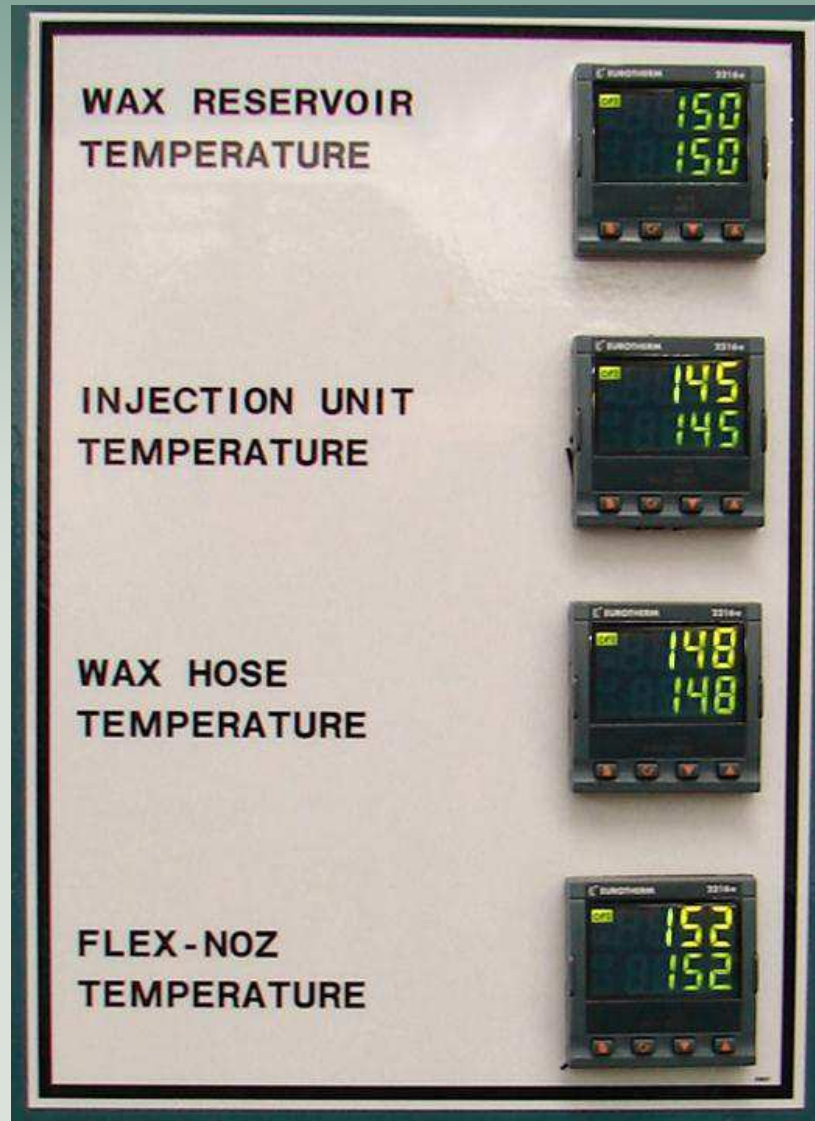
Knowing Your Investment Casting Process

If the temperature variations were removed from the machine, the normal pattern-to-pattern dimensional variation found in production would be reduced, resulting in tighter casting-to-casting tolerances which equals less scrap, better parts and

An Improved Bottom Line

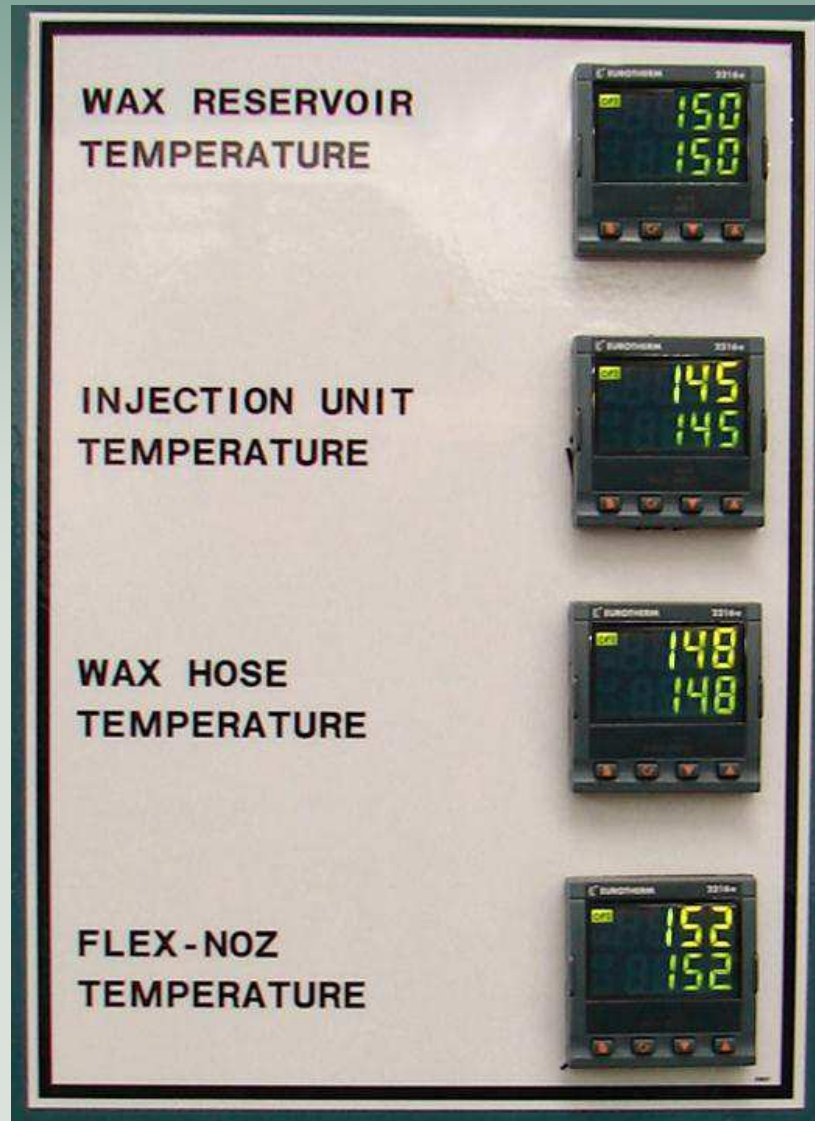


Knowing Your Investment Casting Process



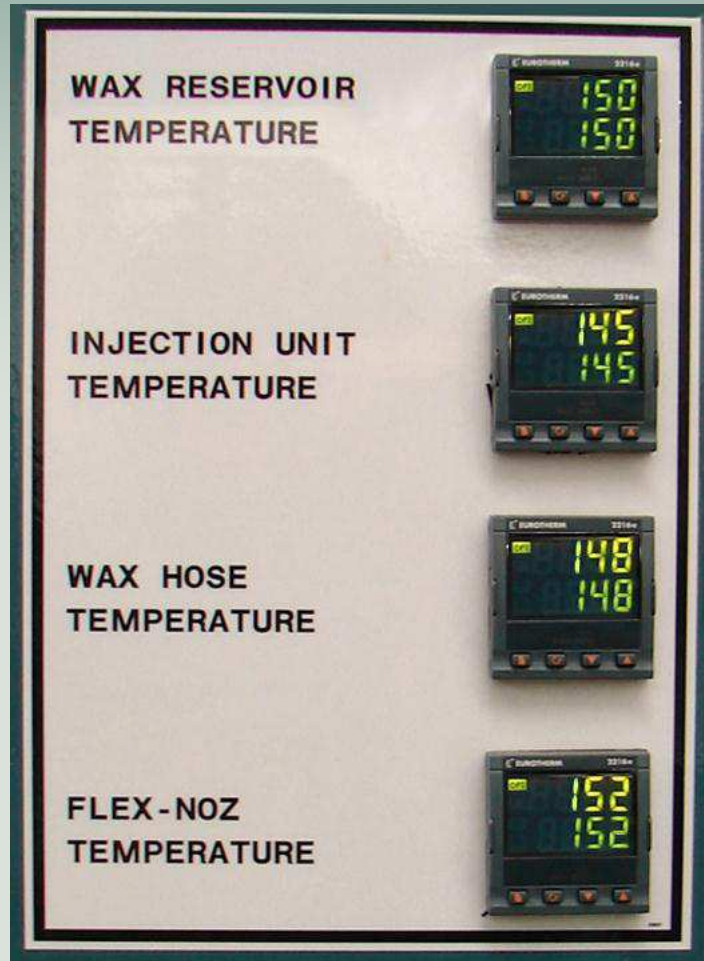
2. Do you see different temperature settings on each of the machines temperature zones? If you do then the operator believes that there is a temperature variation in the wax injector and the operator is compensating for the temperature difference. The fact is that the operator is generally right, there is a temperature variation.

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The problem is the operator can only guess at where the variation is and how much to offset the machine. In short the machine is out of control. Often times the operator is contributing to the problem rather than compensating for the problem.

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3. When you install a new wax injector does your operator adjust the temperature zones to match the settings on the old equipment? If so your operator has jumped to the conclusion that the new machine needs to run at the same injection parameters. Right off the bat the new machine is out of control.

Knowing Your Investment Casting Process

These examples demonstrate a fundamental problem in the wax room.

Knowing Your Investment Casting Process

These examples demonstrate a fundamental problem in the wax room.

First, your operator is controlling the injection process, rather than the injection process controlling the operator.

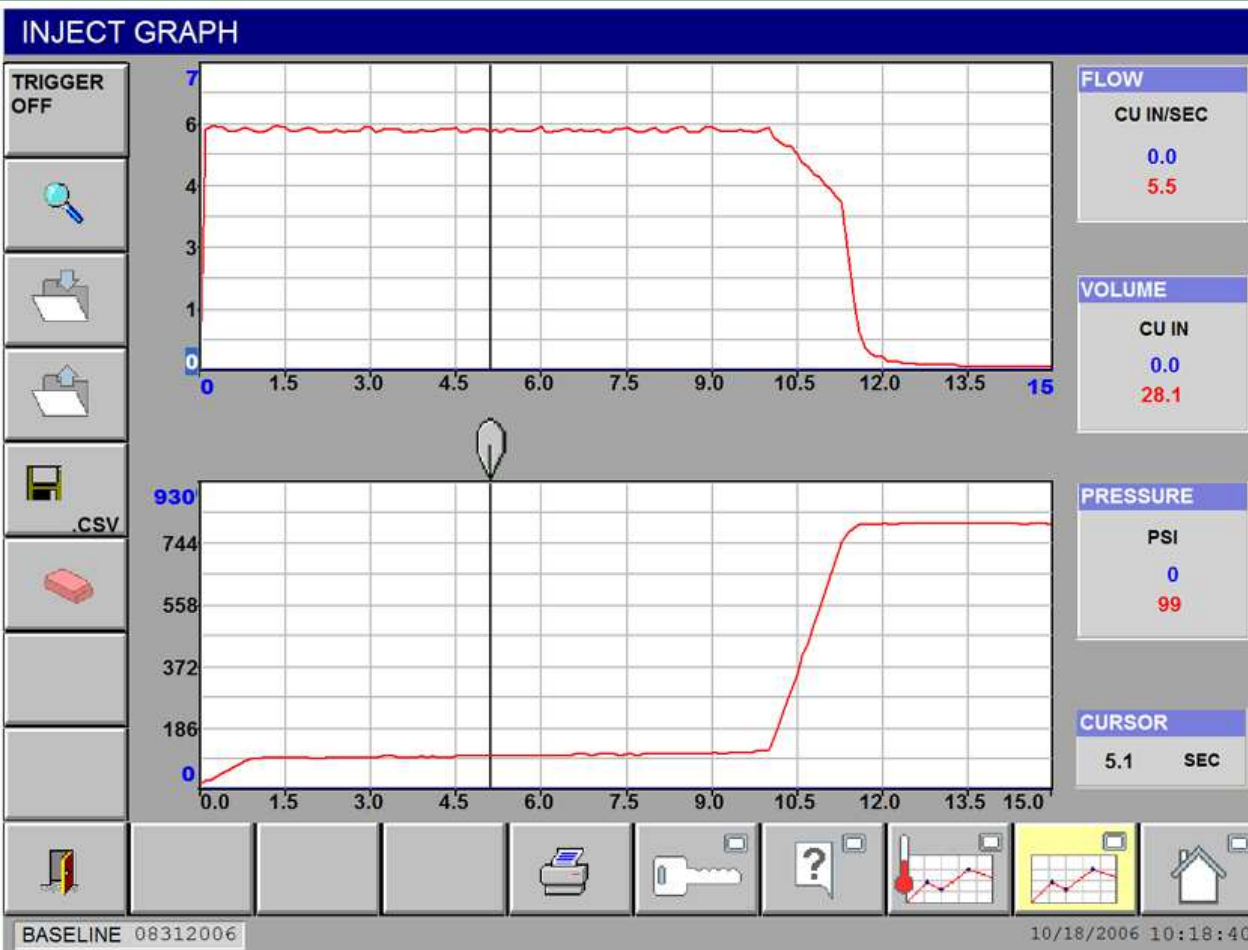
Knowing Your Investment Casting Process

These examples demonstrate a fundamental problem in the wax room.

First, your operator is controlling the injection process, rather than the injection process controlling the operator.

Second, there is often no check to see that your process is in control or out of control. You are not verifying that the wax going into the die is achieving the settings on the machine.

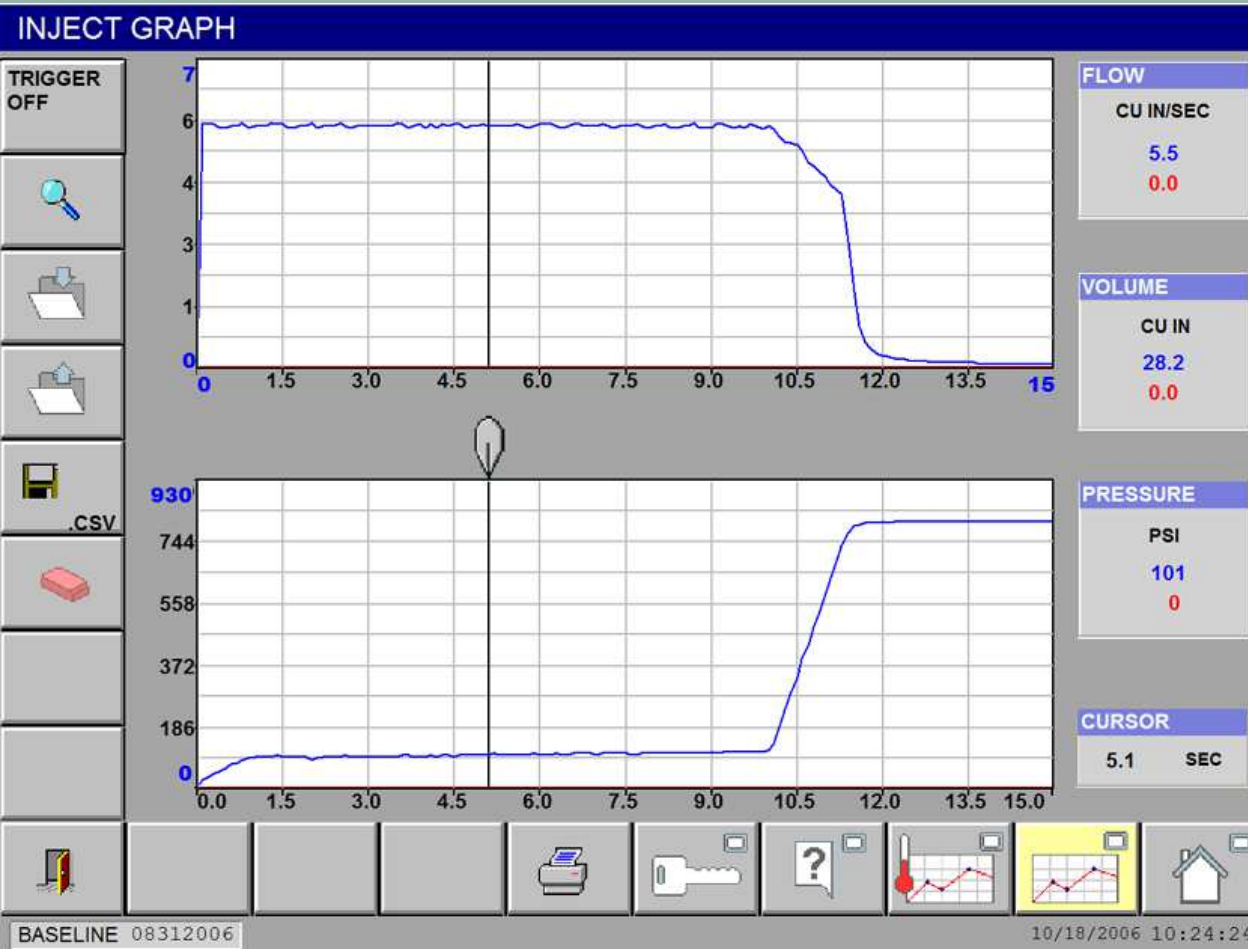
Knowing Your Investment Casting Process



In order to have consistent patterns for consistent tight tolerance castings and bring process control into the injection department we developed our...

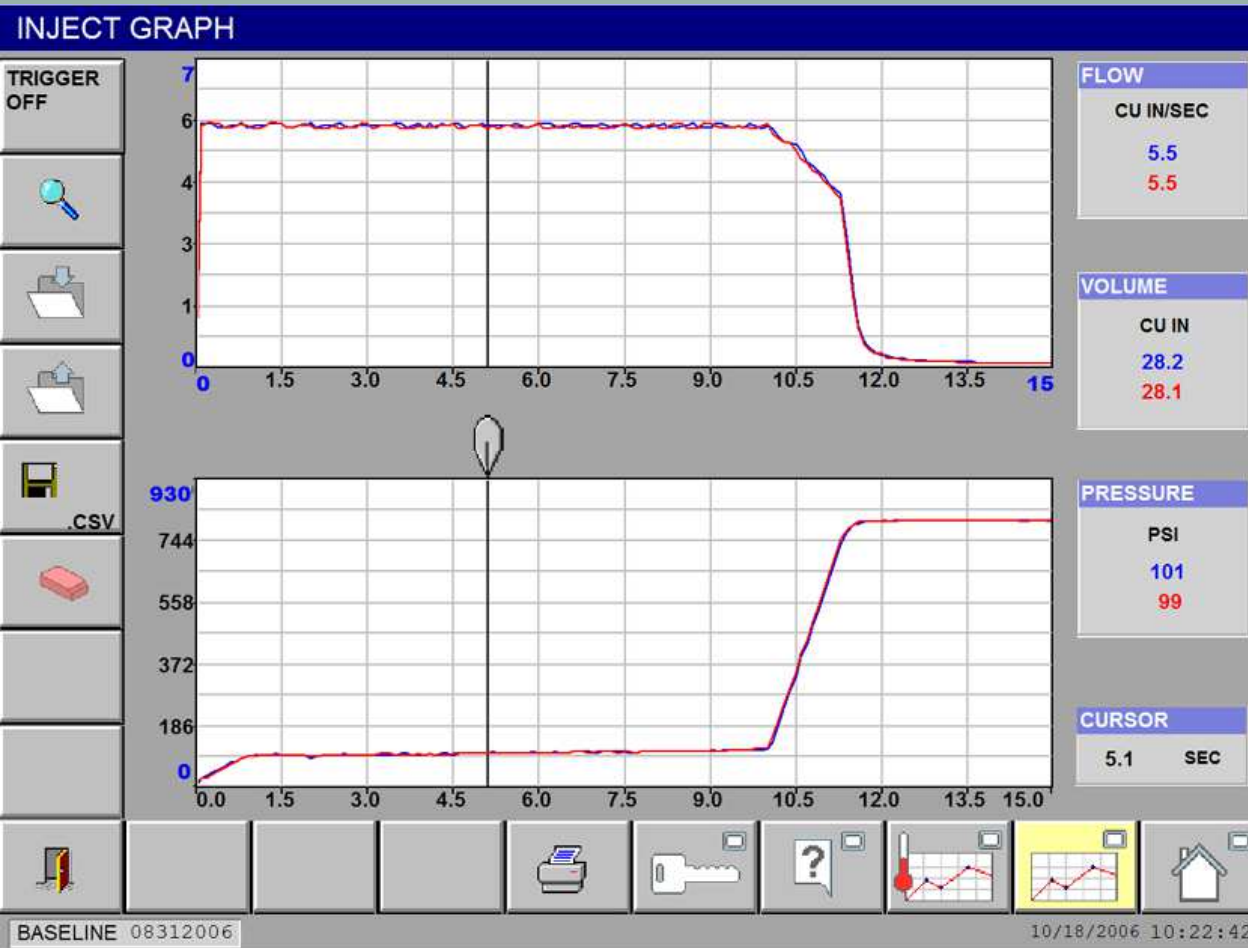
“20-20 Process Vision” graphing system.

Knowing Your Investment Casting Process



The 20-20 is a tool that allows you to visually see what is happening during each injection cycle.

Knowing Your Investment Casting Process



The unit is a tool that brings Process Control into the injection department.

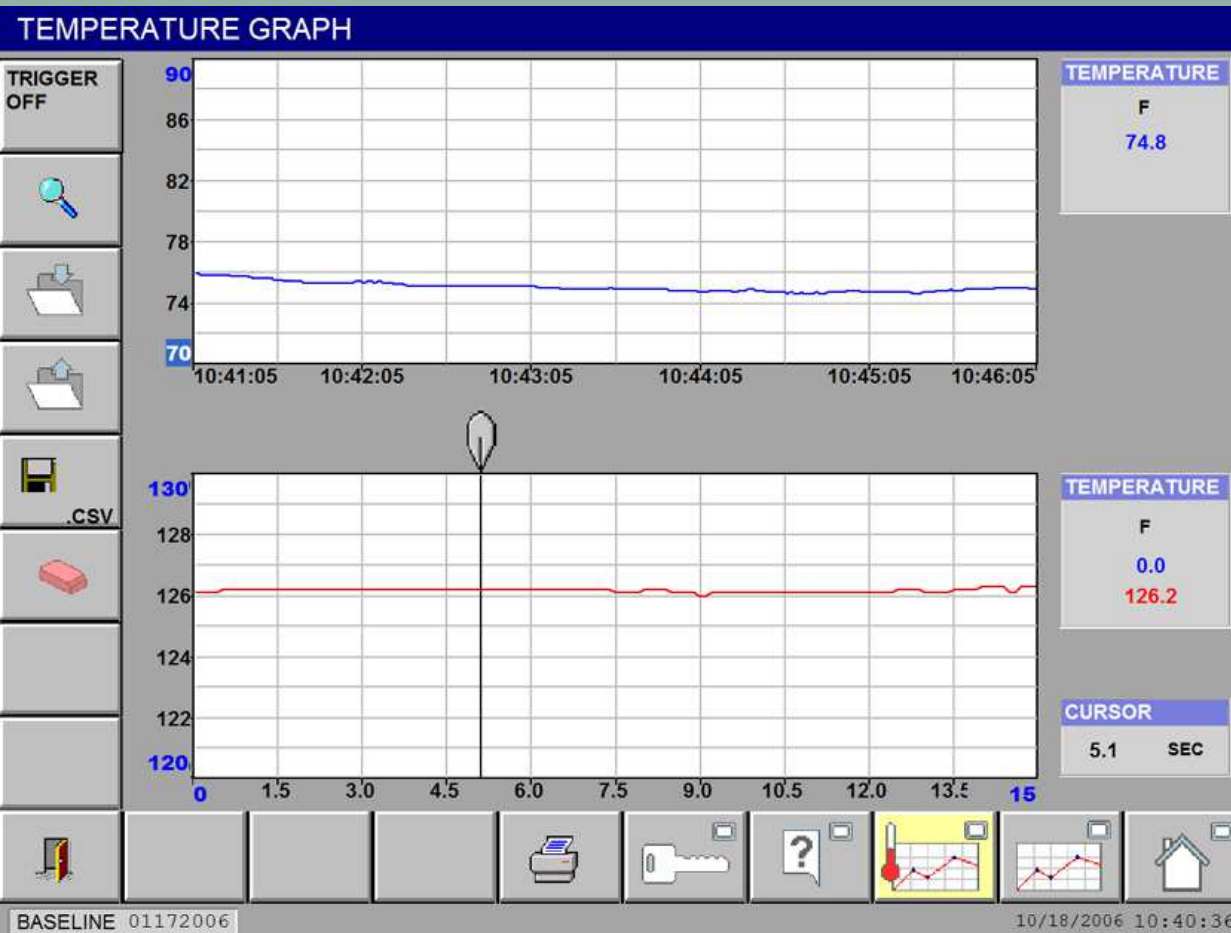
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Our 20/20 “Process Vision” graphing system is packaged as a portable unit.



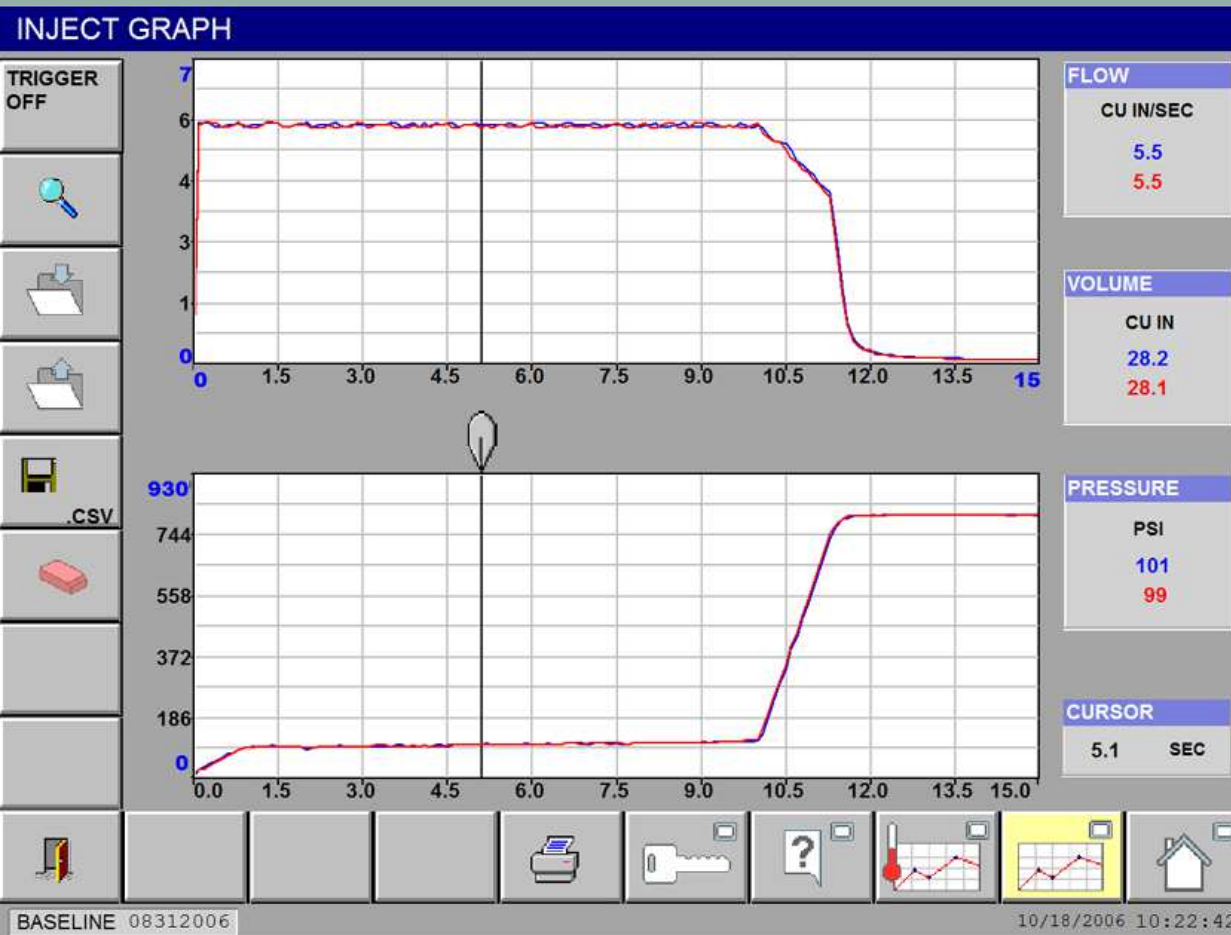
Knowing Your Investment Casting Process

The 20-20 measures actual wax temperature wax flow, and wax pressure during a machine's injection cycle.



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The unit records the information graphically on the networkable Windows based operating system.



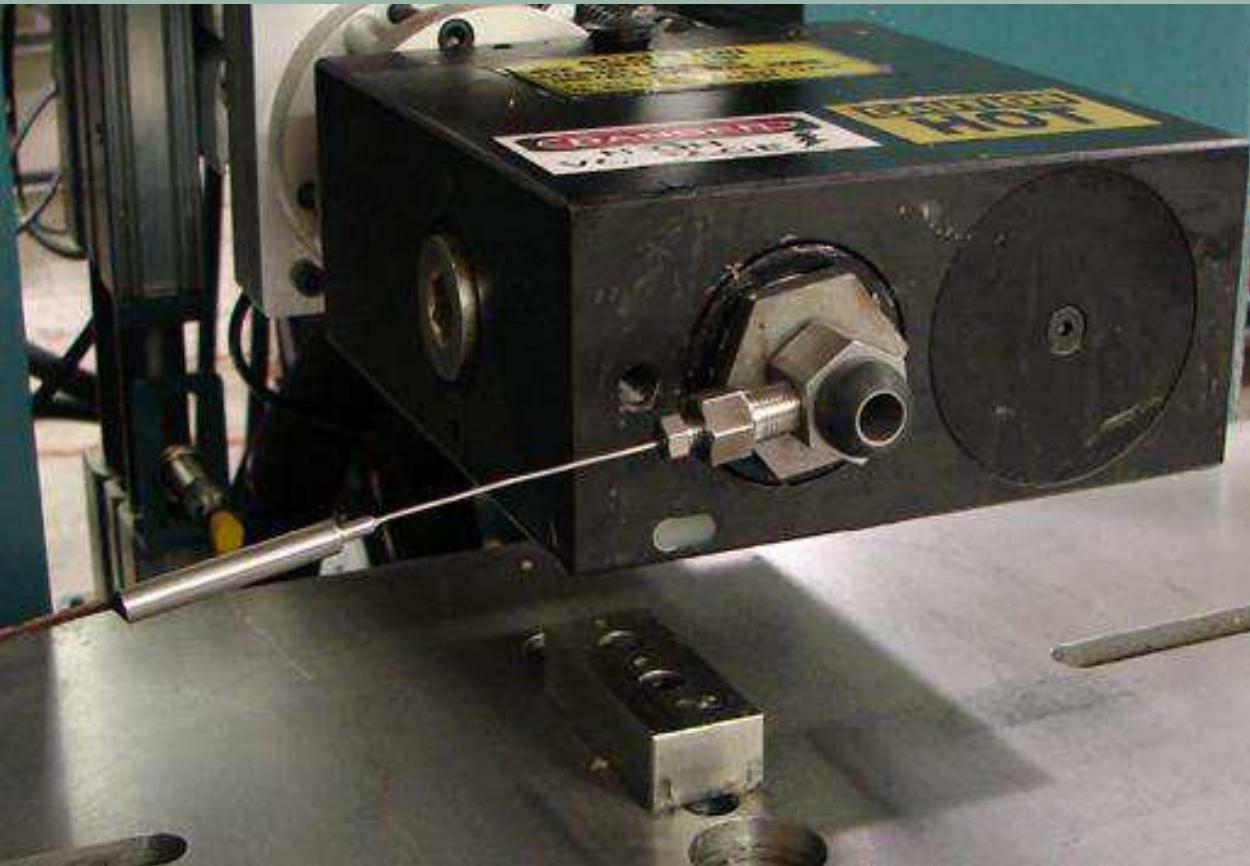
Knowing Your Investment Casting Process



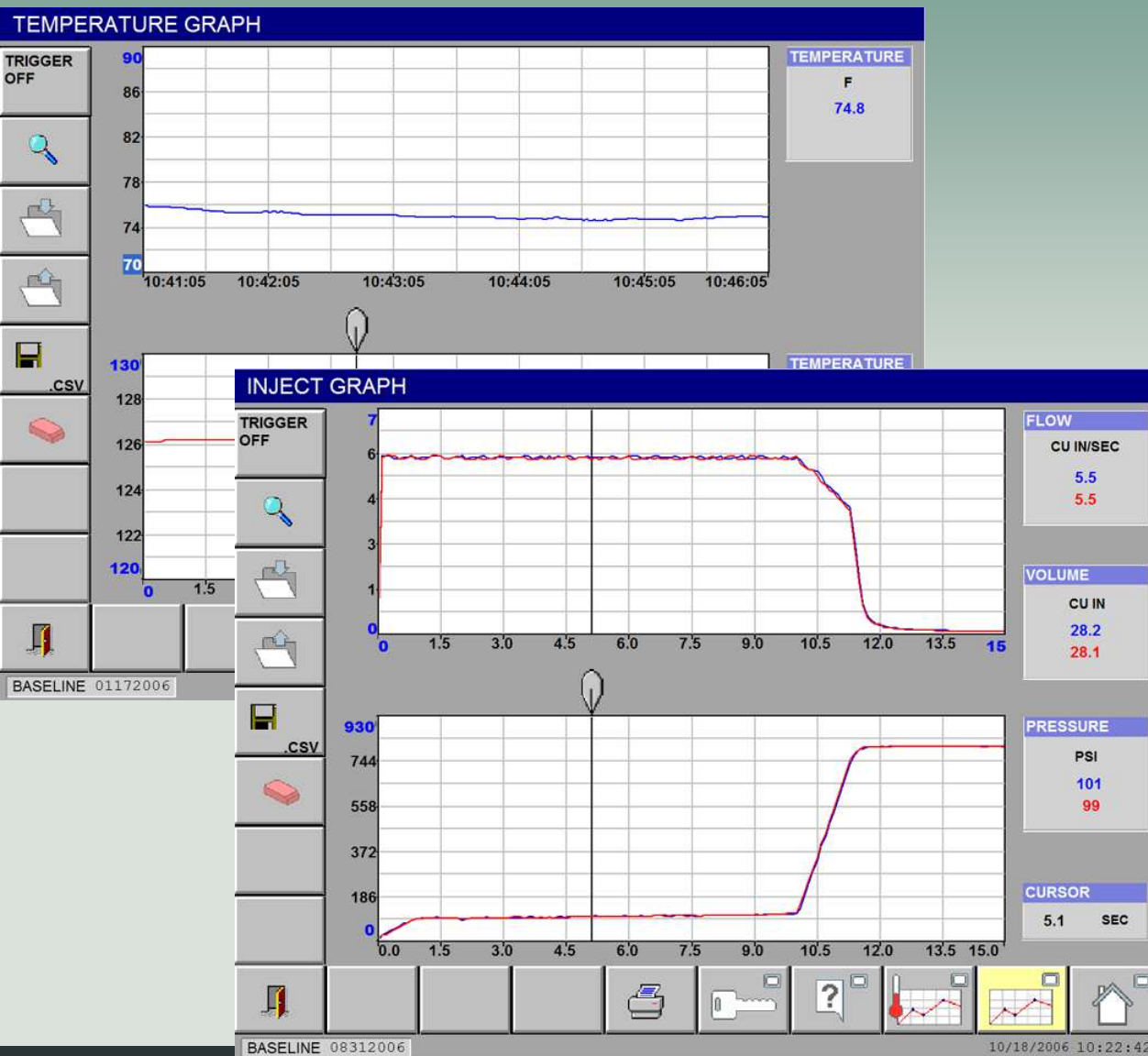
The 20/20 accomplishes this using quick-disconnects to hydraulically connect to a machine's injection cylinder,

Knowing Your Investment Casting Process

and putting a thermocouple into the wax stream in the injection nozzle.



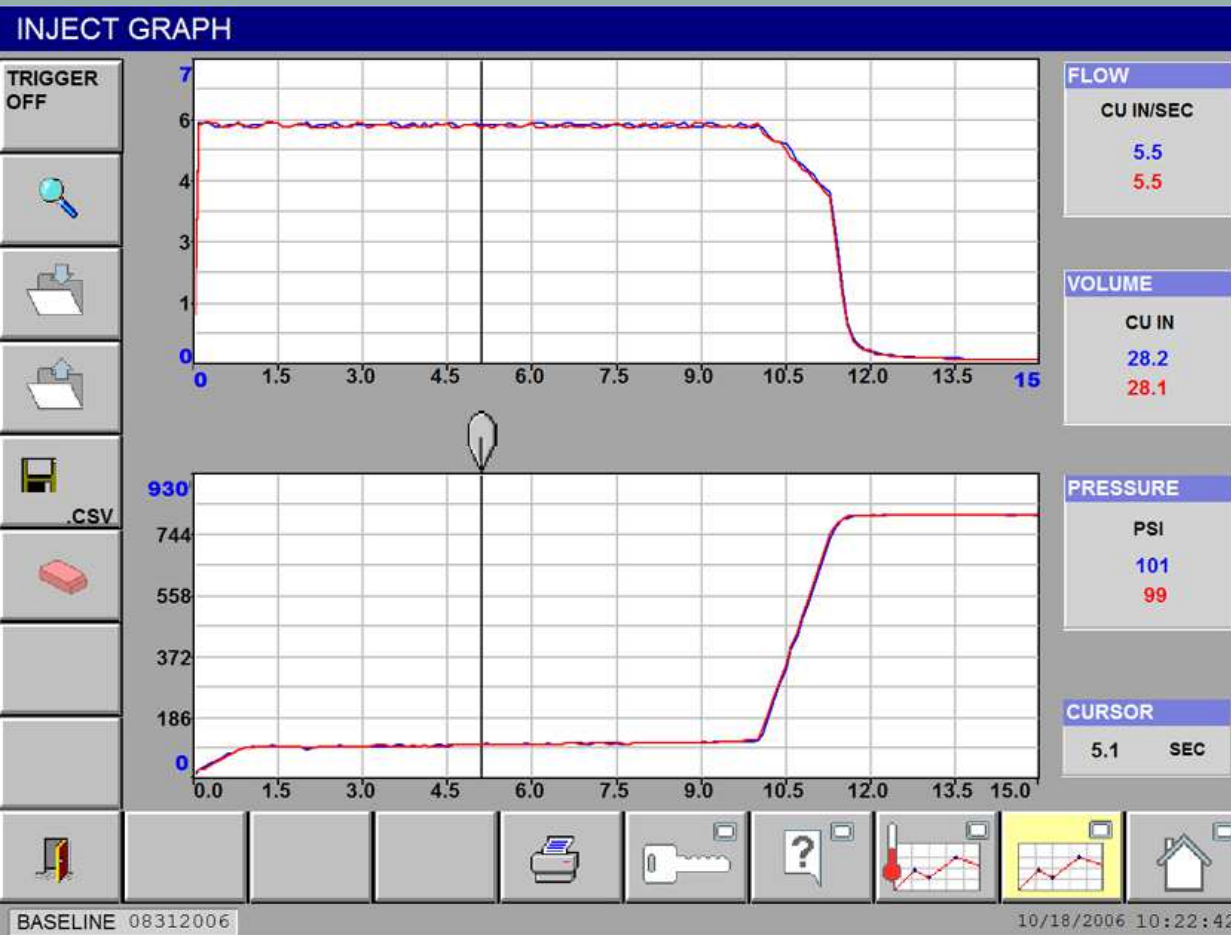
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The injection cycle is recorded as a graph of the actual wax temperature, flow and pressure.

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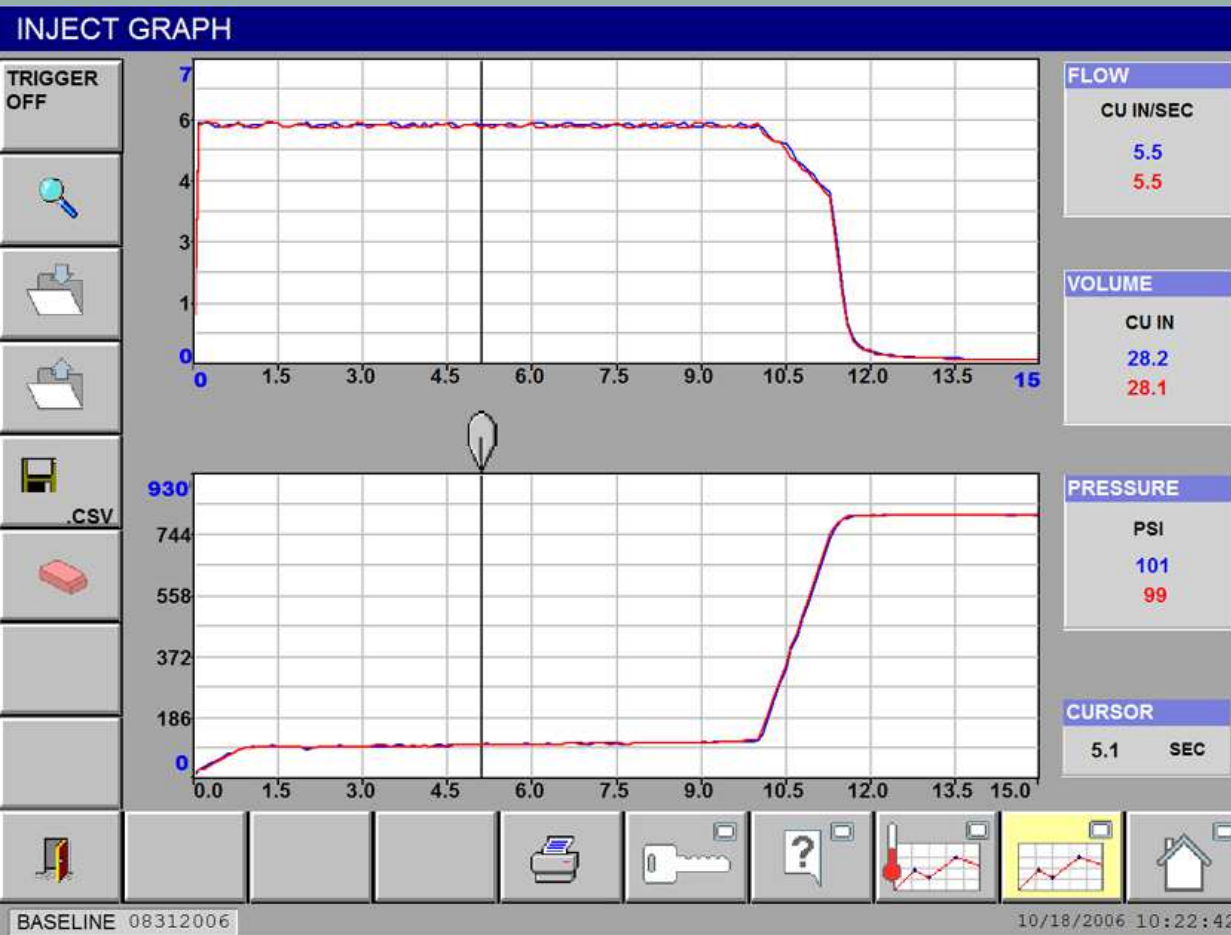
This gives you the capability of recording the injection parameters from a machine that's making a good pattern and transferring those parameters to a second machine.



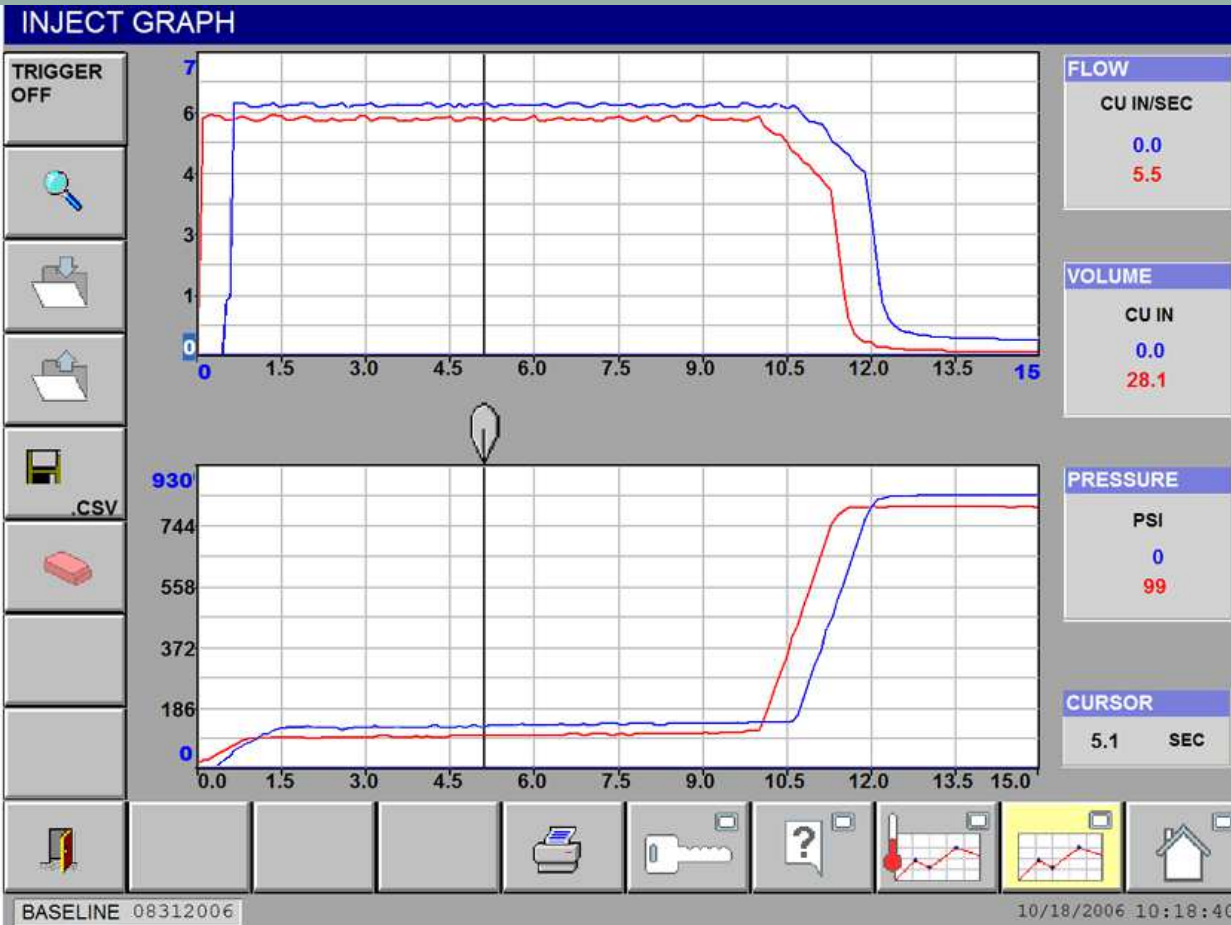
Knowing Your Investment Casting Process

This gives you the capability of recording the injection parameters from a machine that's making a good pattern and transferring those parameters to a second machine.

The second machine can now duplicate the injection parameters of the first machine by adjusting the second machine's controls to match the injection graphs of the first.

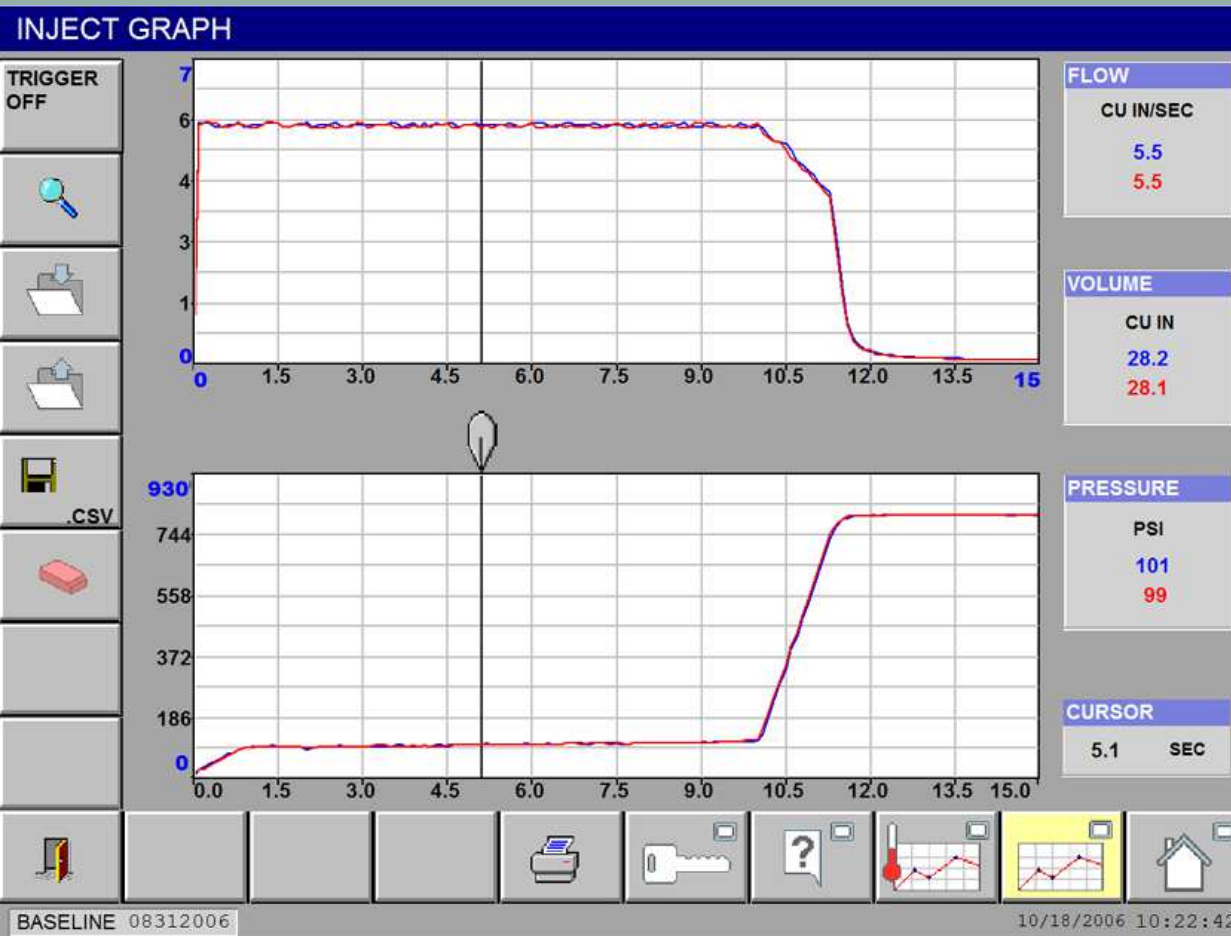


Knowing Your Investment Casting Process



It's that simple; just align the graph of the first machine to the second machine.

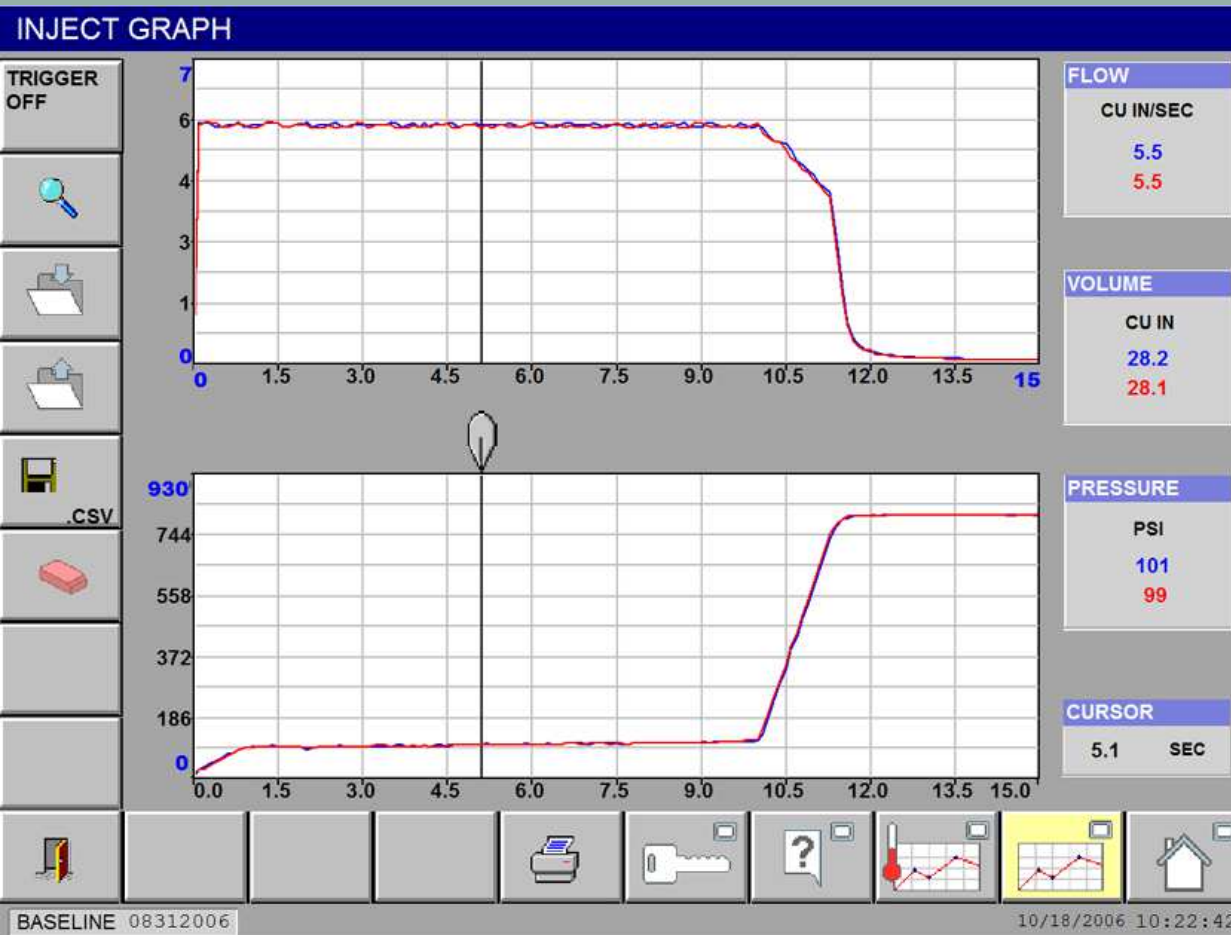
Knowing Your Investment Casting Process



It's that simple; just align the graph of the first machine to the second machine.

Once the graphs match, both machines will inject at the same actual injection parameters regardless of the difference in machine settings.

Knowing Your Investment Casting Process



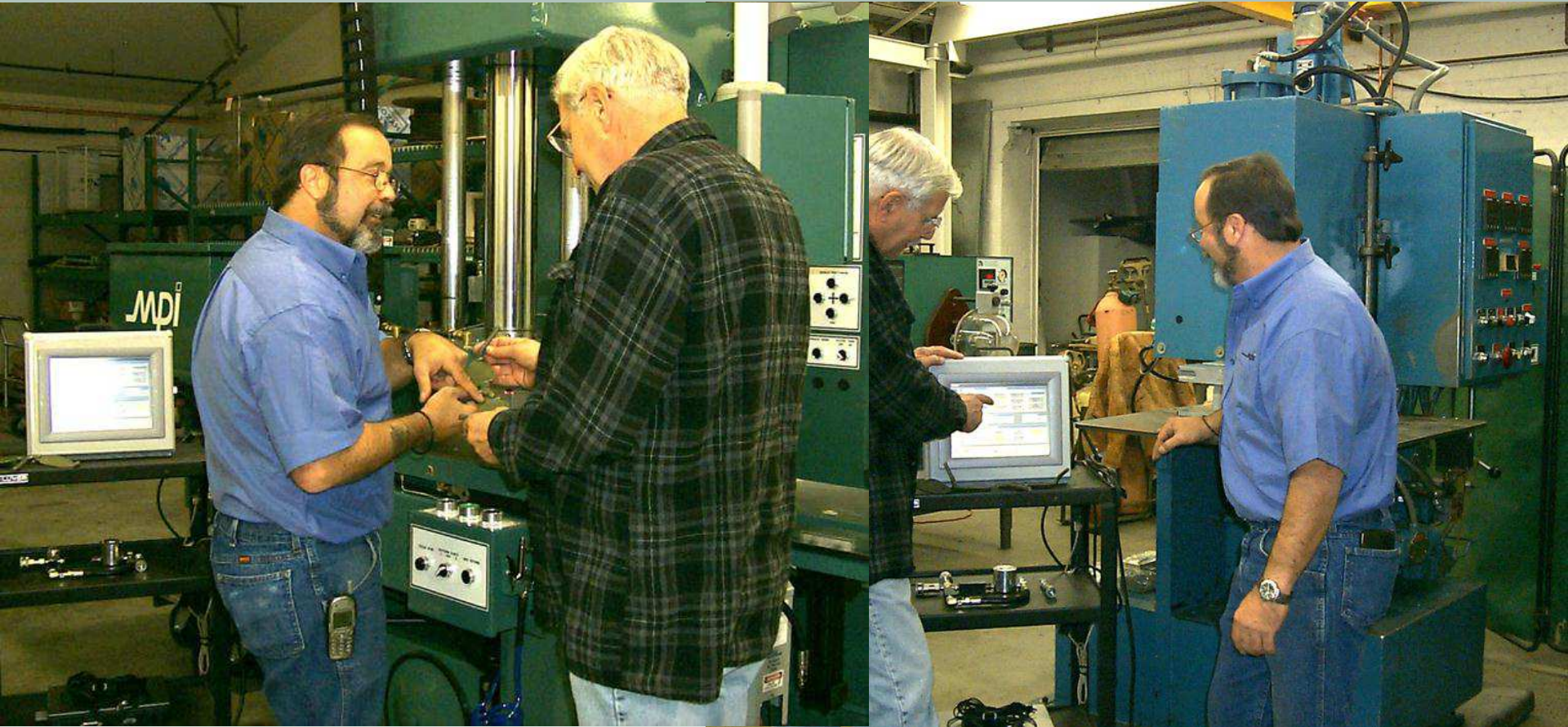
It's that simple; just align the graph of the first machine to the second machine.

Once the graphs match, both machines will inject at the same actual injection parameters regardless of the difference in machine settings.

Both machines can now inject the same quality wax pattern.

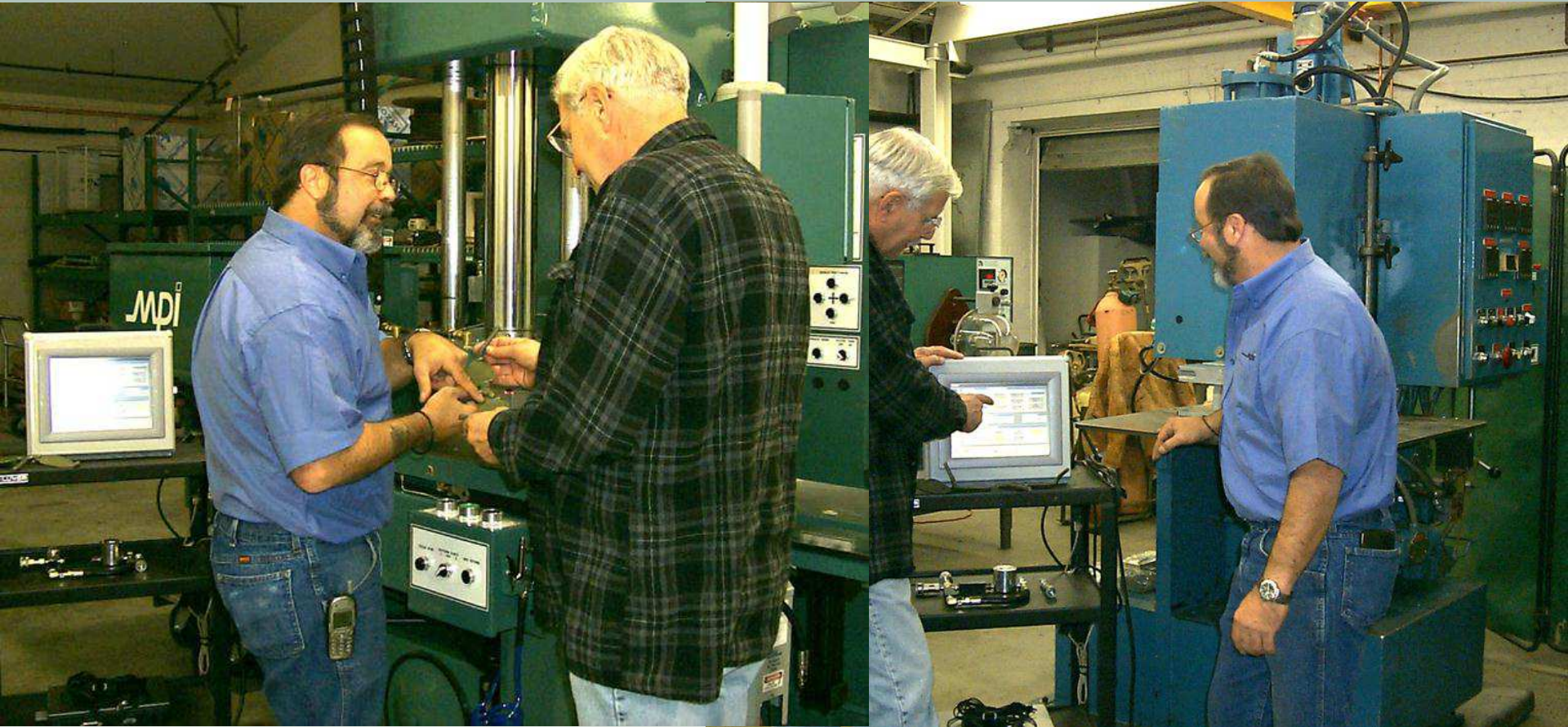
Knowing Your Investment Casting Process

This can also be done effectively from one manufacturer's machine



Knowing Your Investment Casting Process

to another manufacturer's machine so long as both machines have the performance capability to run the die.



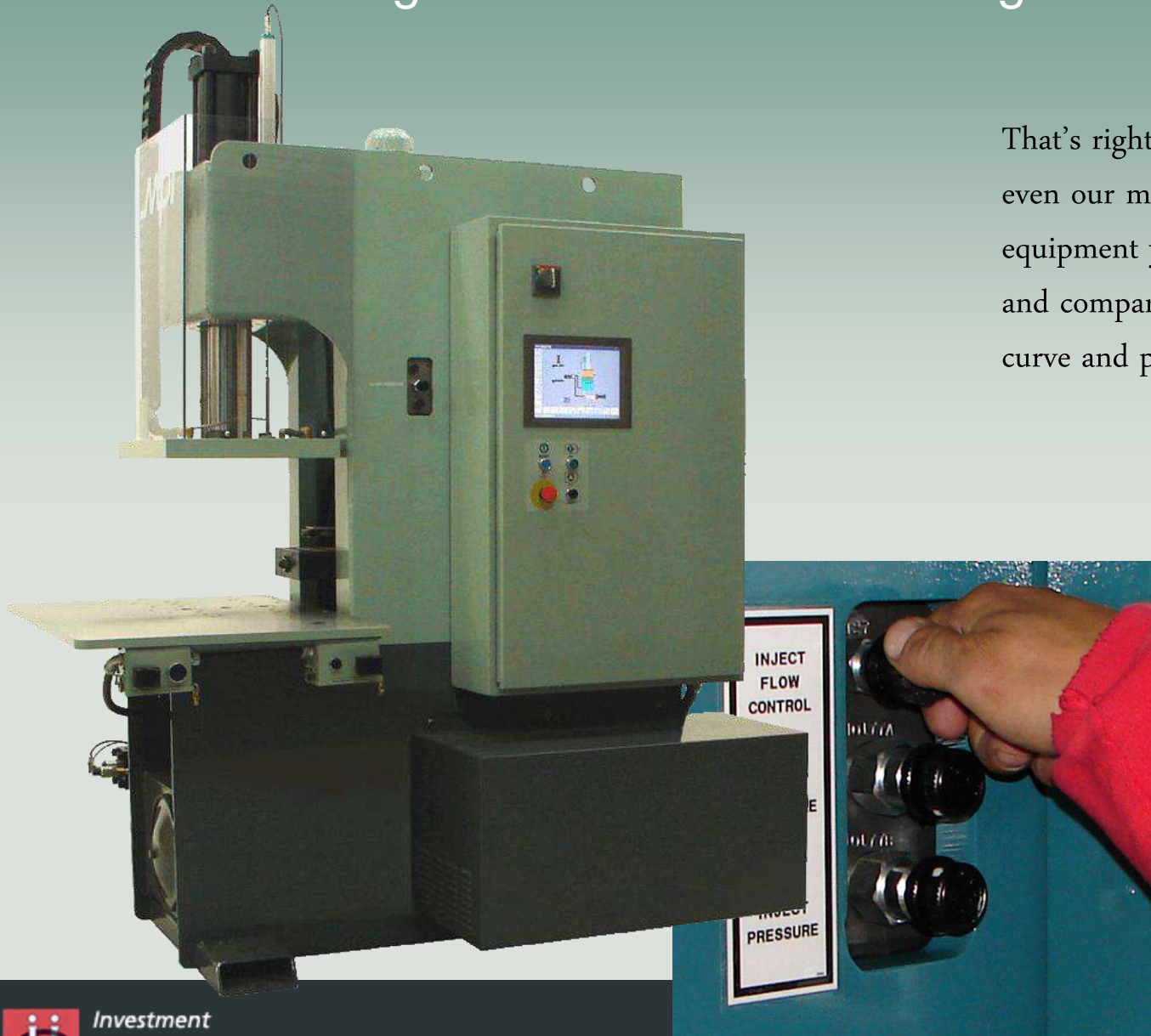
Knowing Your Investment Casting Process



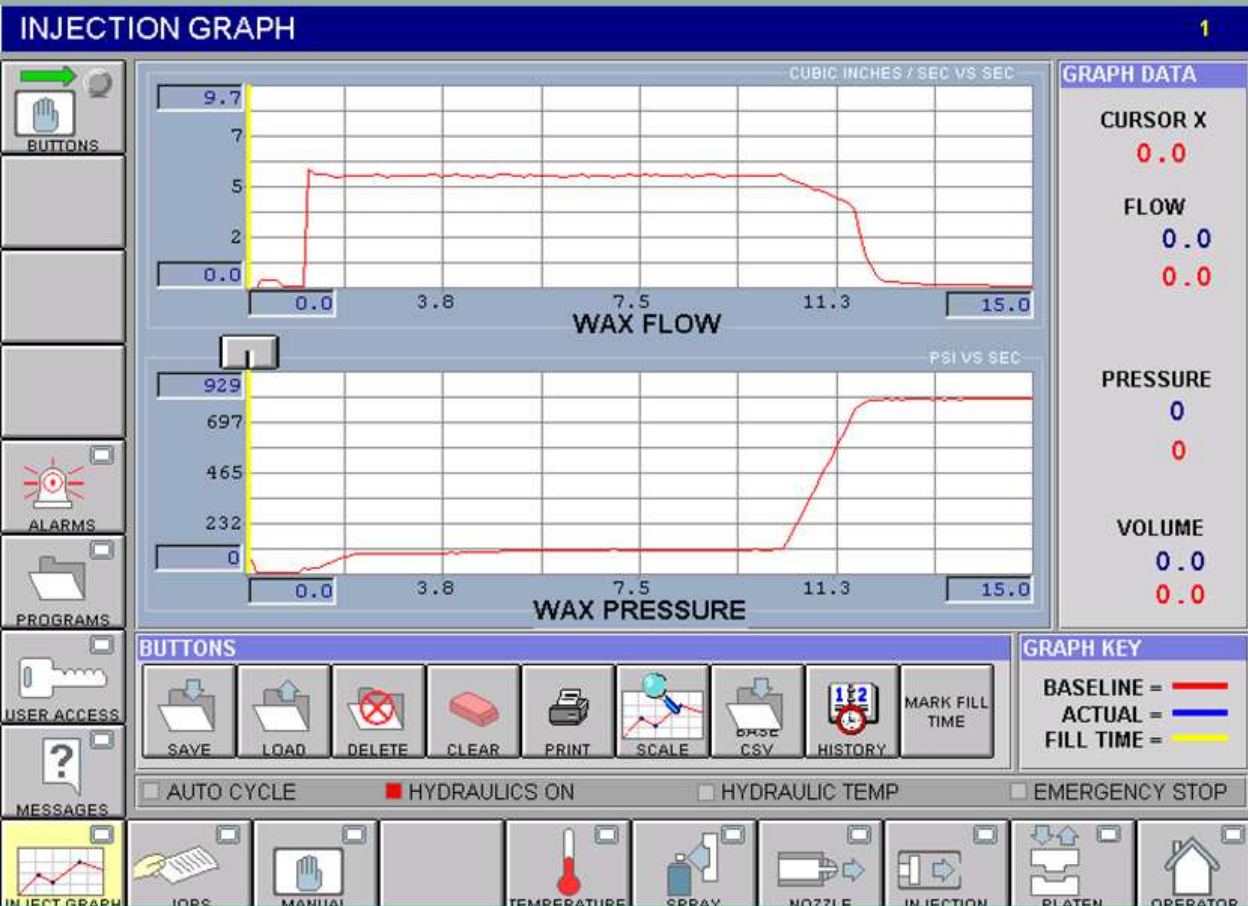
The patented technology developed in the Process Vision graphing system is so beneficial we have made it available on every new MPI wax injection system in our “Smart Line” of wax injection equipment.

Knowing Your Investment Casting Process

That's right; on all injectors, even our manually adjusted equipment you can visually see and compare the wax flow curve and pressure curve.



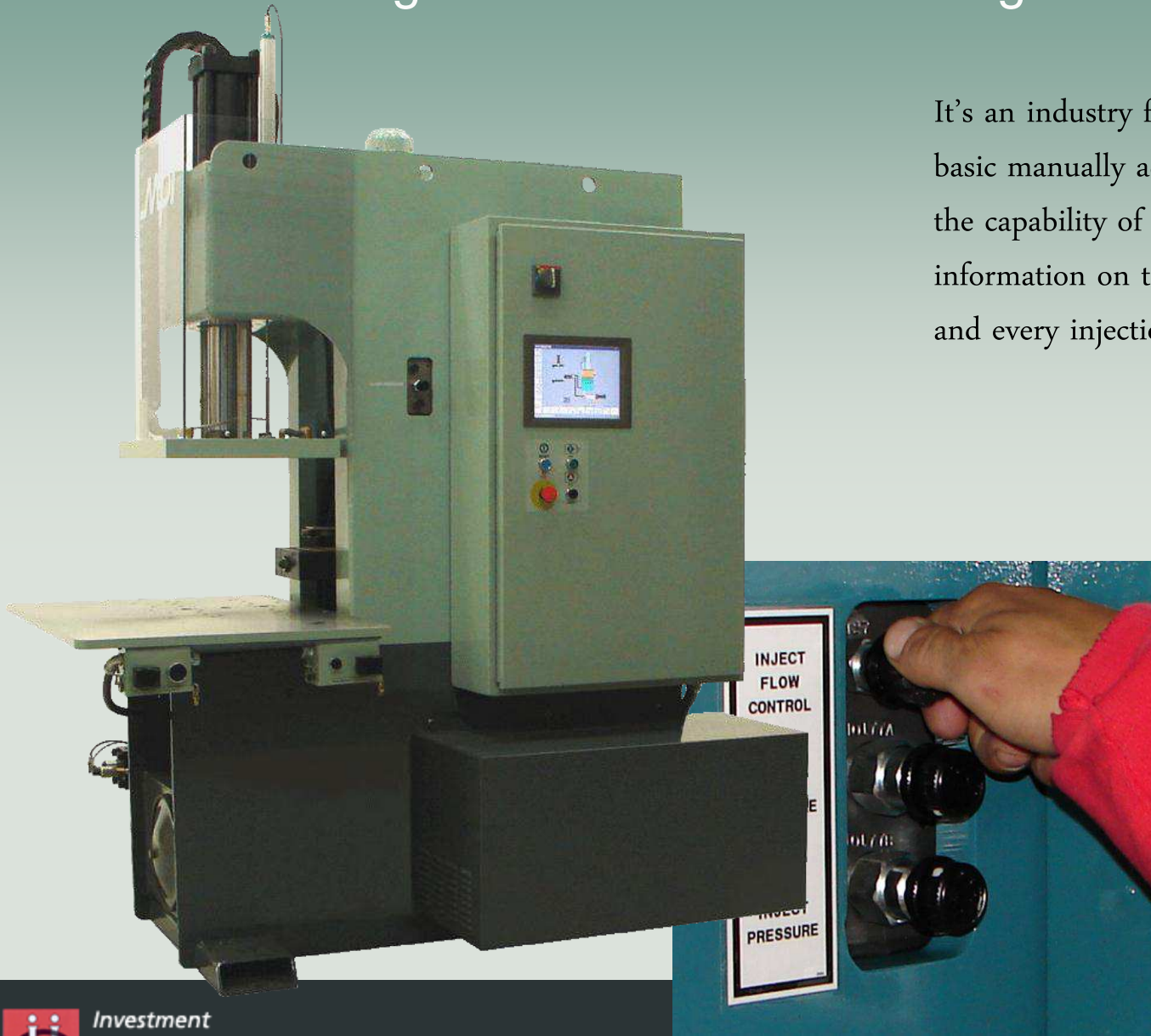
Knowing Your Investment Casting Process



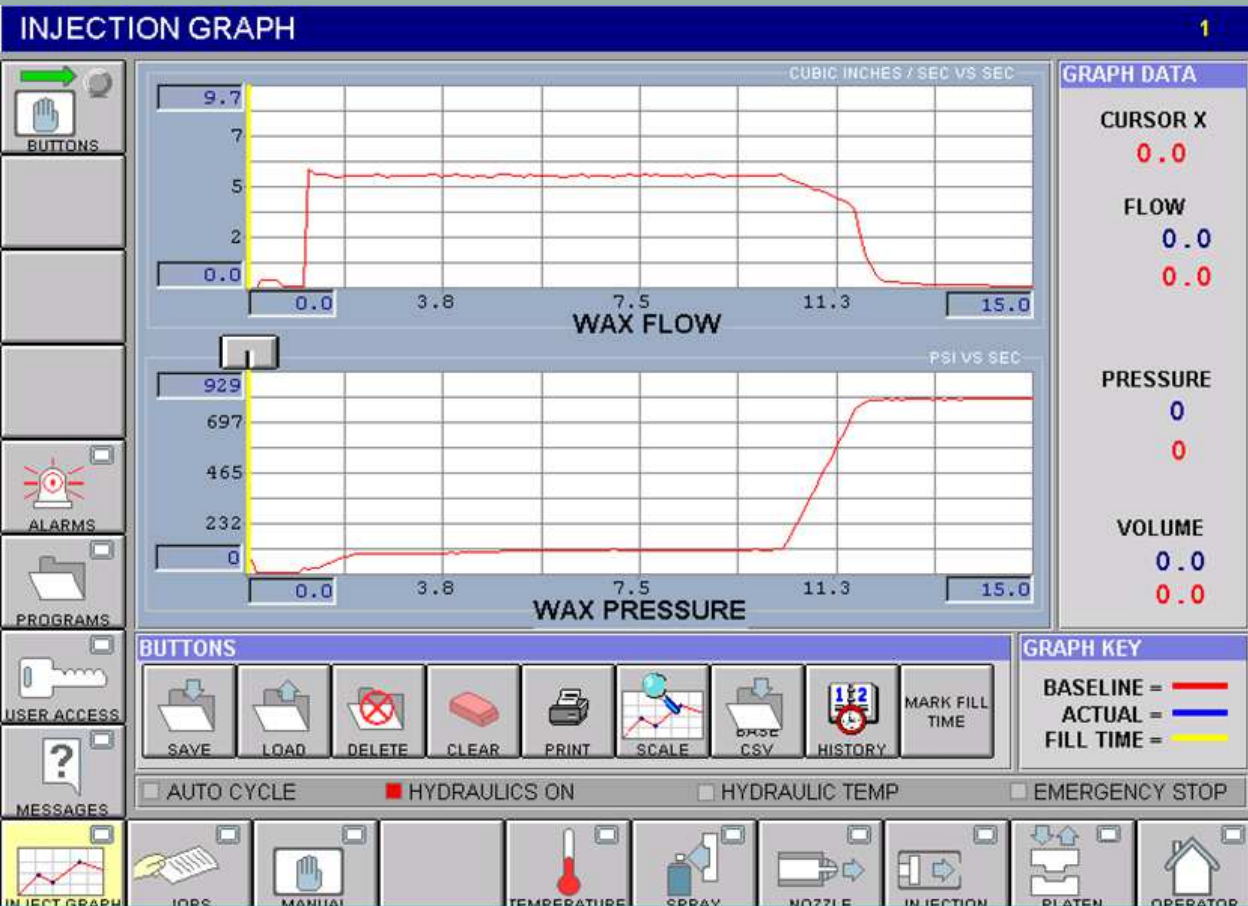
This is an invaluable aid to the set up technician and shows the operator the injection pressure and fill times during each injection cycle.

Knowing Your Investment Casting Process

It's an industry first that a machine with basic manually adjusted control valves has the capability of giving the operator valuable information on the injection process for each and every injection.



Knowing Your Investment Casting Process



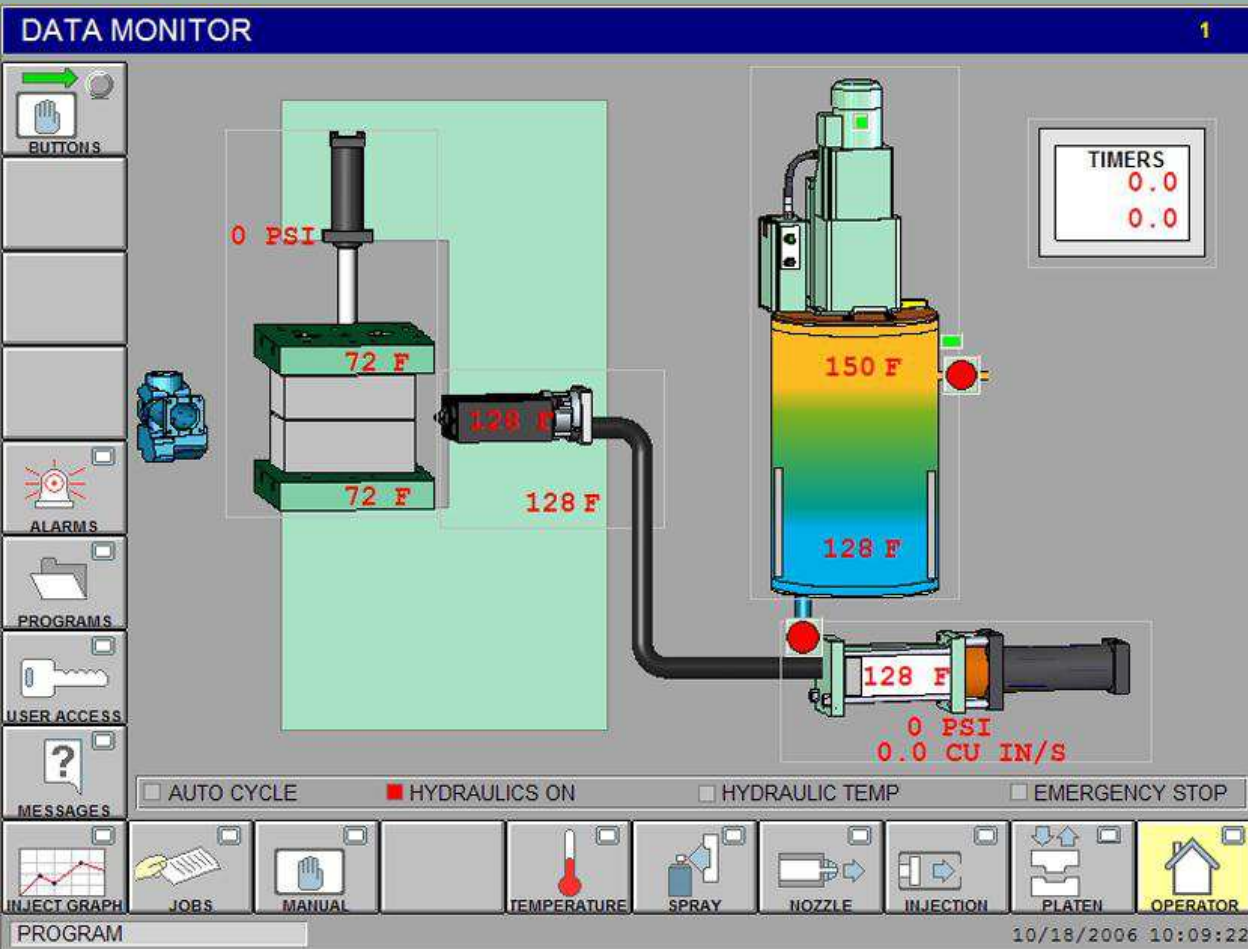
Imagine being able to make a flow or pressure change and visually see the effect on the fill time of the pattern. Even on a machine with manual controls.

Knowing Your Investment Casting Process

Being a Windows based system, it's now possible to network your wax room equipment with your in house information system. You are able to store and transfer your job order and process card from the office into the wax room. The injection process can be displayed on the touch screen. If it's a new job the process parameters can be stored and retrieved by an alpha numeric job number.

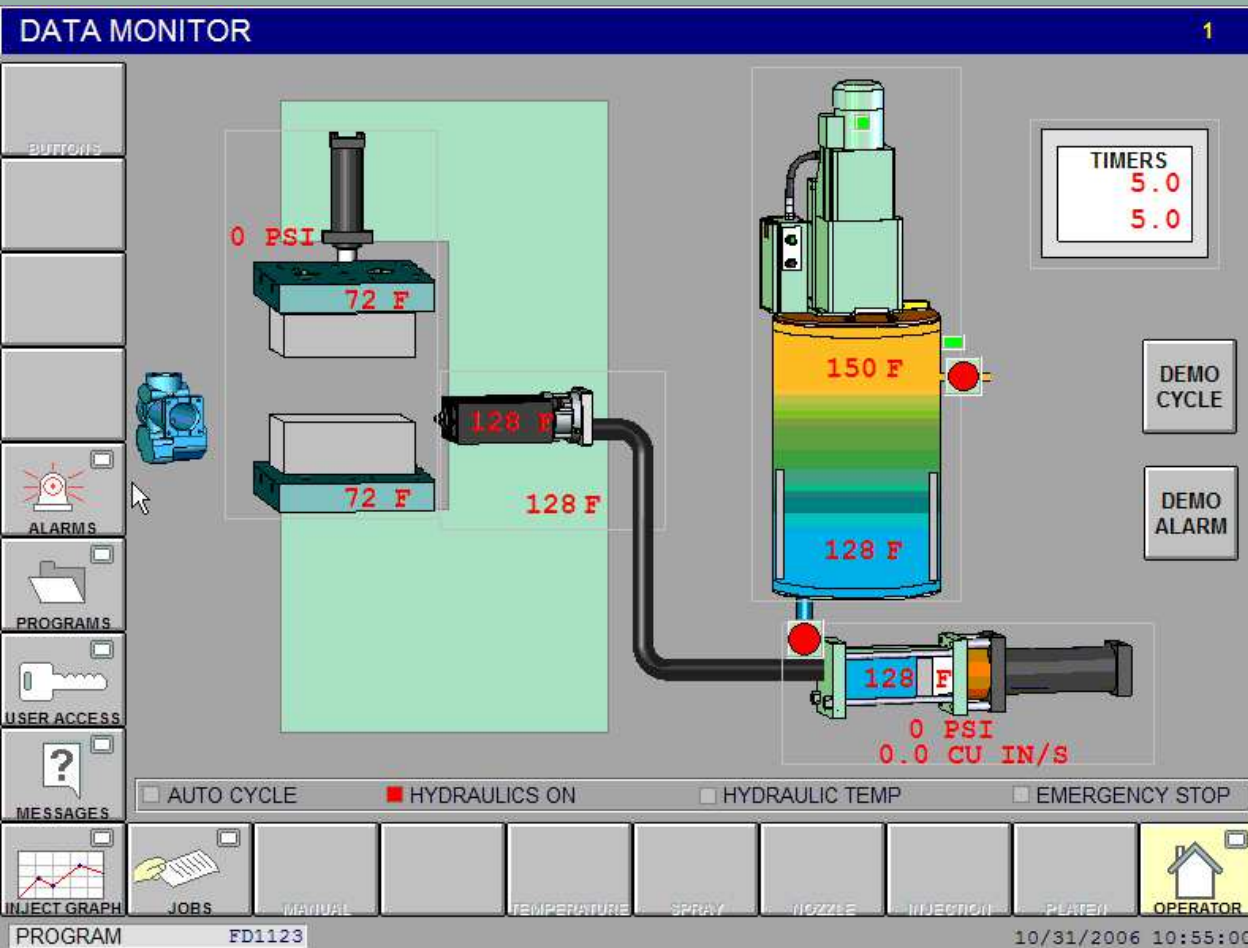


Knowing Your Investment Casting Process



The injector's control system gives you the capability of monitoring your injector's process by graphically viewing the complete injection cycle and all the operating parameters used to make the wax pattern.

Knowing Your Investment Casting Process



The operator is informed where in the injection cycle the process is, and what if anything has changed.

Knowing Your Investment Casting Process

What makes this a real process control system is its ability to run a die the same way it was run previously even on a different machine.



Knowing Your Investment Casting Process



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Every time a job is set up it can be compared against a stored injection graph of operating parameters.



Knowing Your Investment Casting Process



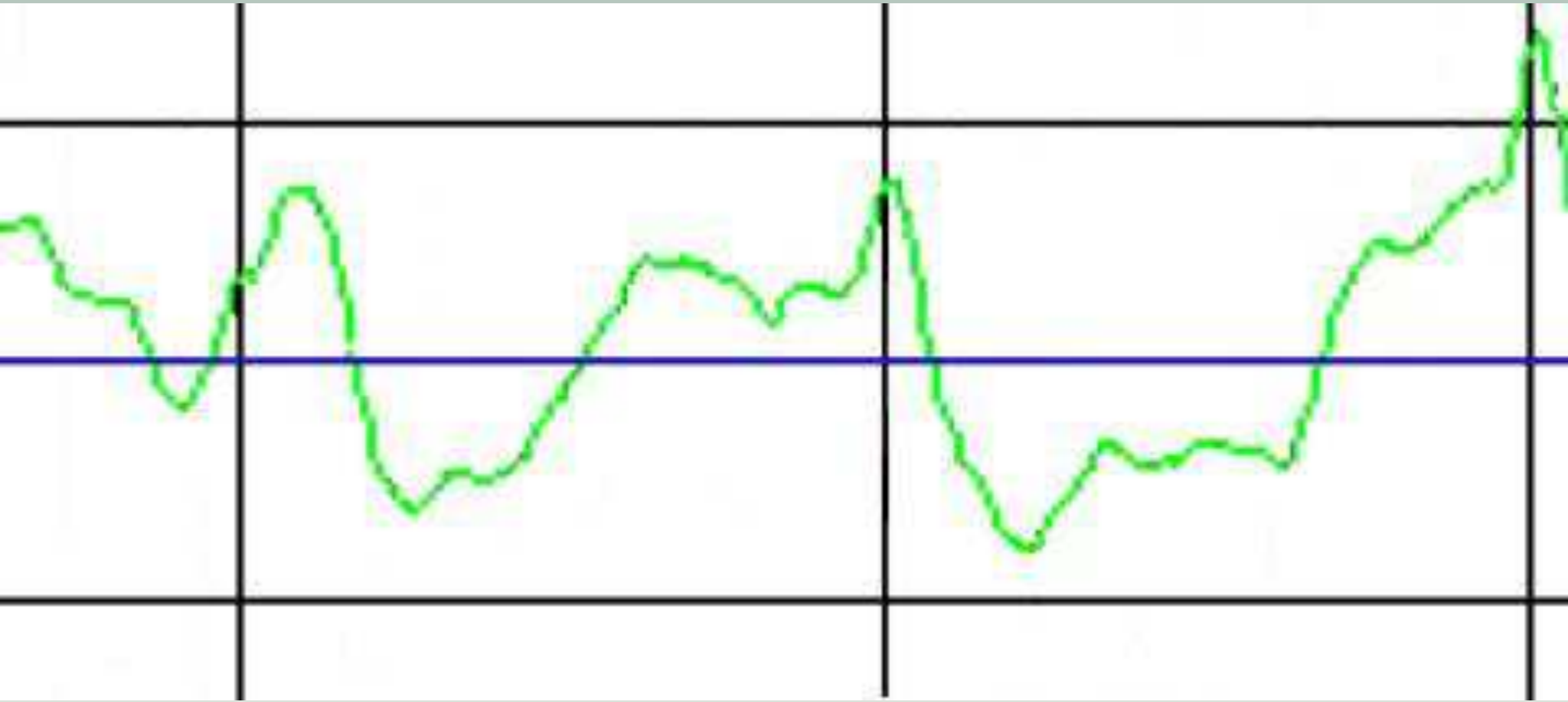
What makes this a real process control system is its ability to run a die the same way it was run previously even on a different machine.

Every time a job is set up it can be compared against a stored injection graph of operating parameters.

This will verify that the process has not deviated from its original operating parameters.

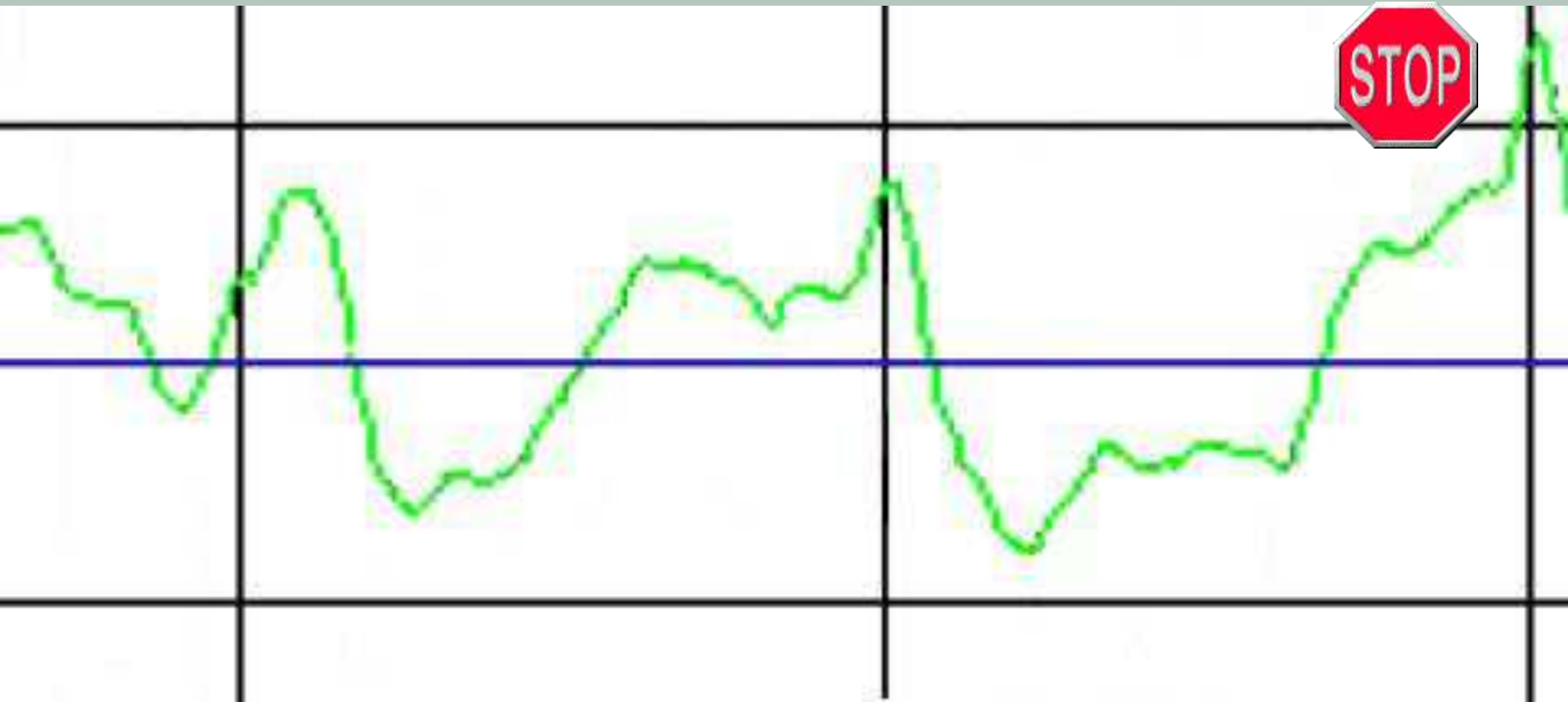
Knowing Your Investment Casting Process

Your process control limits can also be set for each job.



Knowing Your Investment Casting Process

If an operator sets up a job outside of the preset control limits, or the process drifts out of the control limits, the machine will alarm and stop.



Knowing Your Investment Casting Process



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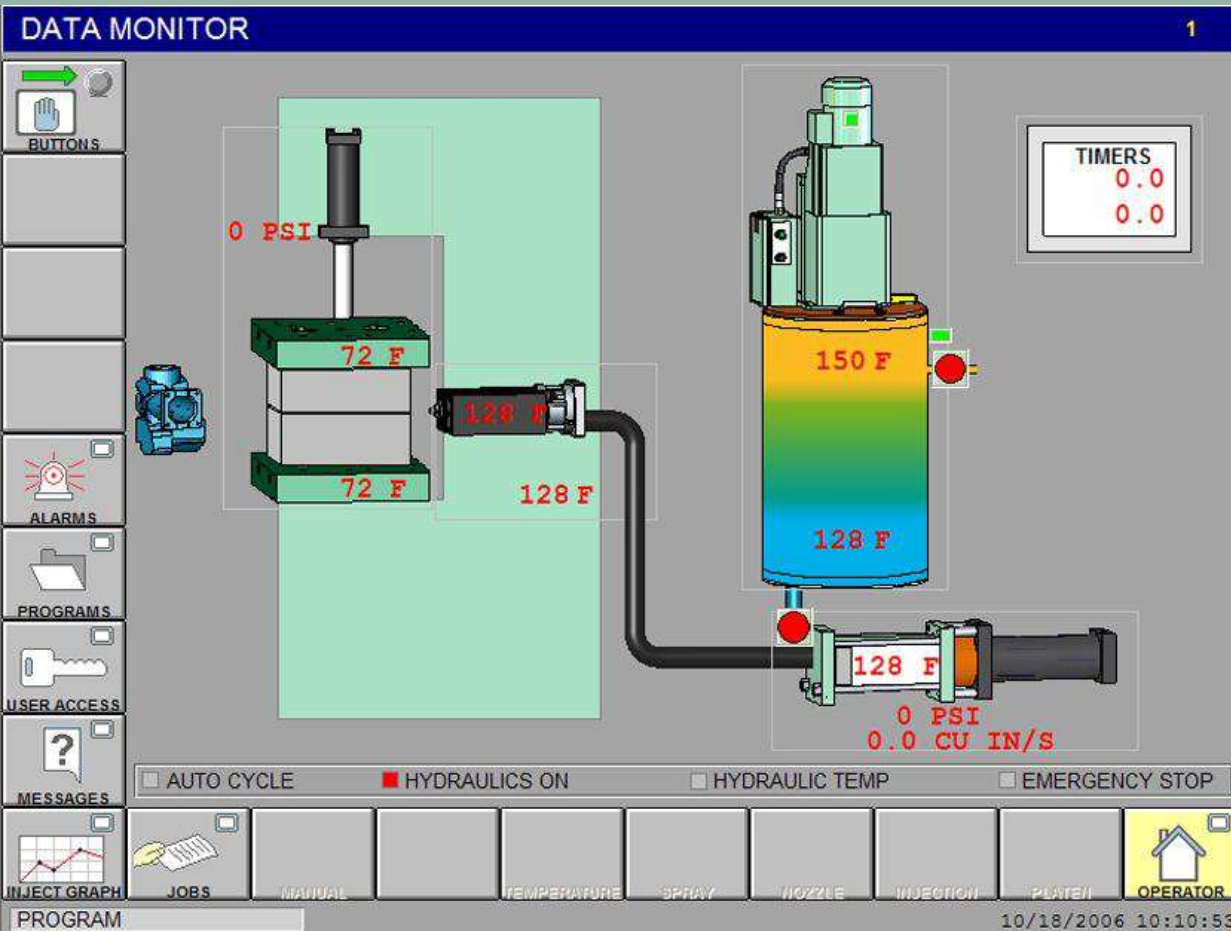
It's now up to a setup person or supervisor to determine what has caused the problem and how to go forward.

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Access to the injection controls is set by levels of authority.

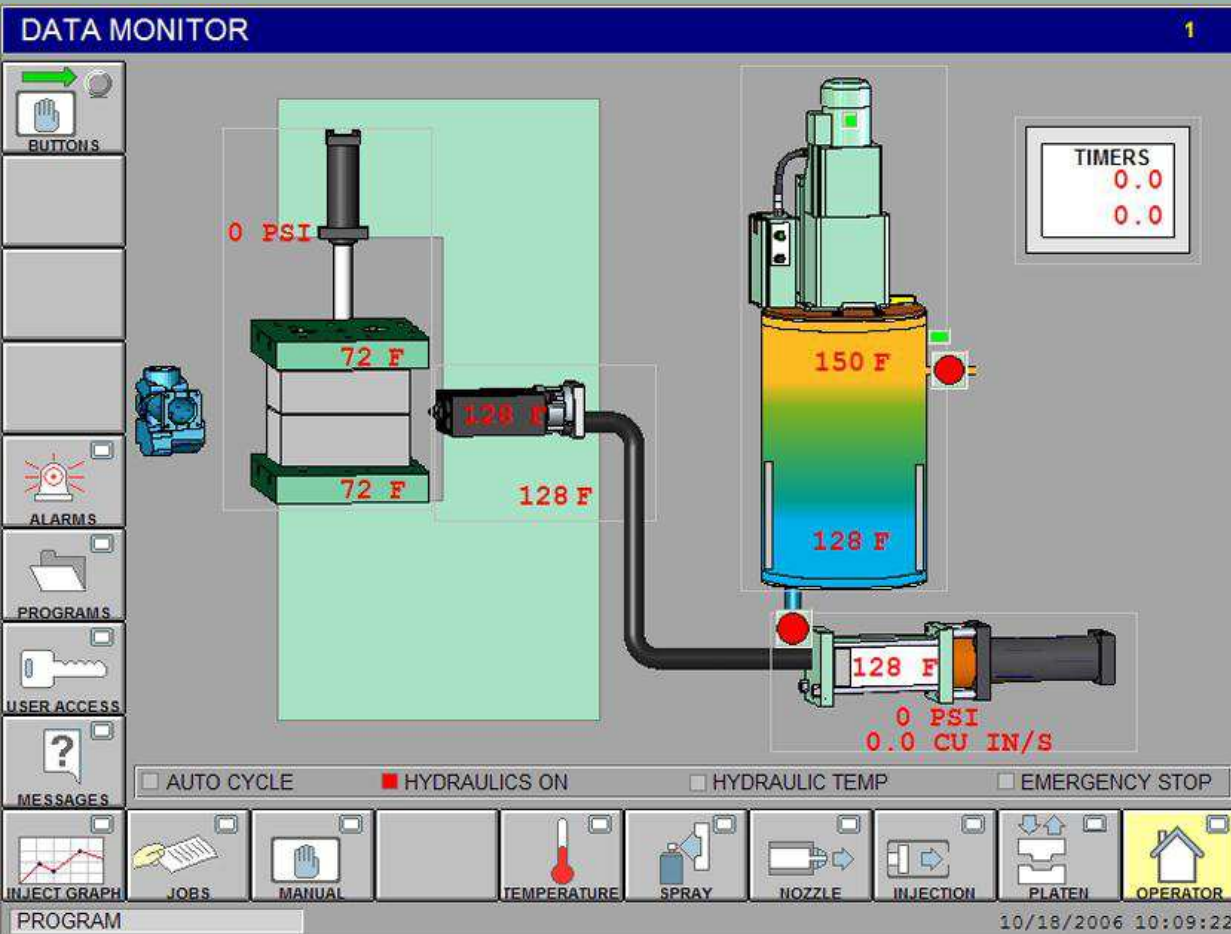


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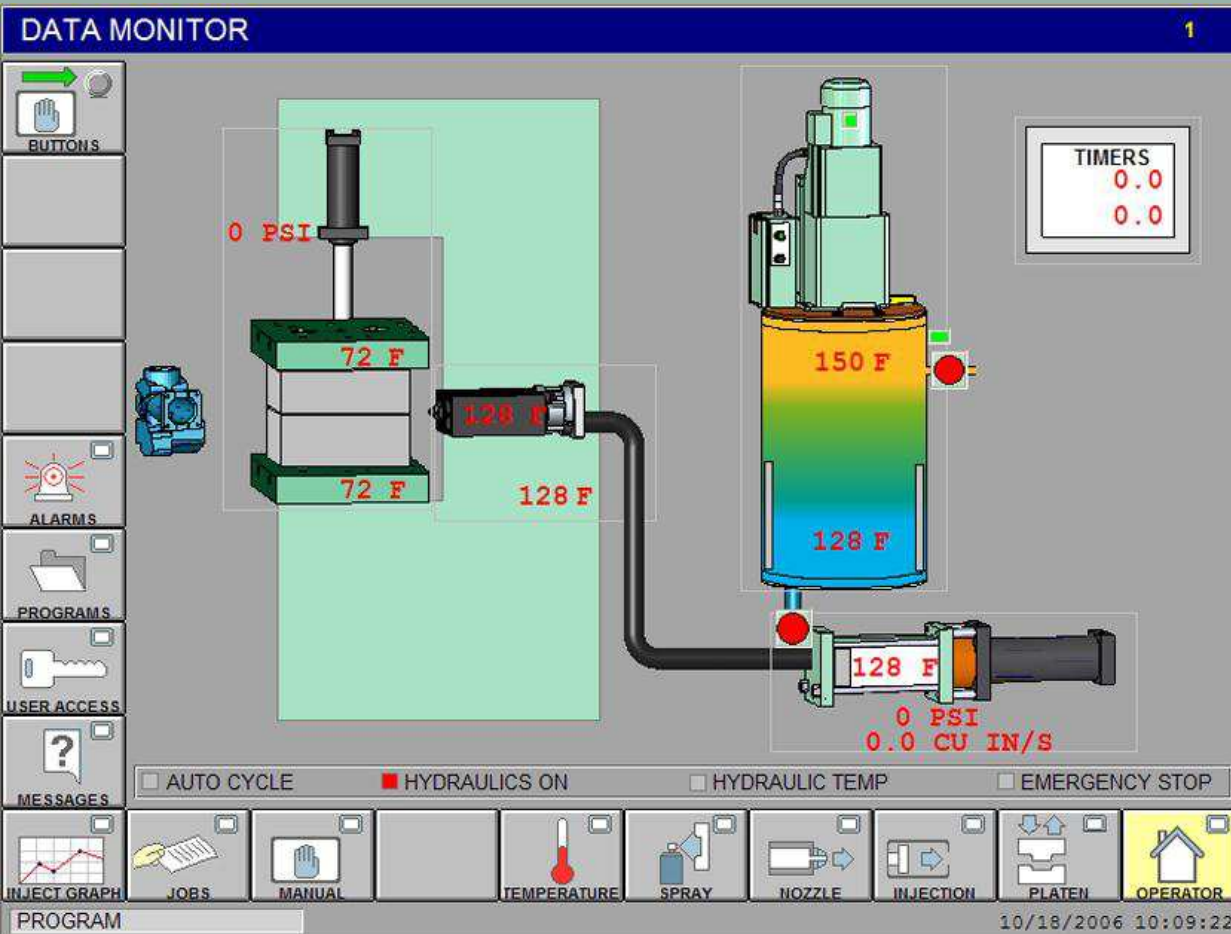
Level 1 for the operator,

Knowing Your Investment Casting Process



Level 2 for the setup person and so on up to full access by a qualified person in the maintenance or engineering department.

Knowing Your Investment Casting Process



The access levels will be set by each individual foundry matching their particular access requirements.

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PLC MONITOR 1 6

	INPUT 1	INPUT 2	INPUT 3	OUTPUT 1	OUTPUT 2	
BUTTONS	CLAMP PRS SW	SHT1 IN SW	CORE LOGIC 1	PLATEN OPEN	FLEX NOZ 2 EXT	
	CYCLE STOP	SHT1 OUT SW	CORE LOGIC 2	PLATEN CL FST	WAX VALVE 2	
	SAFETY VALVE	SHT1 IN SL SW	CORE LOGIC 3	PLATEN CL SL	RES REFILL 2	
	RES 1 ON	SHT1 OUT SL SW	CYL 1 IN	DECOMPRESS	FIXED PURGE	
	NOZZLE SAFE	MAN/AUTO #2	CYL 1 OUT	ADS CLAMP EN	DIE CLAMP	
	HPE BACK	NOT USED	CYL 2 IN	UNUSED	UNUSED	
	HYD ON	GRD OPN SL SW	CYL 2 OUT	UNUSED	UNUSED	
	DIE CLP PRS SW	SHT LT PB1	COR EJECT BK	UNUSED	ADS INJ PRS VENT	
	RES 1 FULL	SHT LT PB2	SHT1 SEL	ADS INJ EN	ADS CLMP PRS DIS	
	INJ CYL FULL	SHT RT PB1	SHT2 IN SW	DISAB INJ PRS	ADS PLN OPN VENT	
ALARMS	HYD HIGH TEMP	SHT RT PB2	SHT2 OUT SW	UNLOAD PUMP	ADS CL SL VENT	
	PLATEN OPEN PB	GRD CL SLW SW	SHT2 IN SL SW	FLEX NOZ 1 EXT	HPE 1 SOL	
	UNUSED	RES 2 ON	SHT2 OUT SL SW	WAX VALVE 1	CORE CYL 1 EXT	
	UNUSED	GRD MON EN	SHT2 SEL	RES REFILL 1	CORE CYL 1 RET	
	ESTOP	RES 2 FULL	UNUSED	SAF VLV CL AUTO	CORE CYL 2 EXT	
	ANTI-TIE EN	GRD OPN SW	UNUSED	SAF VLV OPEN	CORE CYL 2 RET	
	PROGRAMS					
USER ACCESS						
MESSAGES						

STATUS BAR:

☐ I/O 2 ☐ PRINT

☐ AUTO CYCLE ☒ HYDRAULICS ON ☐ HYDRAULIC TEMP ☐ EMERGENCY STOP

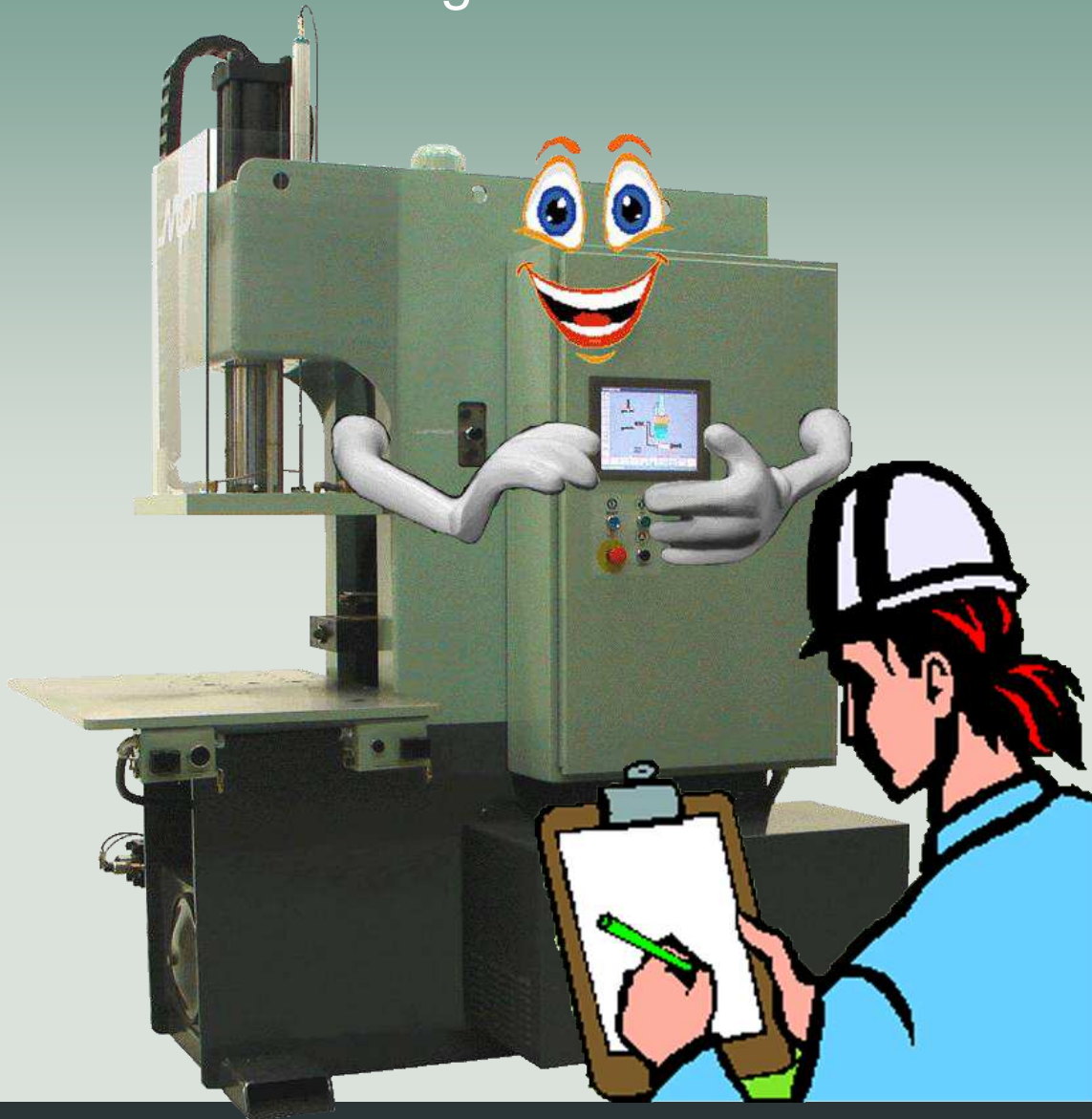
FUNCTIONAL AREAS:

INJECT GRAPH | JOBS | MANUAL | TEMPERATURE | SPRAY | NOZZLE | INJECTION | PLATEN | OPERATOR

PROGRAM 10/19/2006 11:36:13

From the maintenance standpoint, all of the PLC inputs and outputs are displayed and labeled on the touch screen. This allows the technician to pinpoint an interruption in the machine cycle and quickly diagnose the cause of the interruption.

Knowing Your Investment Casting Process



Preventative maintenance can now be performed based on the machine letting the service departments know when it's ready for a PM based on the cycles run and operating conditions of the equipment.

Knowing Your Investment Casting Process

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but let's not forget the reason for Process Vision.

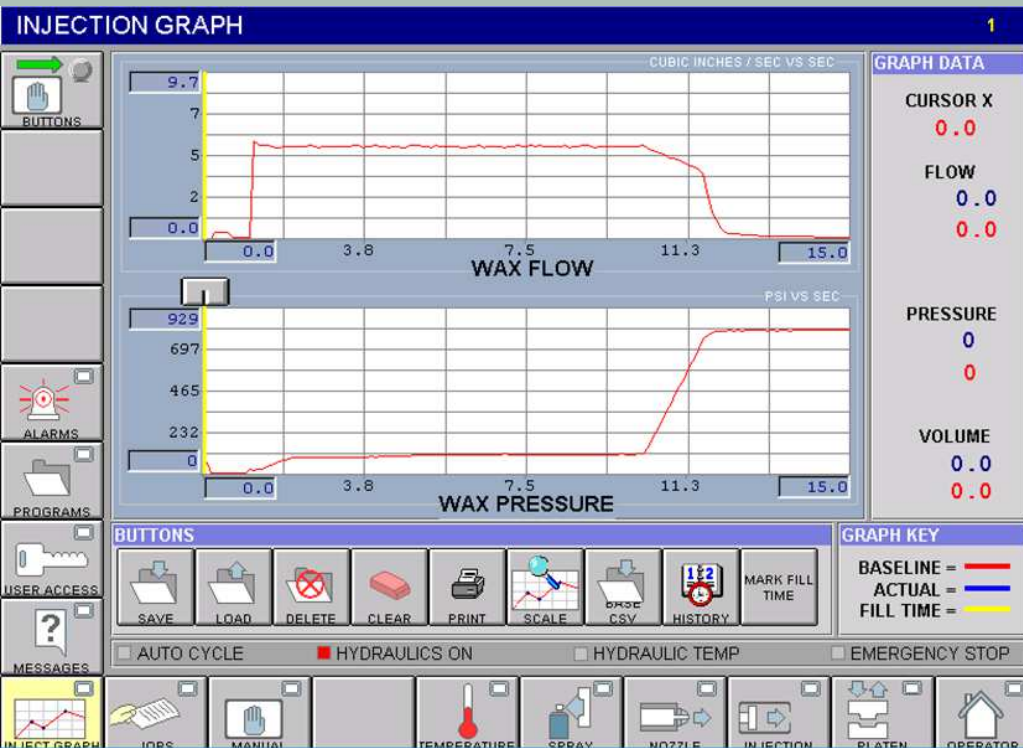


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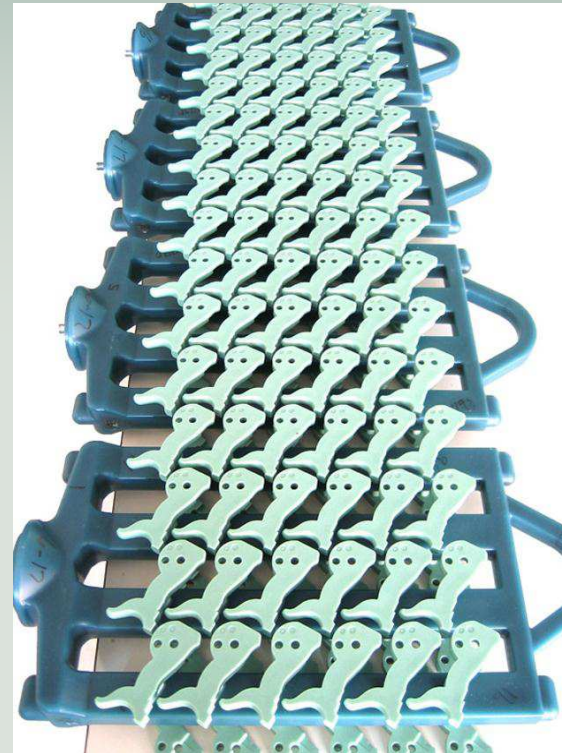
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Process Vision graphing allows you to run a die on any injector capable of running the die regardless of the injector's personality.



Knowing Your Investment Casting Process

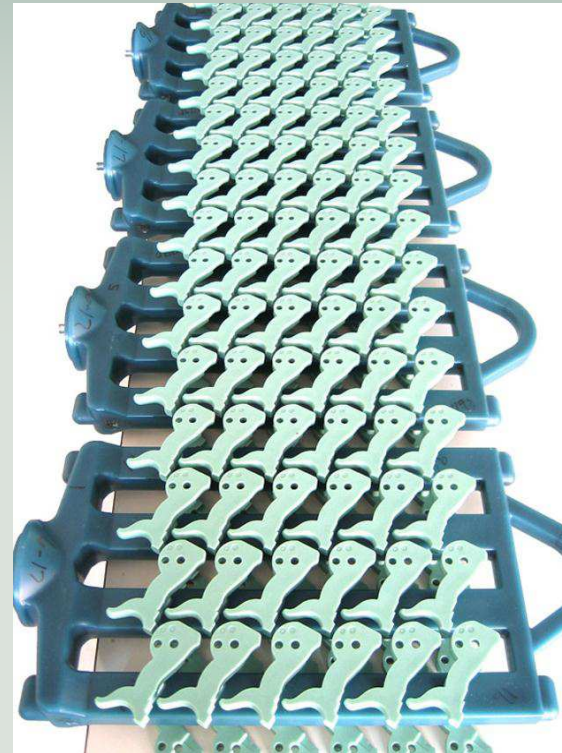
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Knowing Your Investment Casting Process

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What does that mean to you?



Knowing Your Investment Casting Process

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What does that mean to you?

It means confidence that sound castings can be made with each and every wax pattern produced.

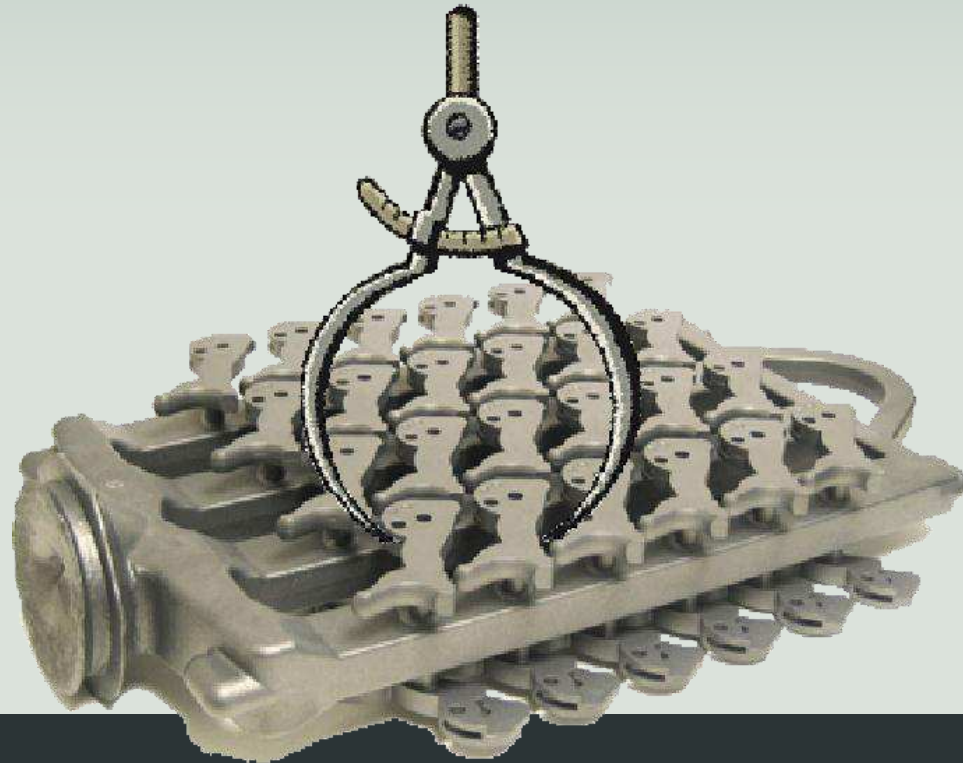


Knowing Your Investment Casting Process

When your process is in control all your wax patterns are the same.

What does that mean to you?

It means more castings with tighter tolerances can be shipped with less wax patterns injected.



Knowing Your Investment Casting Process

When your process is in control all your wax patterns are the same.

What does that mean to you?

It means your foundry is more competitive and has a better bottom line.

Knowing Your Investment Casting Process

It's really that SIMPLE.



Knowing Your Investment Casting Process

Thank You