WELCOME

Profit and Process Control Begins in the Wax Room

Profit and Process Control Begins in the Wax Room

The pressures on foundries today to maintain a competitive edge in the world market is staggering.

India with its lower operating costs can have an advantage getting high volume jobs & can produce them with equal quality & at lower costs.

Gain a Competitive Advantage

How are we going to ***gain*** a competitive advantage?

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Operate Differently

By operating differently.

We need to look at the whole foundry from a different vantage point.

Imagine yourself in your own foundry as I move through this presentation

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Increase Casting Yields

Two areas that will gain significant casting yields are:

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Two areas that will gain significant casting yields are:

- Decrease or even eliminate rework in every step on the foundry operation.

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Two areas that will gain significant casting yields are:

- **Decrease or even eliminate rework in every step on the foundry operation.**
- **Pour less metal for the same amount of casting.**

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How can this be done?

How can we eliminate rework and reduce the amount of metal poured per casting?

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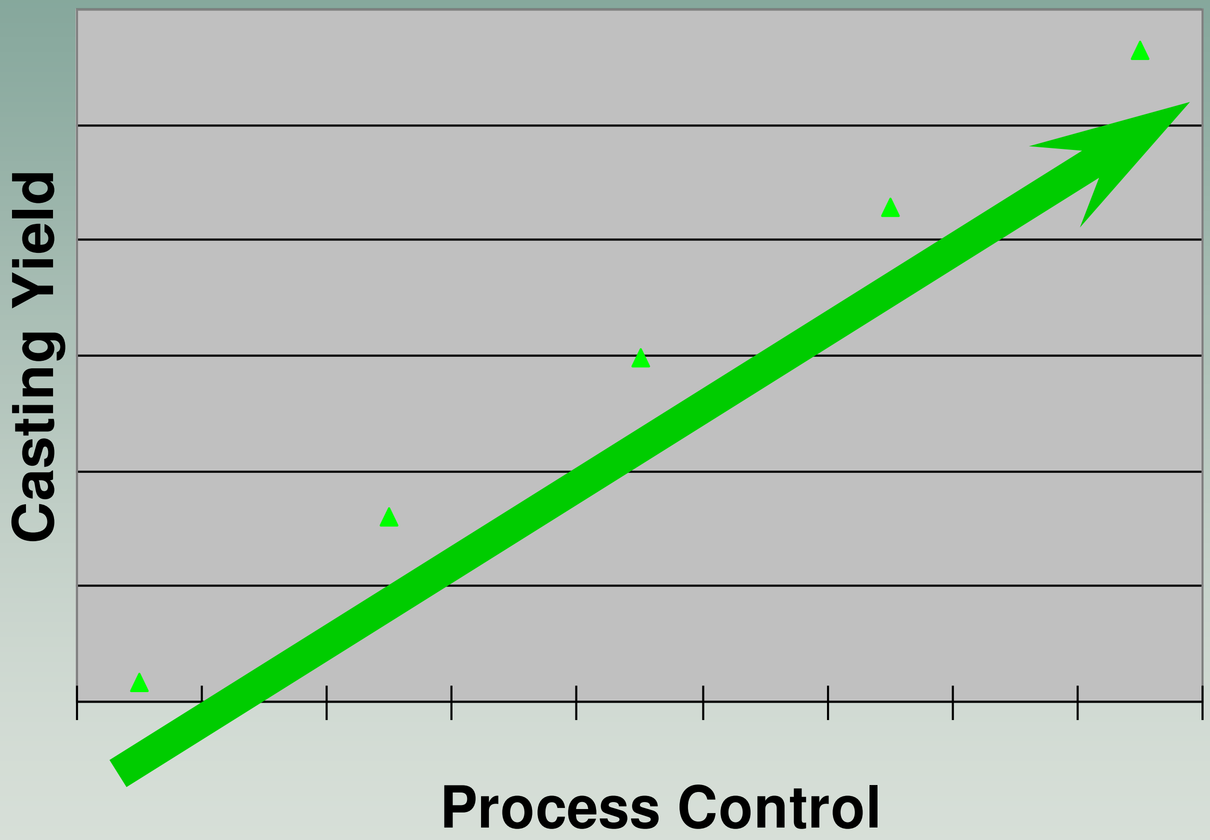

We can do this by improving the process control at the front end of your foundry.

This is the way to take a significant step in eliminating rework and reducing the amount of metal poured.

Increased process control = increased casting yield

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Take the shell room as an example. Automation has been very effective in the shell room. It has made the dipping operation extremely repeatable from shell to shell. But…

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Is the shell coating itself really uniform and consistent from pattern to pattern? When you look carefully…

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The answer is often no.

When you analyze what is causing the differences you can see that…

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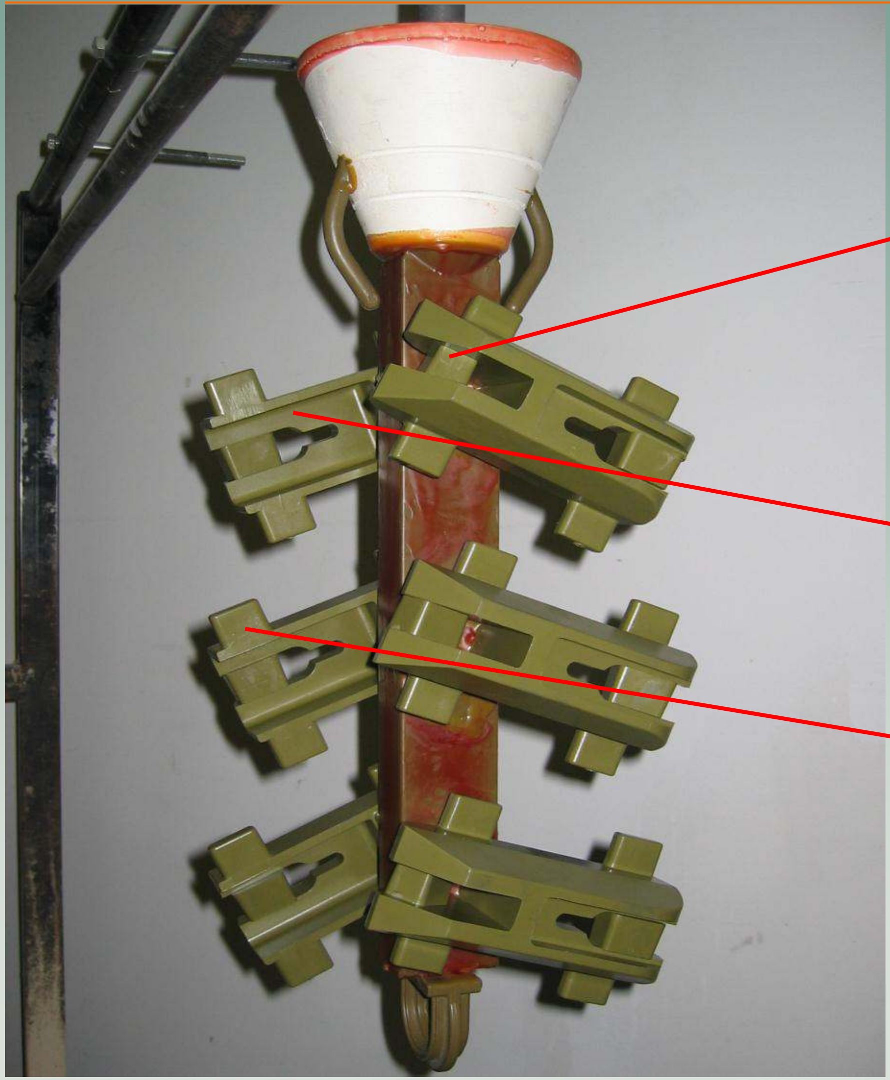

It is caused by the variability in the placement of the patterns on the runner?

What is causing this variability?

It's caused by the variability of manual pattern assembly.

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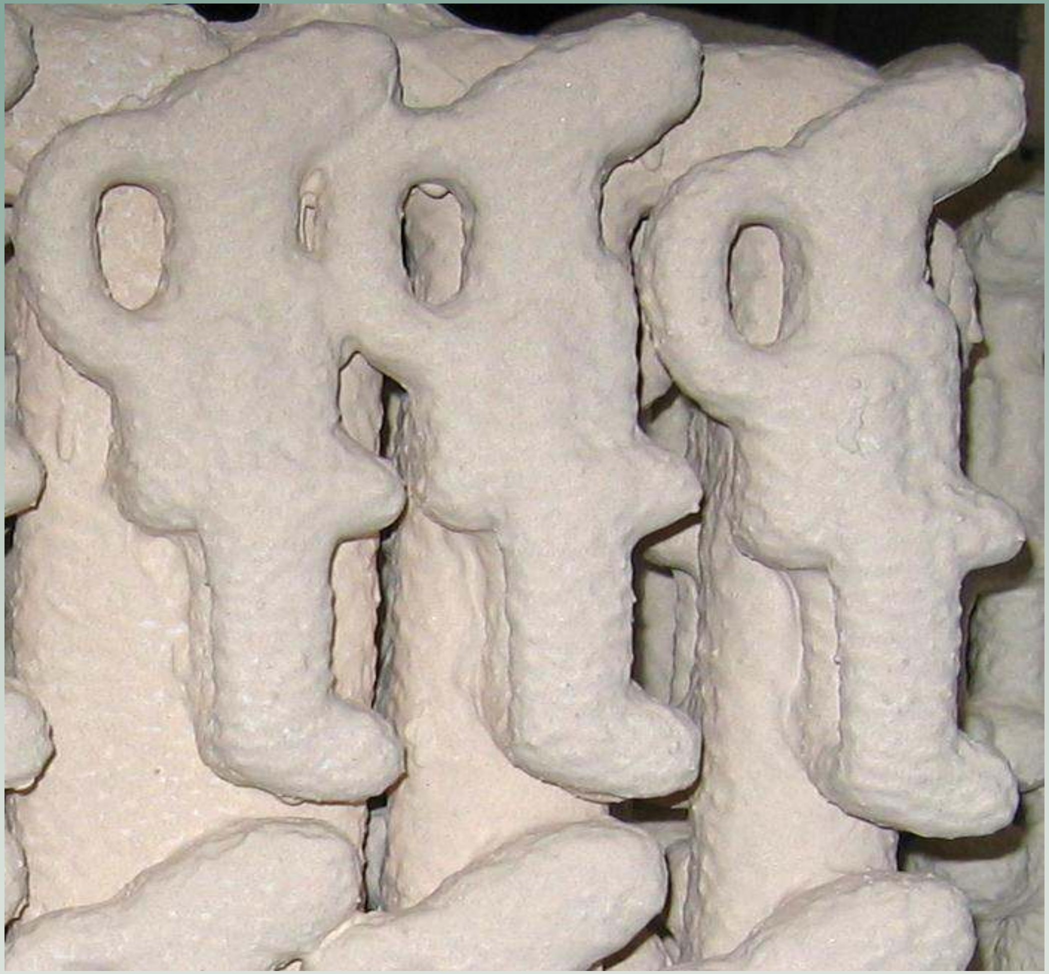

If the wax assembly is not uniform going into the automated shell room, the finished shell coming out of the shell room is not, and cannot be uniform from pattern to pattern.

There is variation in spacing in this example caused by manual assembly.

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Lamothermic Corp. Job Traveler

Page: 1
Date: 9/10/2004

Job: 57221 Asm: 0 Part: 216537 Rev: G
Description: Round Assm. Drawing:
1/4" L3168

Die Location: HF GEMSEN Metal Tree Pour Wt. 49.00 JM ___ LM ___ PM *Y N* SM ___

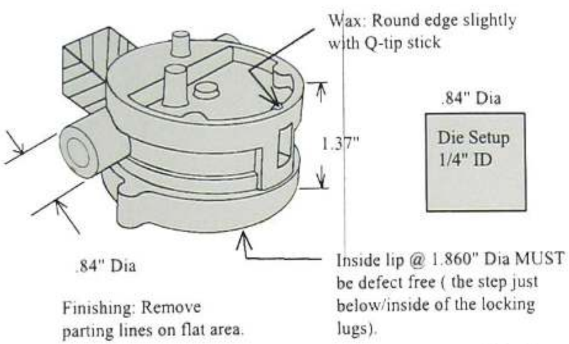
CERT 1 tree MPI wax

Overship: 10 %

For Stock	For Order	Total		Schedule Date
24	0	24	Start: 9/10/2004	Required By: 10/22/2004

RAW MATERIAL COMPONENTS:

Seq No.	Part Number	Description		Required Qty	Whse	Rel.OP	Status	
20	B504	Long 3 Runner Sprew		1.00EA	WAX	20		0.04 EA
		Pcs/Tree 24, Pcs/Side 3, No of Sides 8 *Add spaghetti drains, sprew with open side facing out.* *Use MPI provided waxes*						
30	DA-Ceramic	Ceramic		24.00LB	CER	30		1.00 LB
40	1300-C875 *C875*	C875	Bubble No. Parts	25.45lb	FND	60		0.82 lb



L-3168

Alloy C875

Let's stand back for a moment, and look at your wax assembly procedure.

Why do you have the pattern-to-pattern spacing that you are presently using?

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Is one of the reasons for this spacing to accommodate for the manual wax assembly process, and the variability of the manual assembly process?

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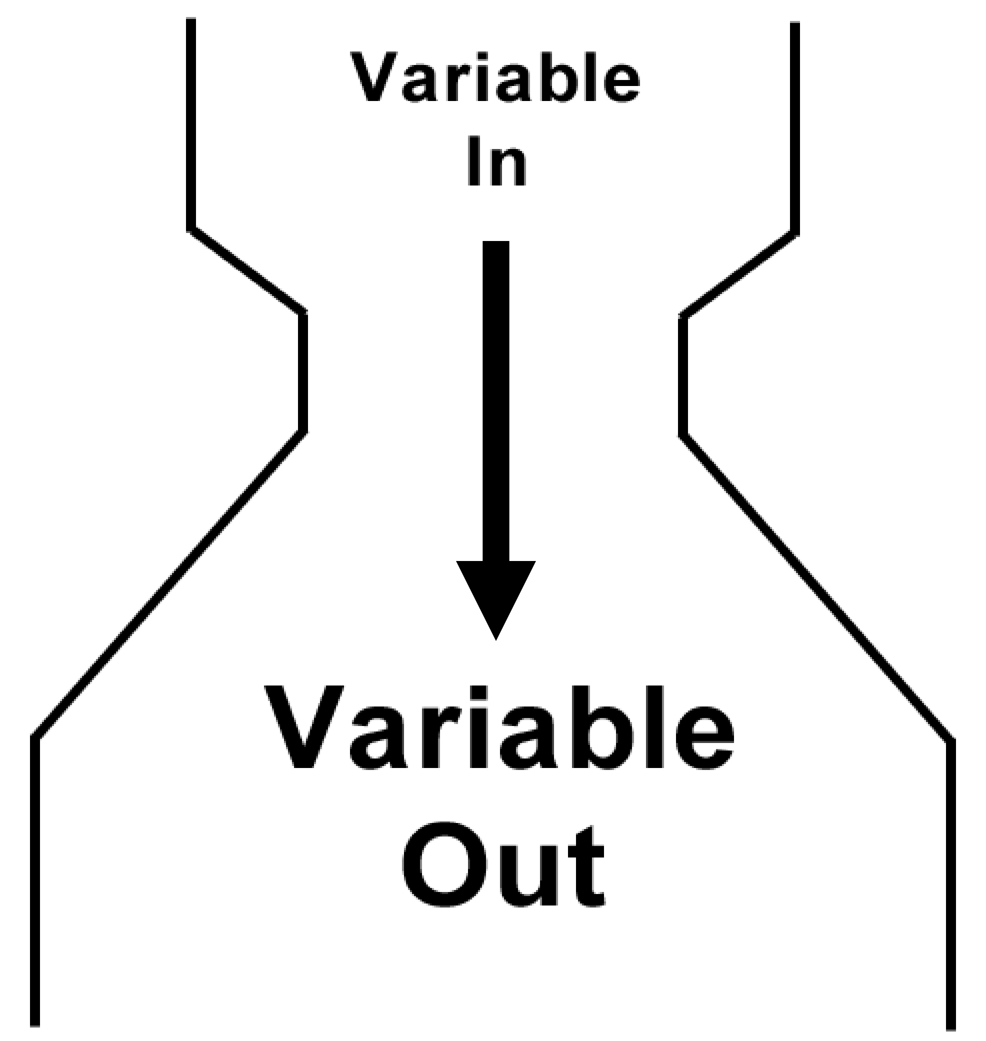

If it is, ask yourself, "Is it really necessary to build into my process the variables of manual pattern assembly and have it prevent the down stream operations from being consistent?"

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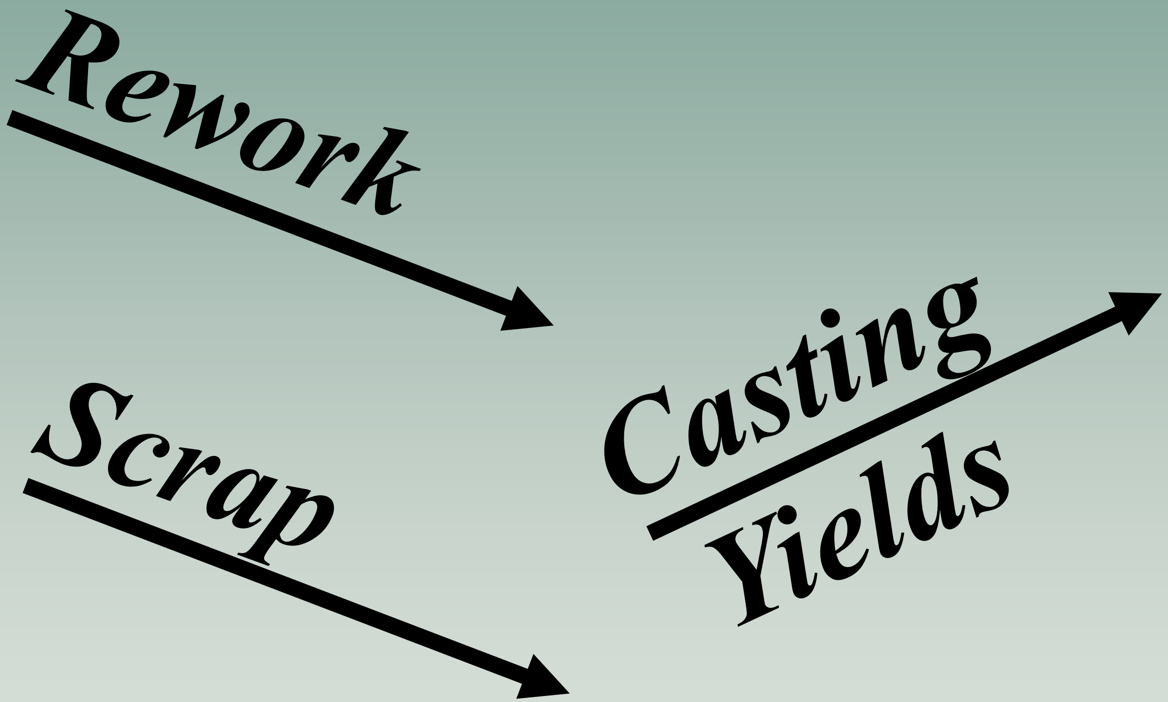

If you improve the beginning of your process, by eliminating the variables of manual pattern assembly, you will reduce down stream rework, reduce scrap, and increase your casting yields.

Smart Machines, Smart Business, Smart Choice

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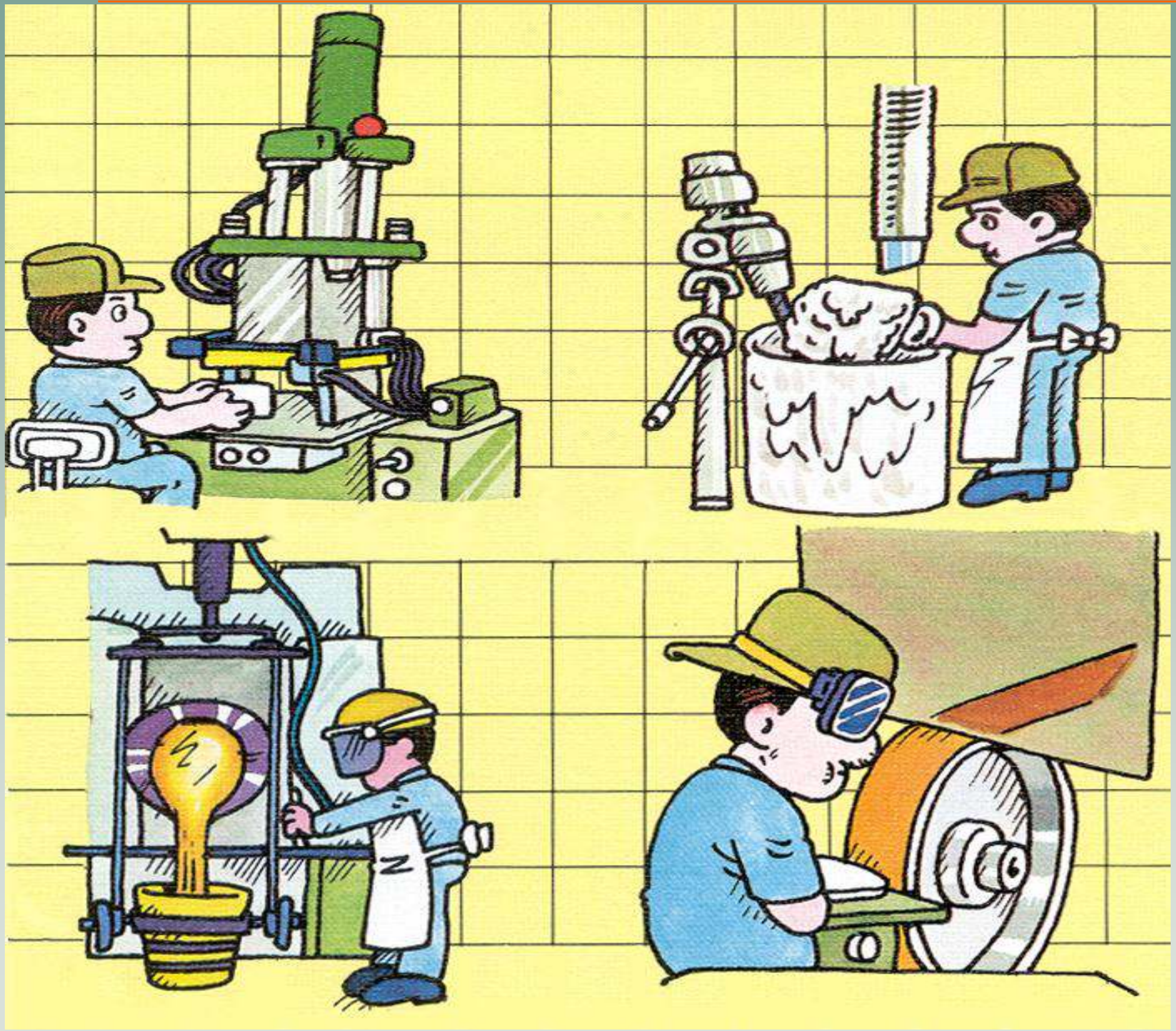

Imagine the yield gains that can be achieved throughout the entire investment casting process.

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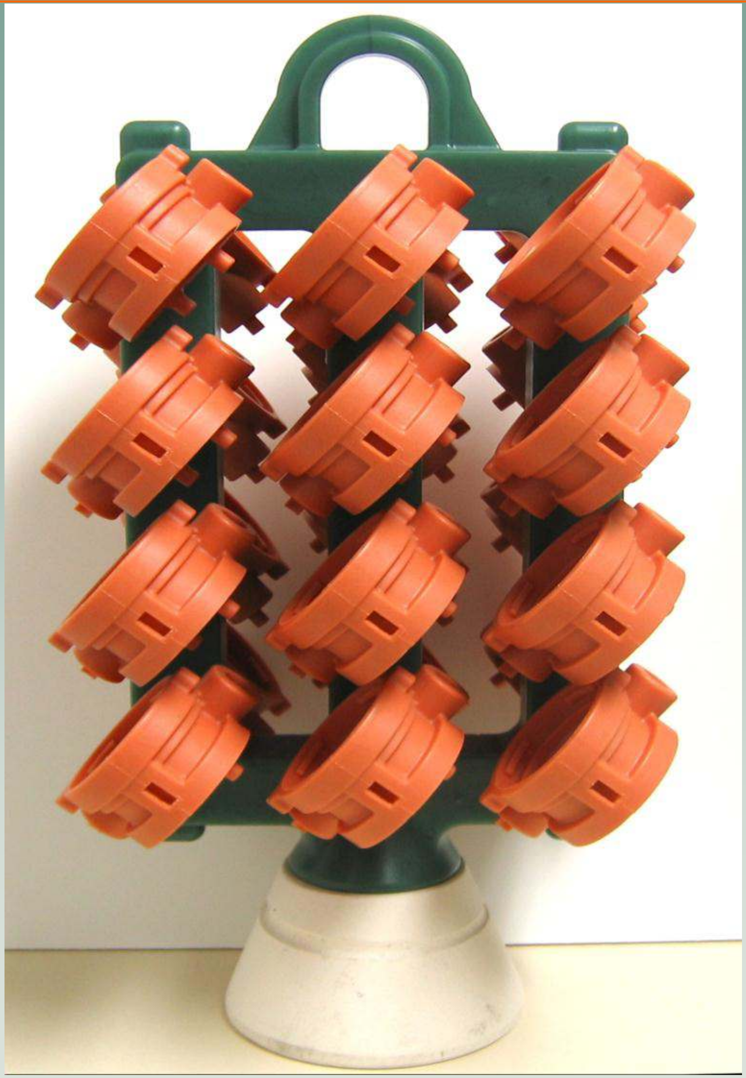

With identical wax assemblies, automation in the shell room has a greater ability to be a repeatable process that is in control. It's the first time that every wax pattern, that's welded to a runner, is at the exact same angle, with the exact same spacing and with a quality weld.

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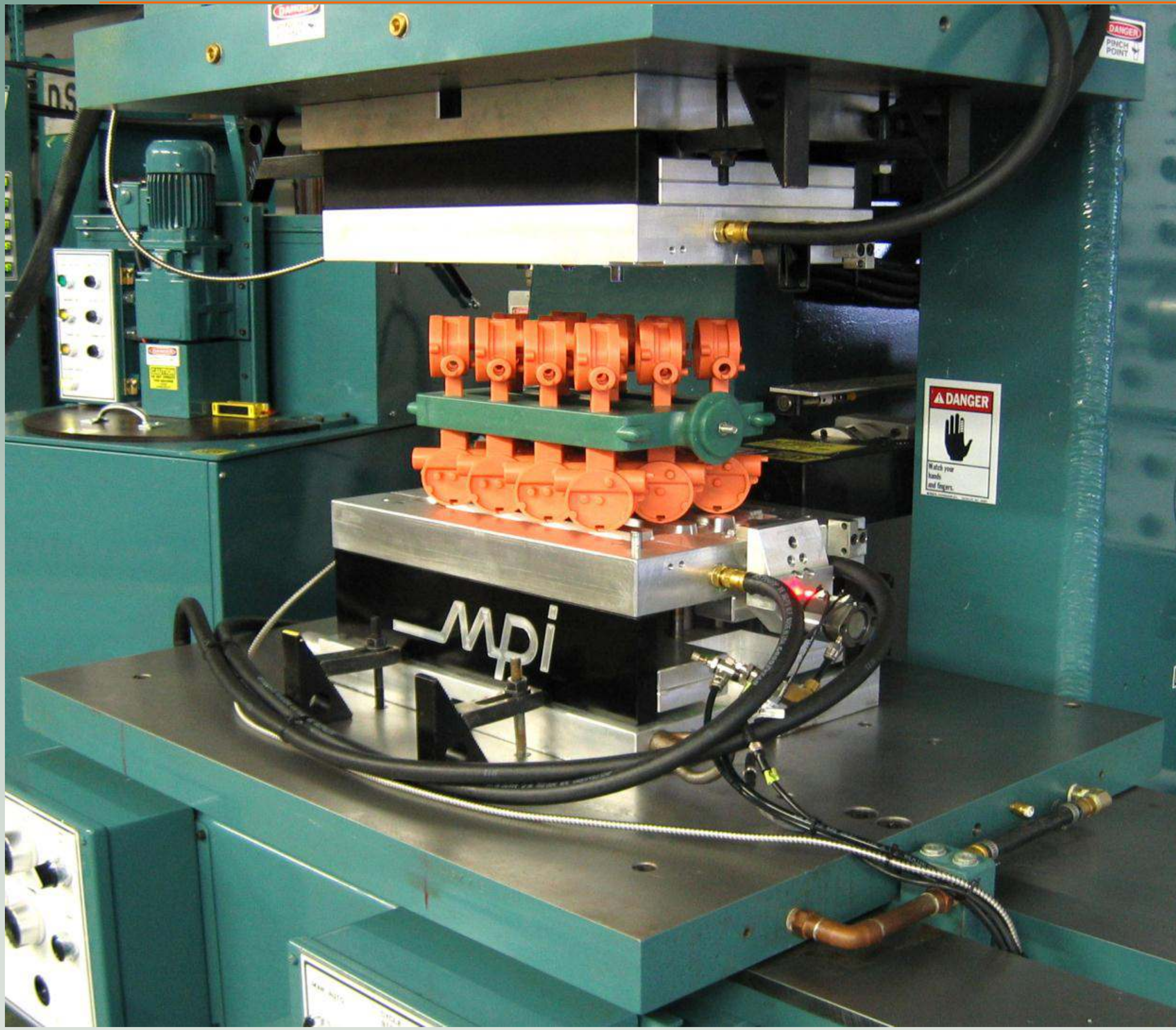

The pattern assembly is as accurate as if the entire assembly were injected in a single cavity die. When coating the assembly you will have the same coverage, the same drainage, and repeatability assembly after assembly, and pattern after pattern

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Picture what this means to the rest of your process.

In de-wax, the drainage will be exactly the same for every pattern, no variation.

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Metal pour will be more repeatable assembly after assembly.

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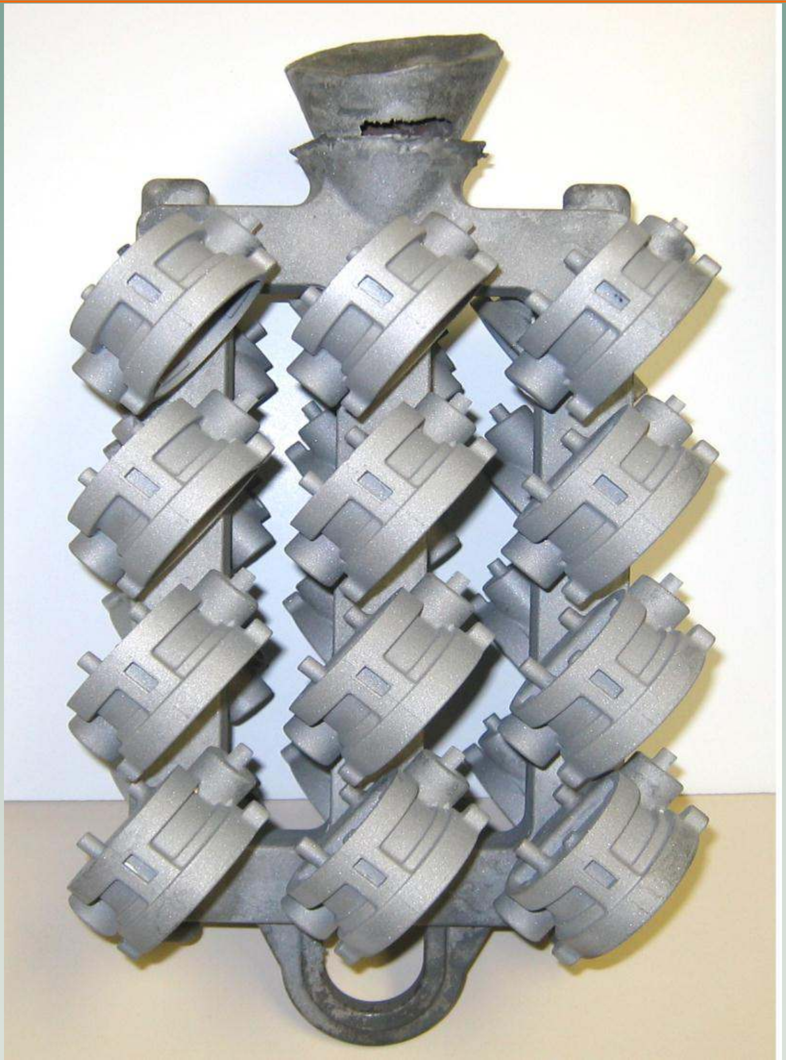

Metal solidification will be uniform from part to part due to a uniform shell coverage which is now possible due to the uniform pattern spacing.

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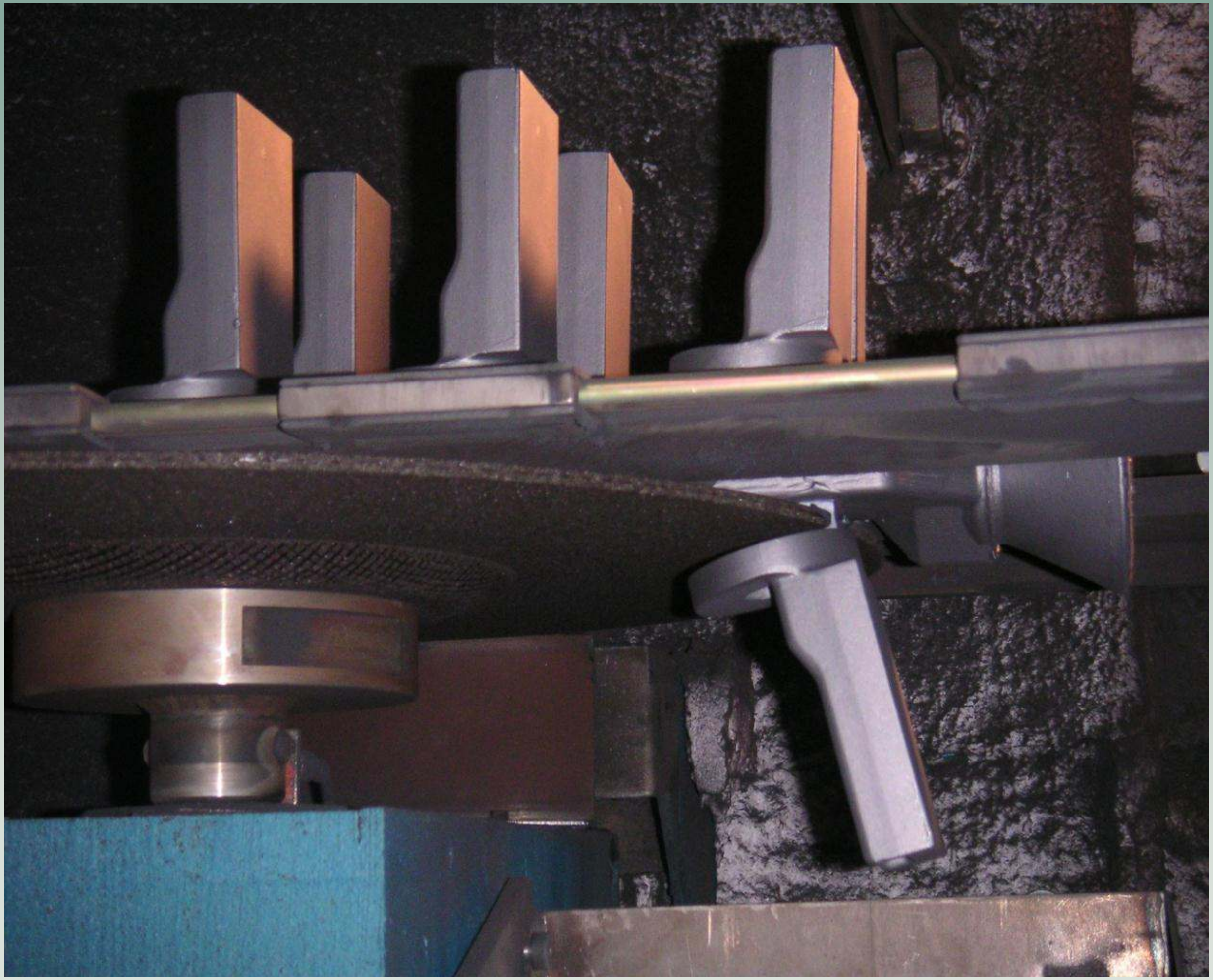

Envision what this means to your cut off operation. You'll be able to cut off automatically with improved accuracy pattern after pattern. Control of the process will allow you to eliminate many secondary and finishing operations.

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Rework, for the first time, has the possibility of being reduced or eliminated.

How can I be so confident?

Let's analyze it.

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Pattern Assembly Variability

If the pattern assembly variable from the beginning of the process is eliminated you will have a foundation on which to improve the down stream process and eliminate rework.

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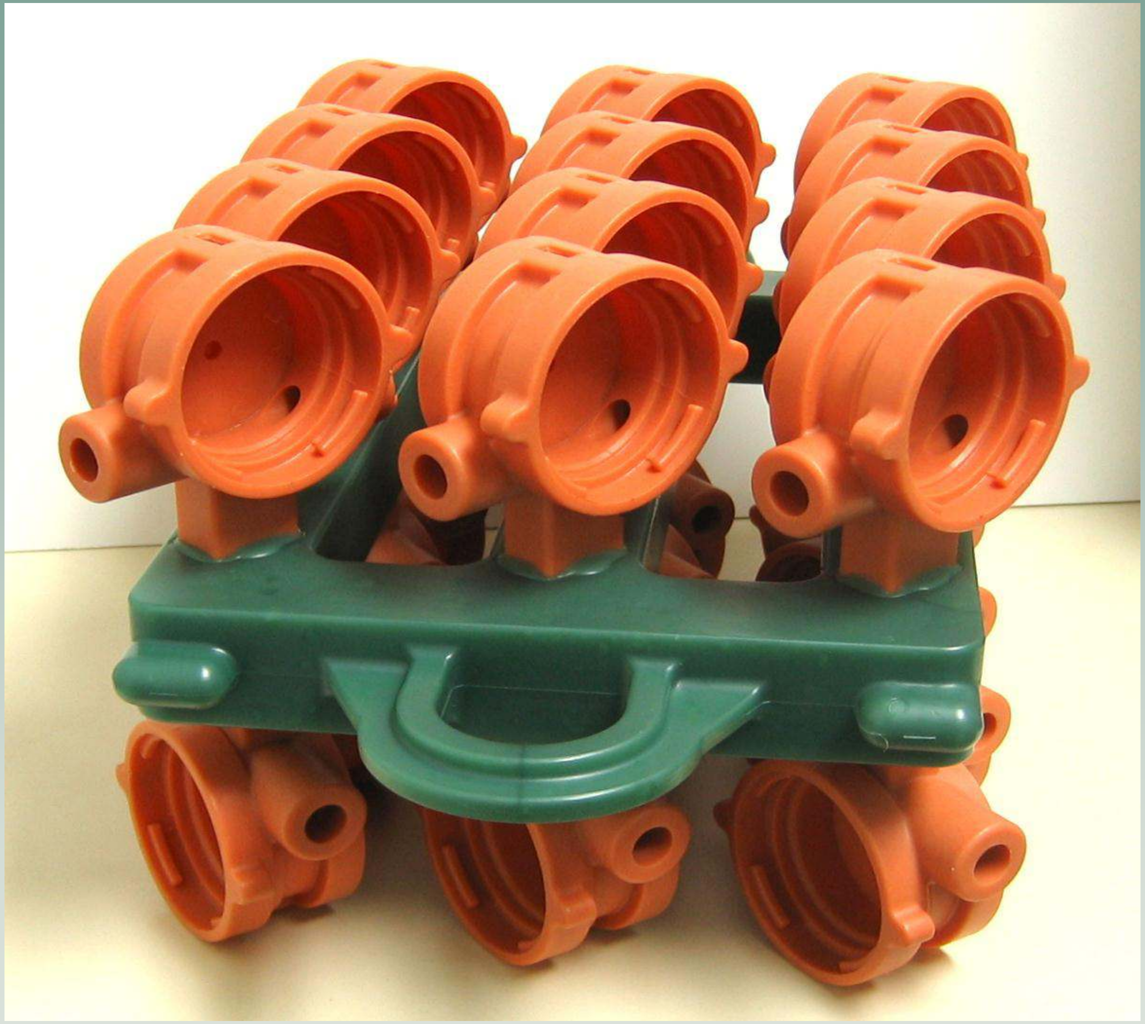

Some of you are saying, is it really possible for the wax pattern assembly process to have such a significant effect in every single step of the investment casting process?

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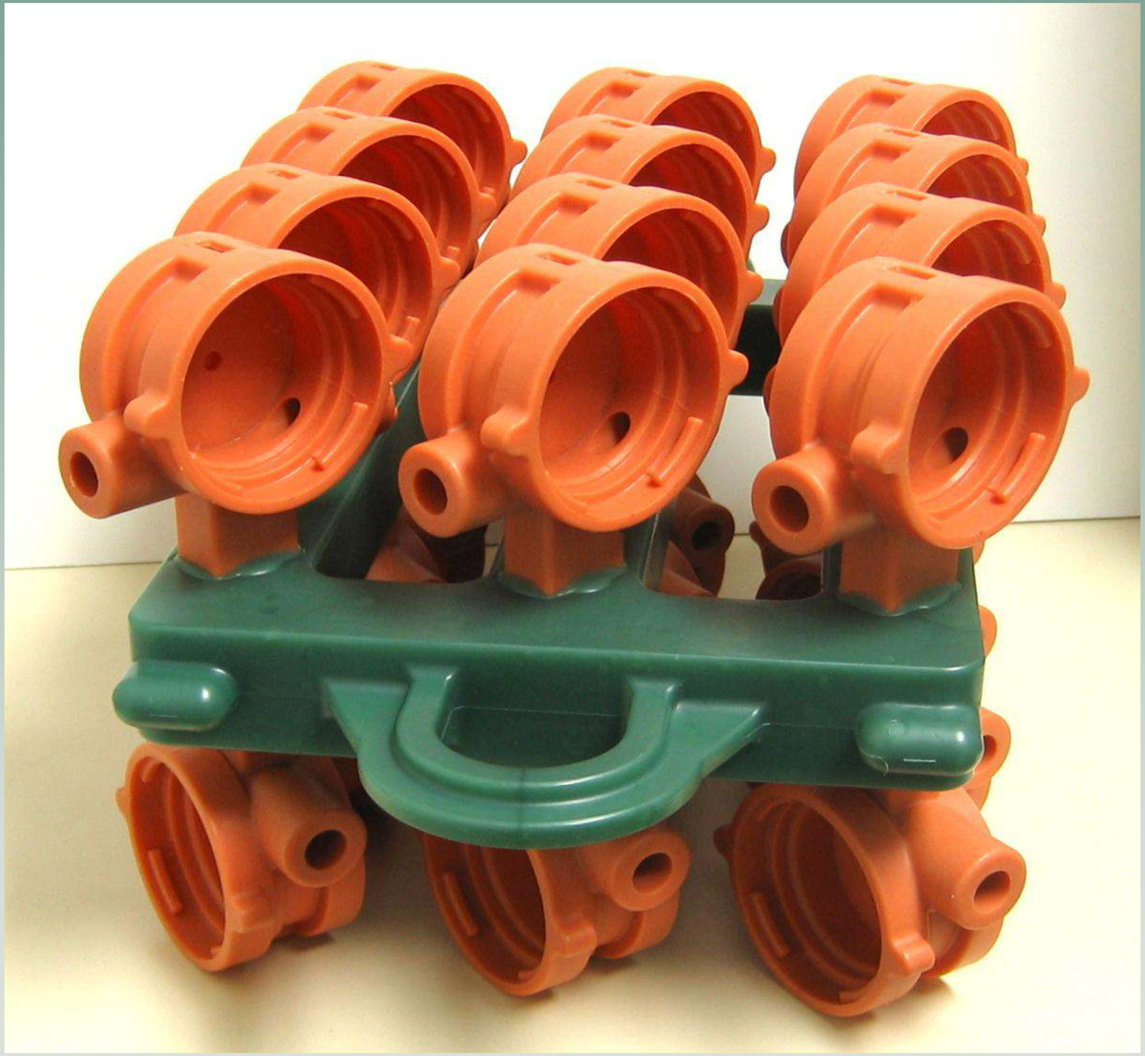

Some of you are saying, is it really possible for the wax pattern assembly process to have such a significant effect in every single step of the investment casting process?

The answer is yes.

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Can Variation in Equal No Variation Out?

You need to ask the question differently.

Is it possible to have a down stream step in your process with no variation, if the first step in the process has variation and is out of control?

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Can Variation in Equal No Variation Out?

The answer of course is no.

Unless the first step of a process is in control, you cannot expect your last step to be in control.

Your product will vary from part to part.

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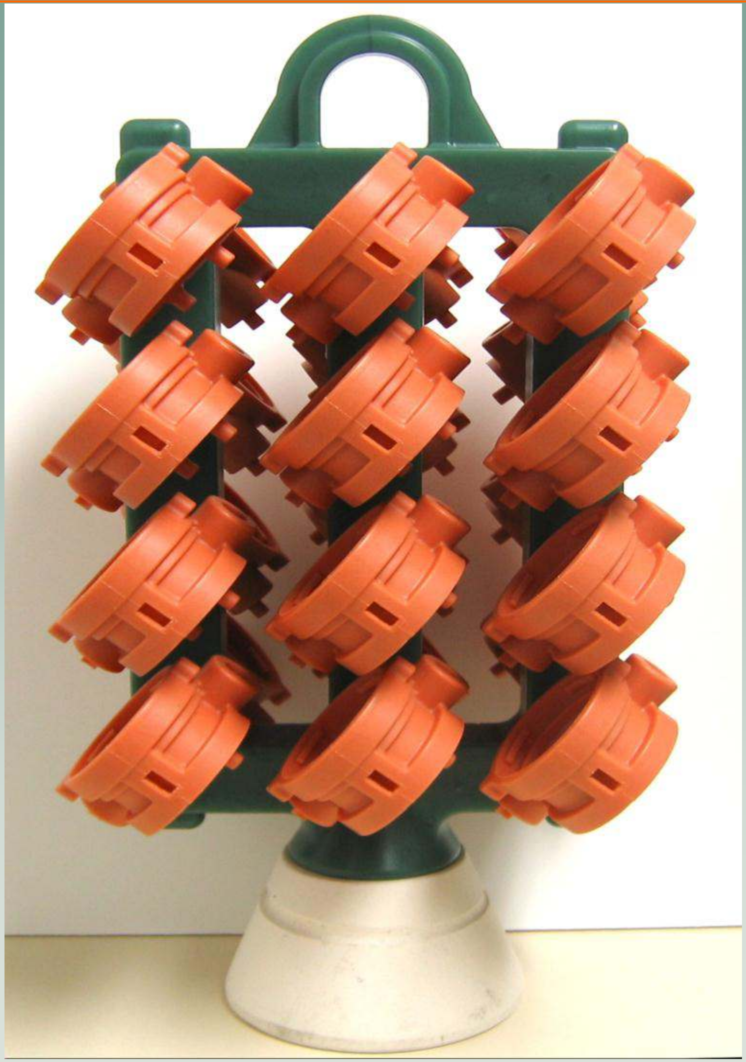

Now that we have an assembly that has uniform pattern spacing lets consider improving the pattern density on the runner.

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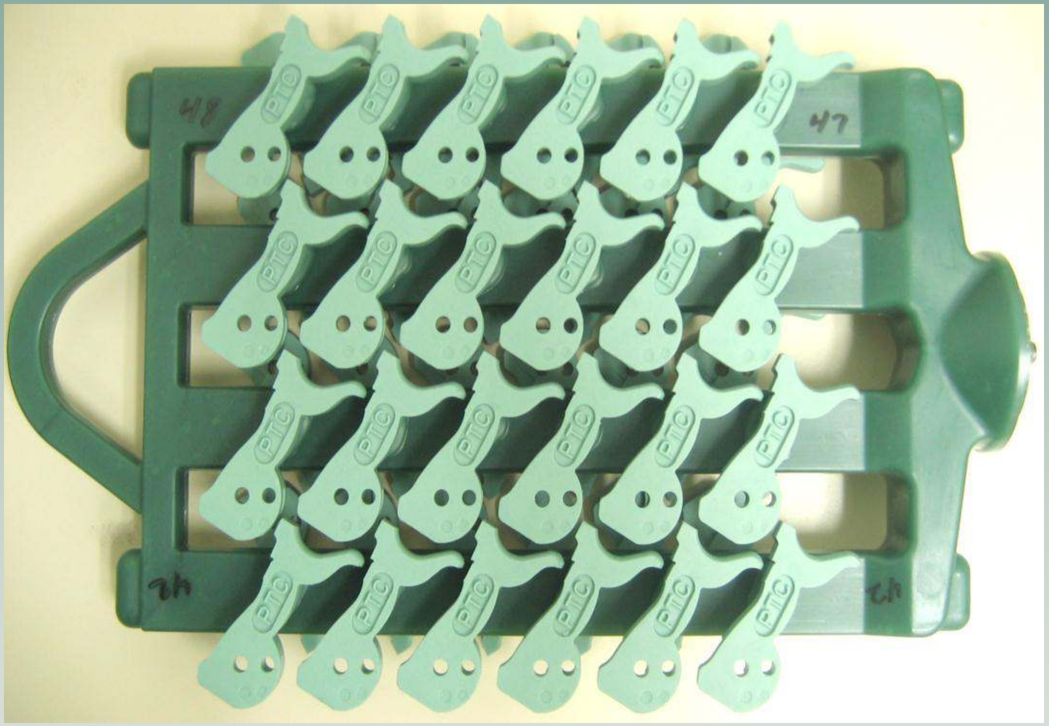

Lets take this assembly as an example

What would happen if you reduced the pattern spacing on your runner from 0.400" to 0.100" (10mm to 2.5mm)?

You might say, come on now, that spacing is to tight, we can't shell it. That's not possible.

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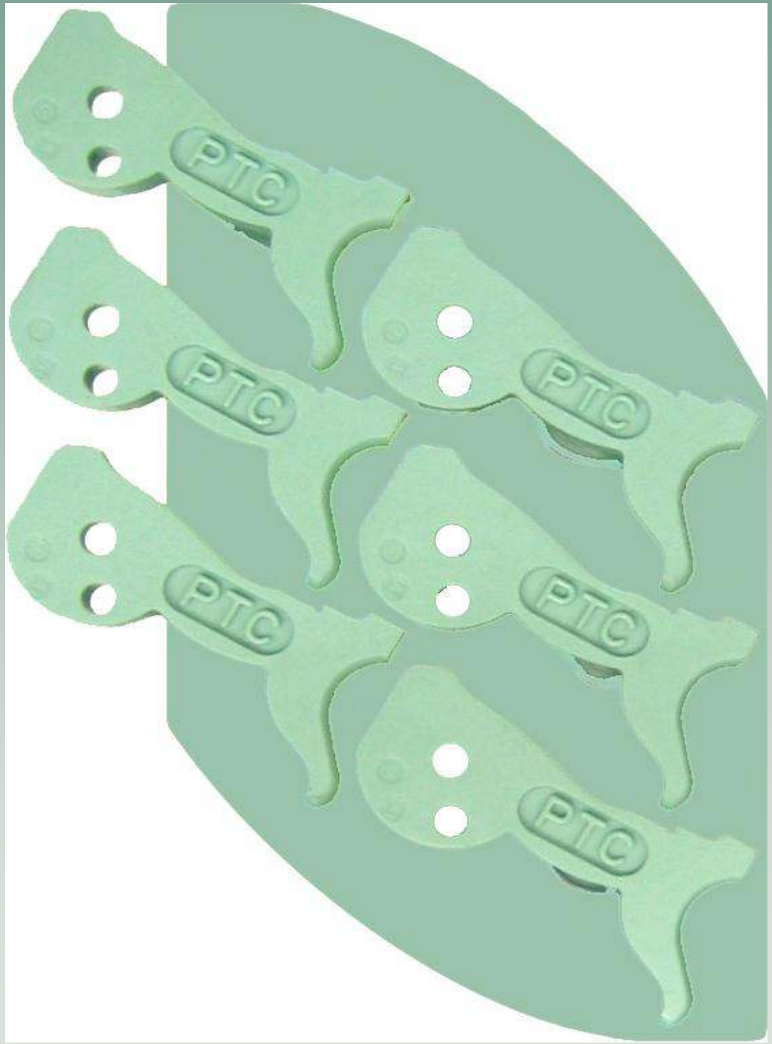

But what would you say if I asked you to cast a single part with the same configuration and part features as an assembly with spacing of 0.100” (2.5mm).

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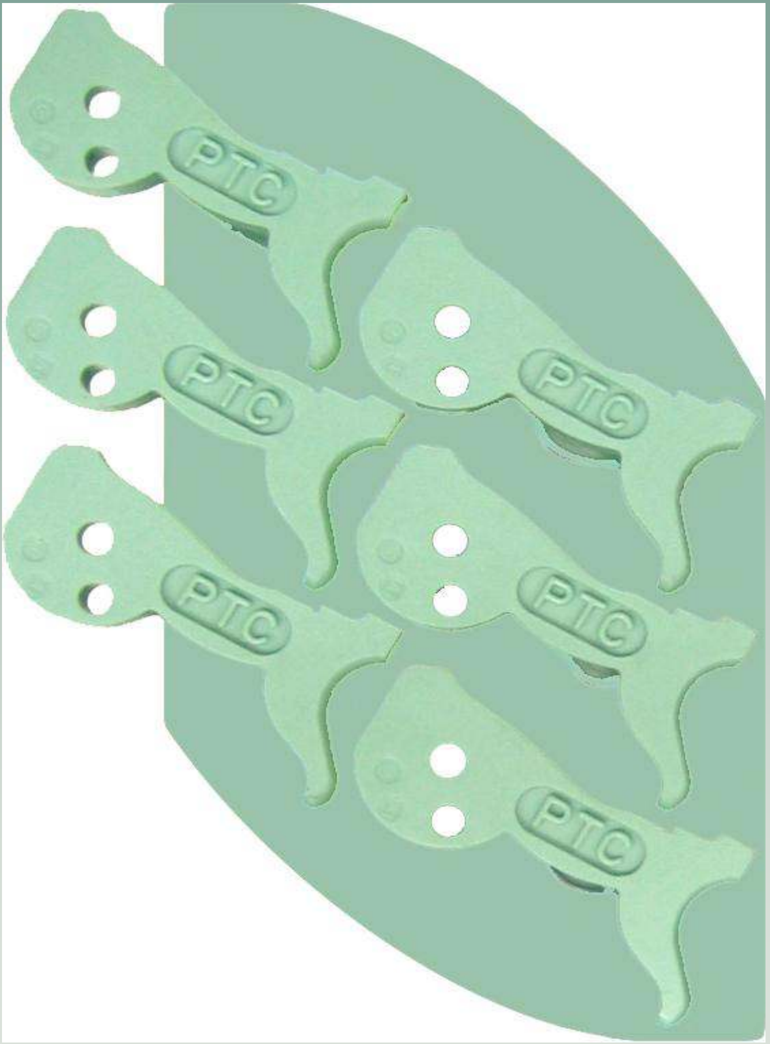

But what would you say if I asked you to cast a single part with the same configuration and part features as an assembly with spacing of 0.100" (2.5mm).

Would you say, "No Problem"? We can do that!

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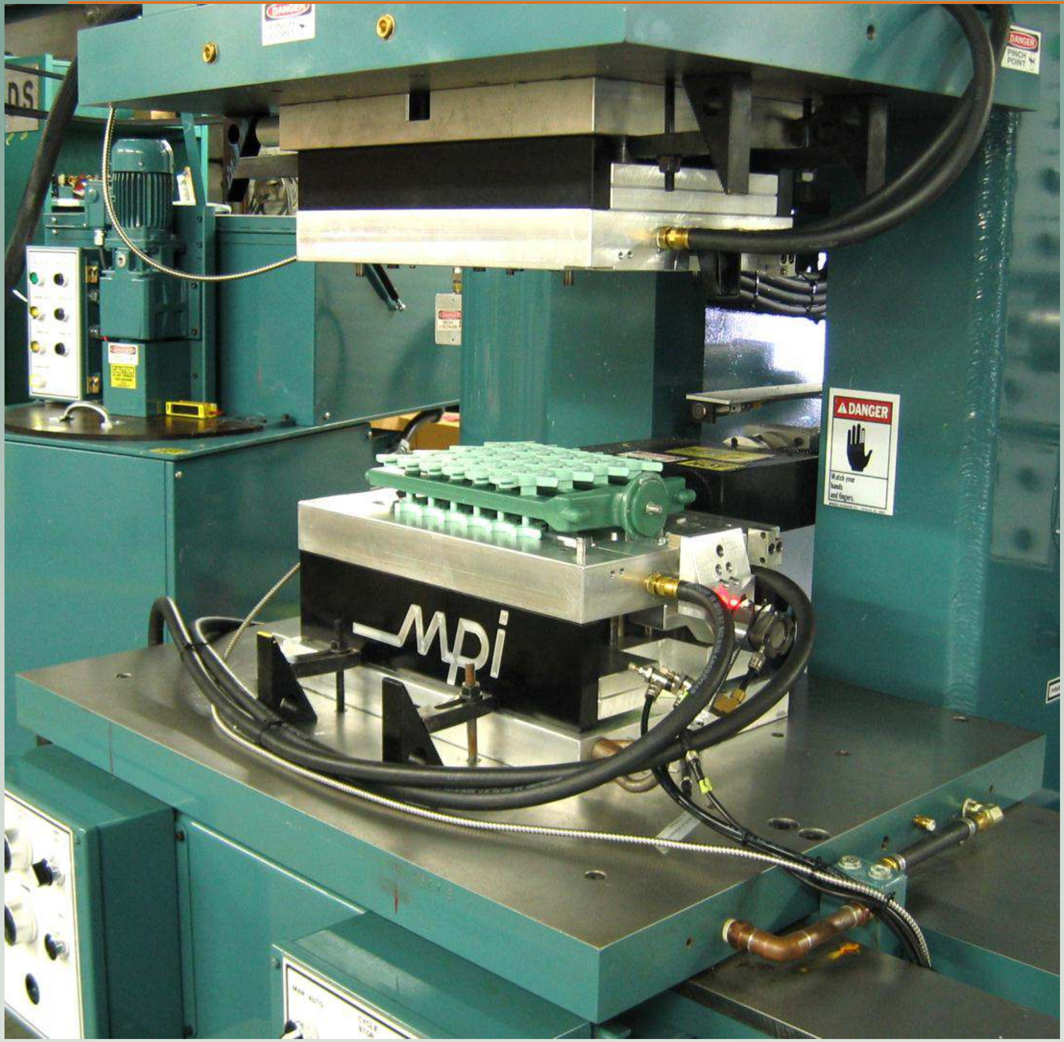

So it's time to start thinking of the assembly as a single wax pattern.

The approach is to create an assembly so accurate that it could have been injected as a single injection.

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Single injections, which incorporate the patterns on the runner, are being done on some high volume parts, and this is extremely efficient.

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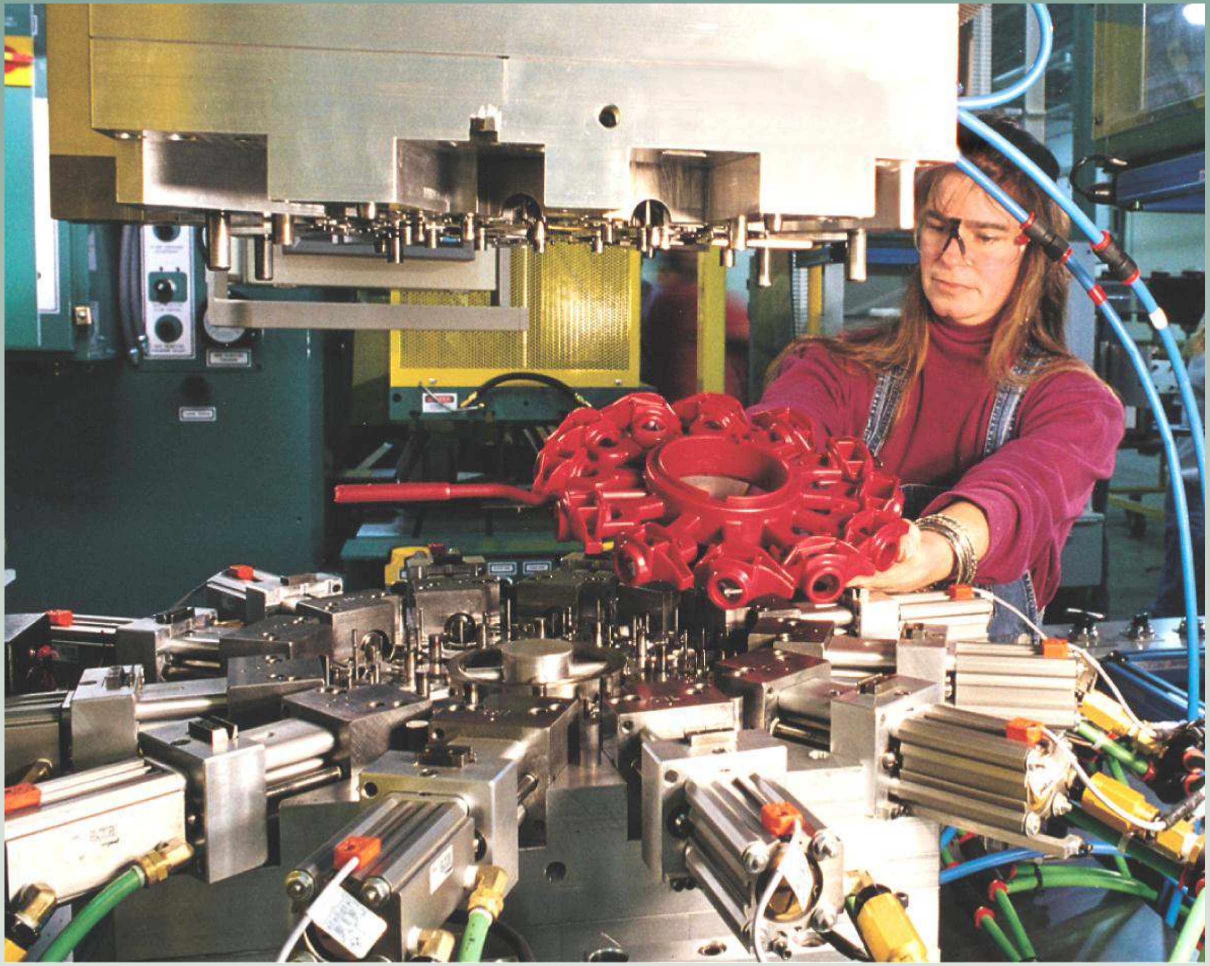

Hitchiner Mfg is a company that is doing an excellent job of injecting the runner with the wax patterns as a single injection.

This is a 12 cavity die that injects a section of a circular runner.

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They stack the injected rings to create a complete assembly.

Note the tight accurate spacing.

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There are two major benefits:

- The assembly time is reduced.

They simply stack the injected rings.

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There are two major benefits:

- The assembly time is reduced.
- The casting yield is increased.

The reason the casting yield is increased is due to the improved process control created by the consistent pattern placement, and quality pattern to runner attachment.

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Hitchiner does not invest in a die of this complexity and cost without testing the process first. They start production using injected patterns and assemble them manually onto the runner.

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Each time Hitchiner goes through the steps of verifying their process with manual pattern assembly, and then convert the manual assembly process to injected rings, they realize a casting yield increase.

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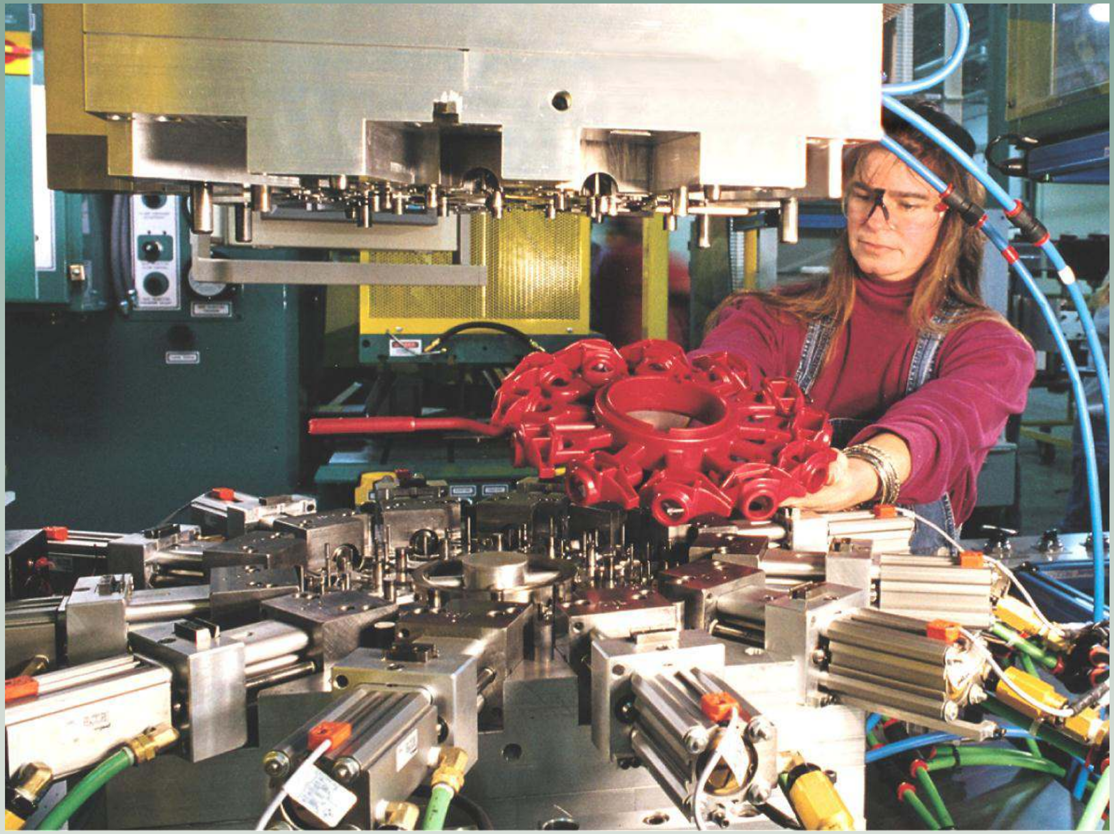

If you would like to gain the down stream benefits created by accurate pattern spacing and quality pattern to runner attachment, but are unable to build your tools in this way, due to part geometry or cost, the next step is to automate the pattern assembly process.

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Total foundry involvement is required to effectively implement automated pattern assembly.

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Total foundry involvement is required to effectively implement automated pattern assembly.

Why do you need to involve the entire foundry to automate the wax room?

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Total foundry involvement is required to effectively implement automated pattern assembly.

An example of automation that does not work is, the automation of a single manual process without consideration of the steps before and after the automated process.

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Total foundry involvement is required to effectively implement automated pattern assembly.

Evaluate the inconsistencies in each step of your entire foundry operation from part cut off and finishing, forward to the wax room.

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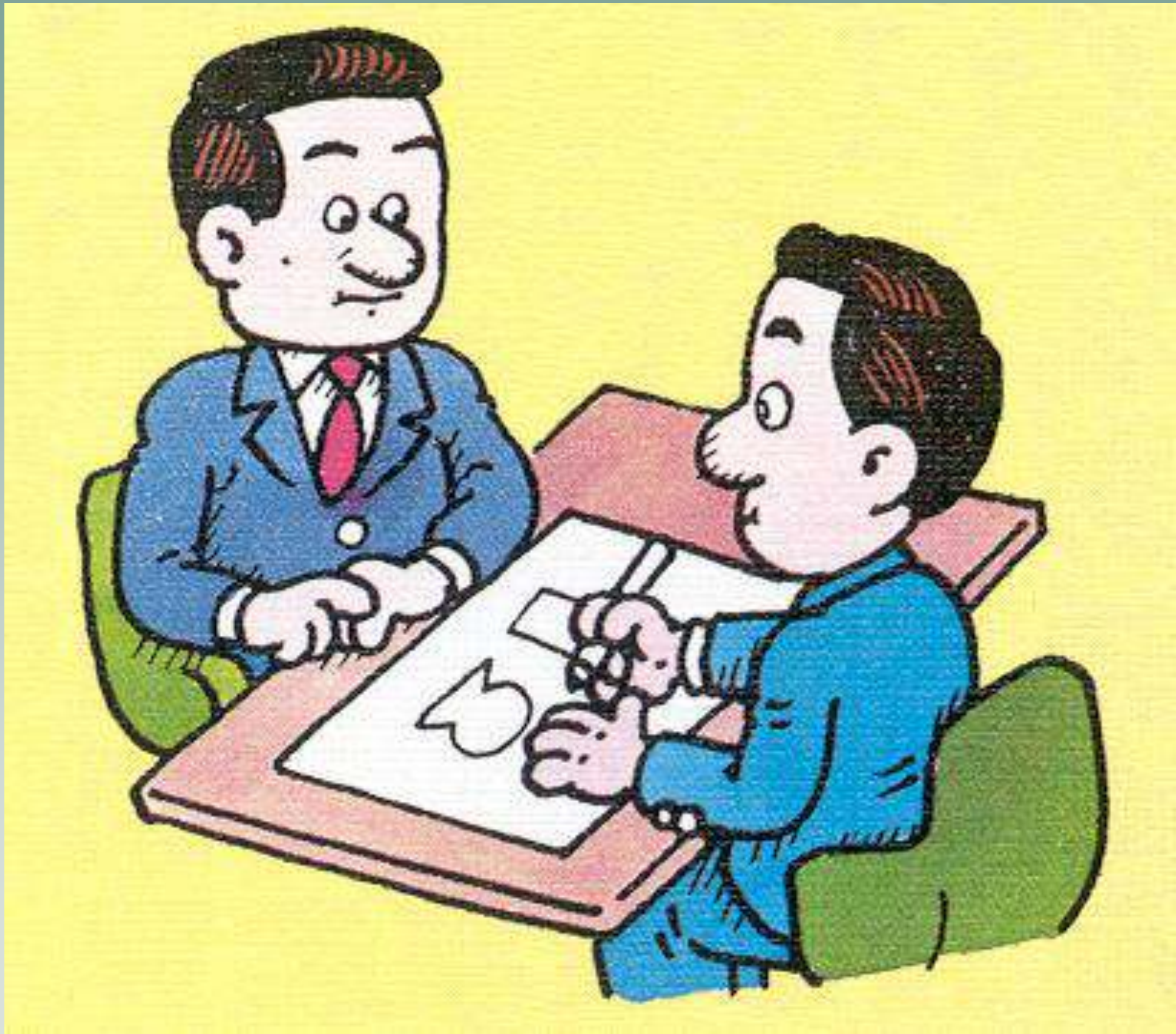

Carefully evaluate each foundry operation and consider the best way to automate the entire foundry process. What can be done upfront to improve down stream operations?

Some examples of the thought process might be as follows:

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Finishing:
What type of finishing work is performed on each job and why?

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Cut off: Why is there so much gate material left after cut off? Why is there weld repair after cut off?

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Knockout: Why are some castings cleaner after knockout than others?

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Casting: Why are there some trees that have a higher yield than other trees of the same part? What is causing casting inclusions?

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De-wax: Why is there non-uniform wax drainage from all cavities?

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Shelling: Why are the wax patterns not uniformly coated and the holes filled identical from pattern to pattern if the wax assembly is dipped robotically each and every time?

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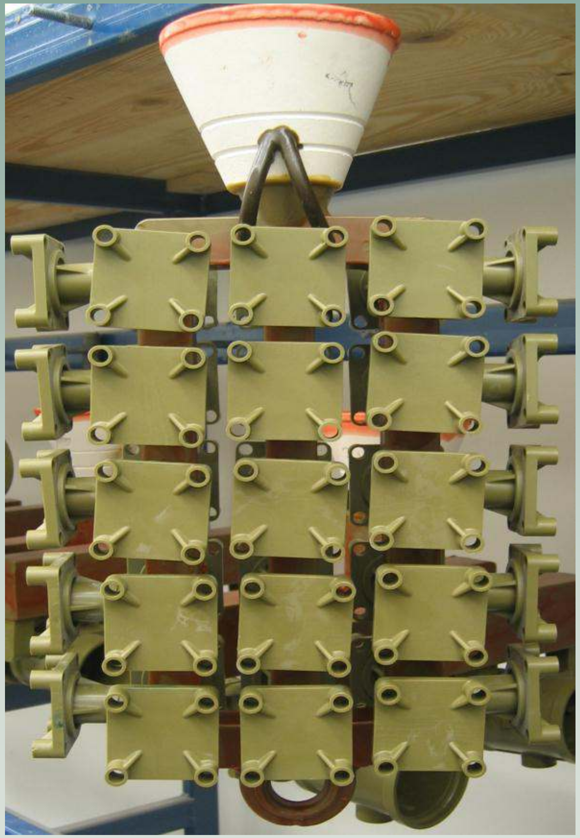

Pattern assembly: Why do wax assemblies vary from assembly to assembly? Why do you have pattern break off?

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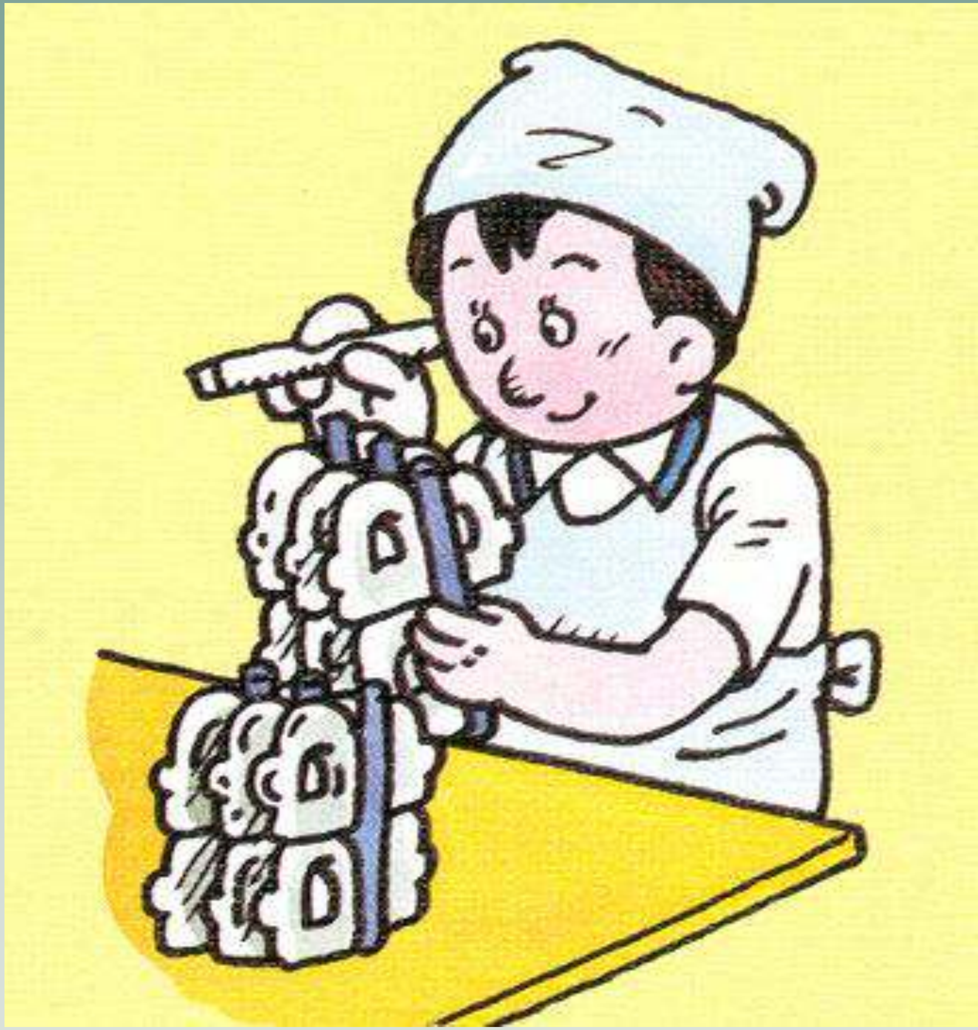

Every one of these examples can have a direct link to pattern assembly, and the correct approach to pattern assembly can impact positively the casting yield gains in the investment casting foundry.

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The following is an example of a part whose assembly is being redesigned for total foundry automation. From casting cut off to wax pattern assembly.

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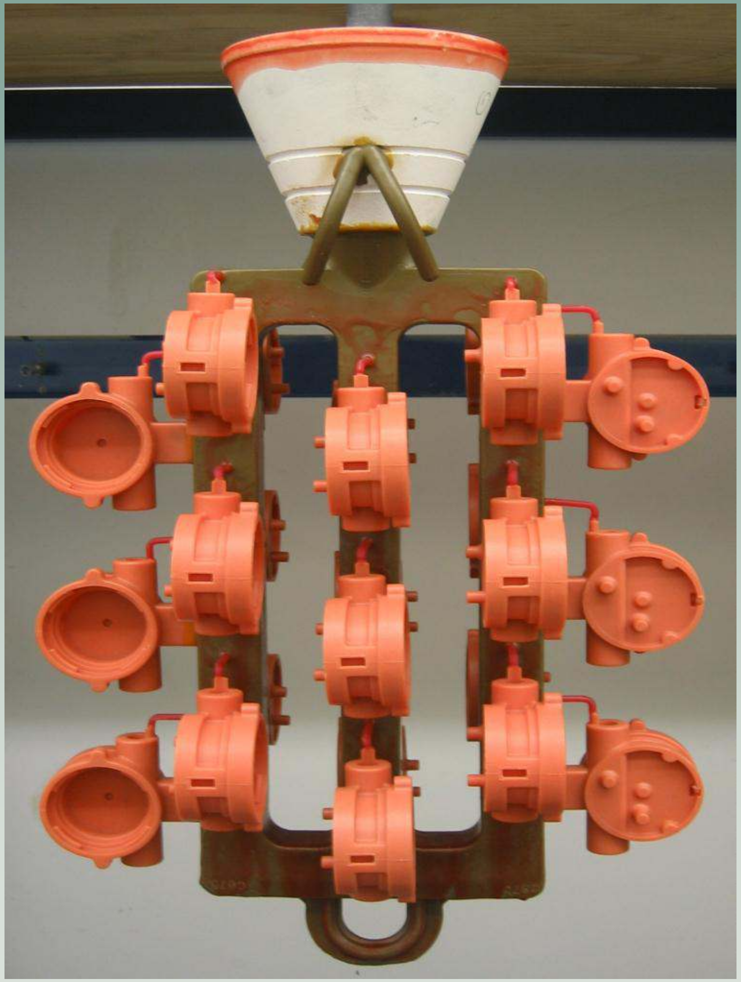

This is the assembly as it was done manually. The three bar runner was assembled with 8 rows of 3 patterns for a total of 24 patterns per assembly.

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The arrangement of the patterns on all four sides complicated part cut off but was required in order to achieve a good ratio of castings to metal poured.

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The lack of a casting support fixture for cut off resulted in varying gate lengths and sometimes resulted in a part being nicked and damaged during cut off.

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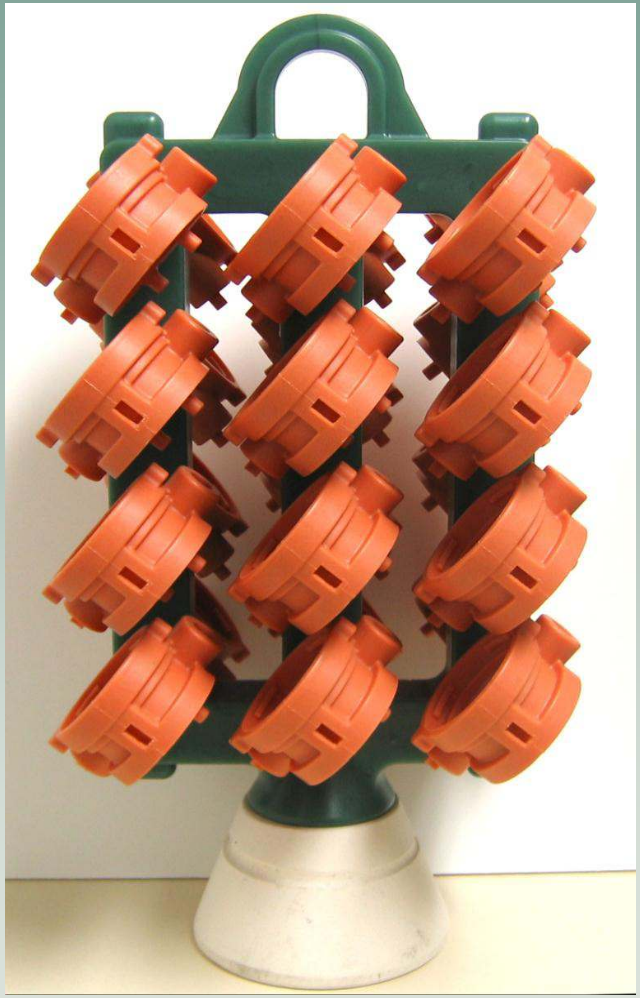

This is the new assembly which was designed for total foundry automation. The new layout uses 6 rows with 4 patterns per row achieving the same 24 castings per pour.

Runner length was reduced and now 13.4% less metal is poured per assembly.

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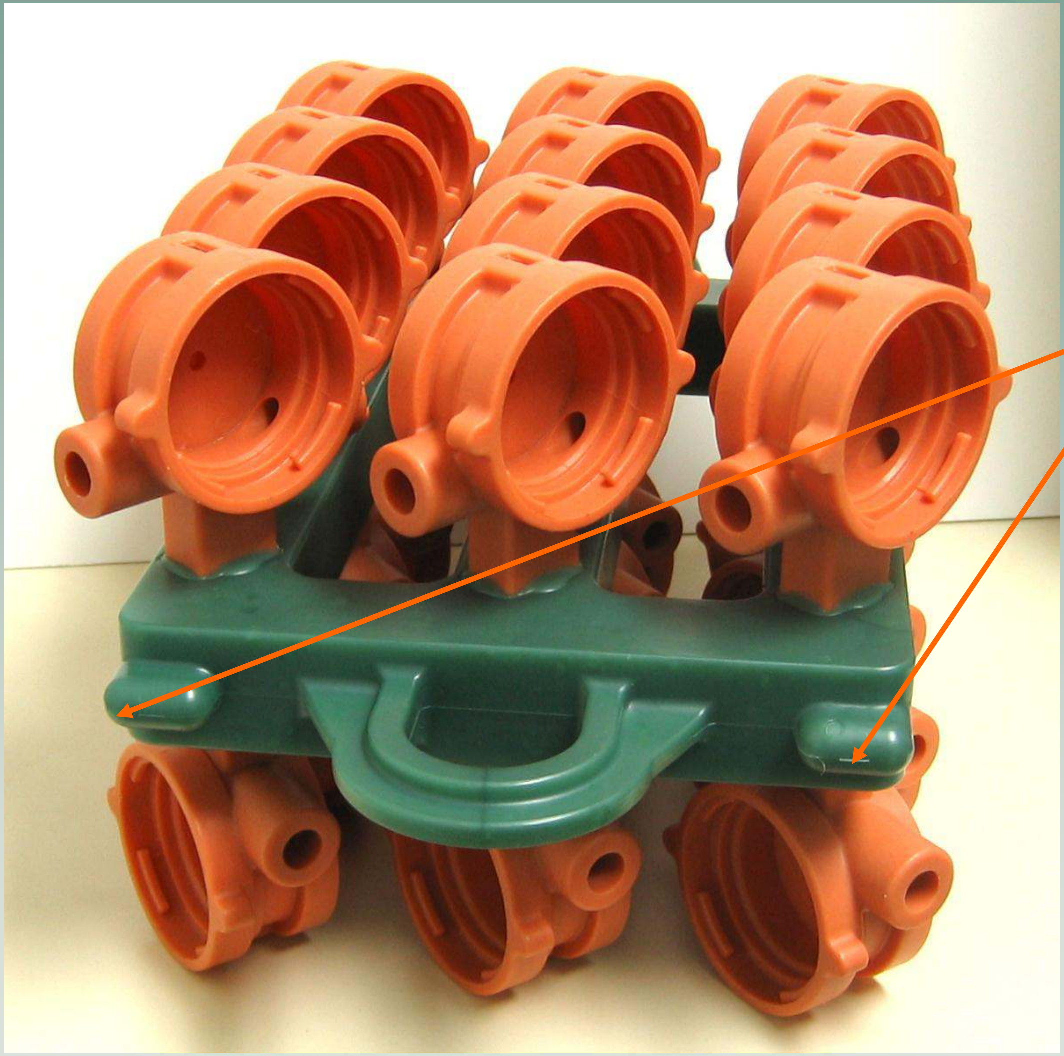

The runner has been designed with locating features which allow for accurate positioning for automated pattern assembly.

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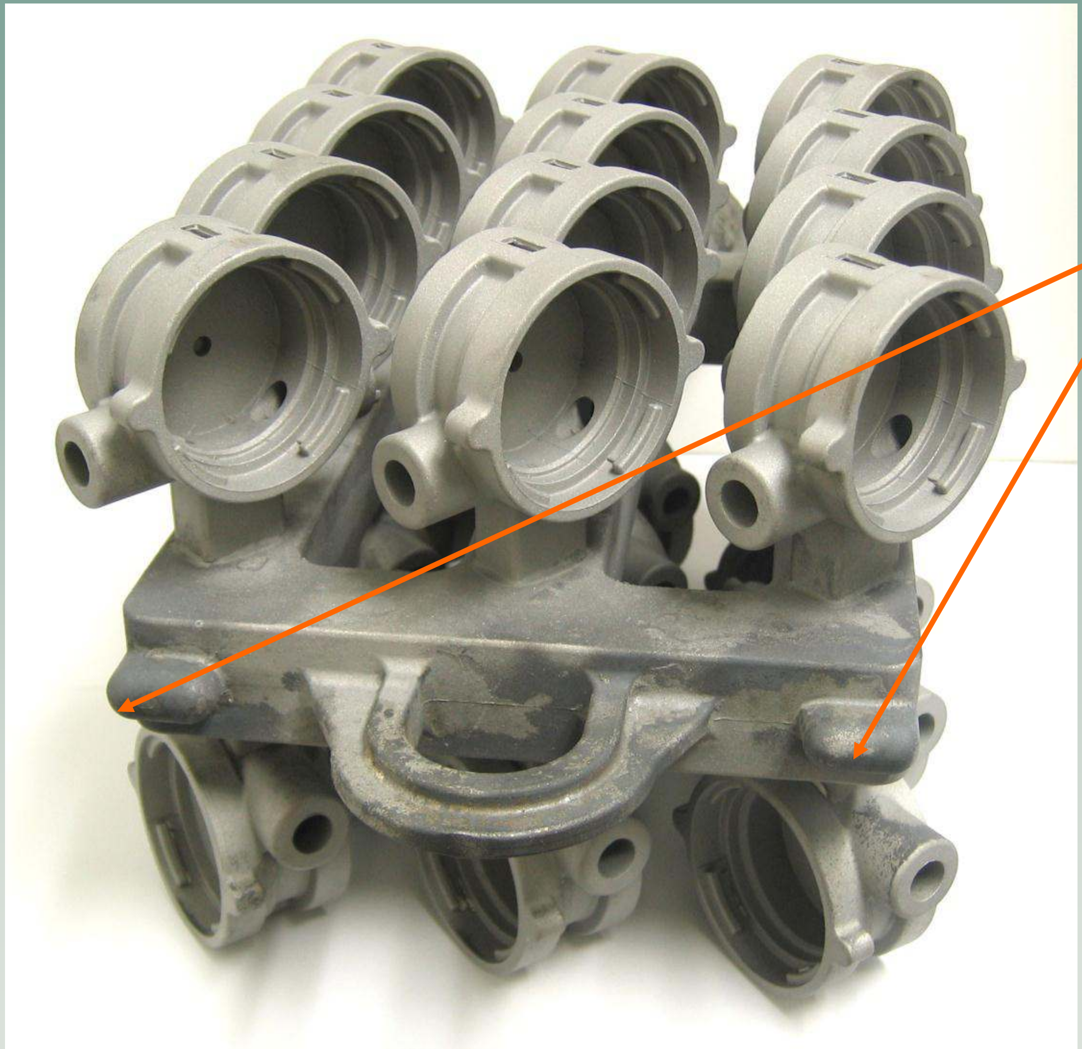

The same locating features will be used to locate the assembly for automated cut off.

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Accurate assemblies coming out of your wax room, designed around a total foundry involvement can truly make your company World Class by:

a. **Reducing rework**

b. **Reducing scrap**

c. **Reducing the amount of metal poured**

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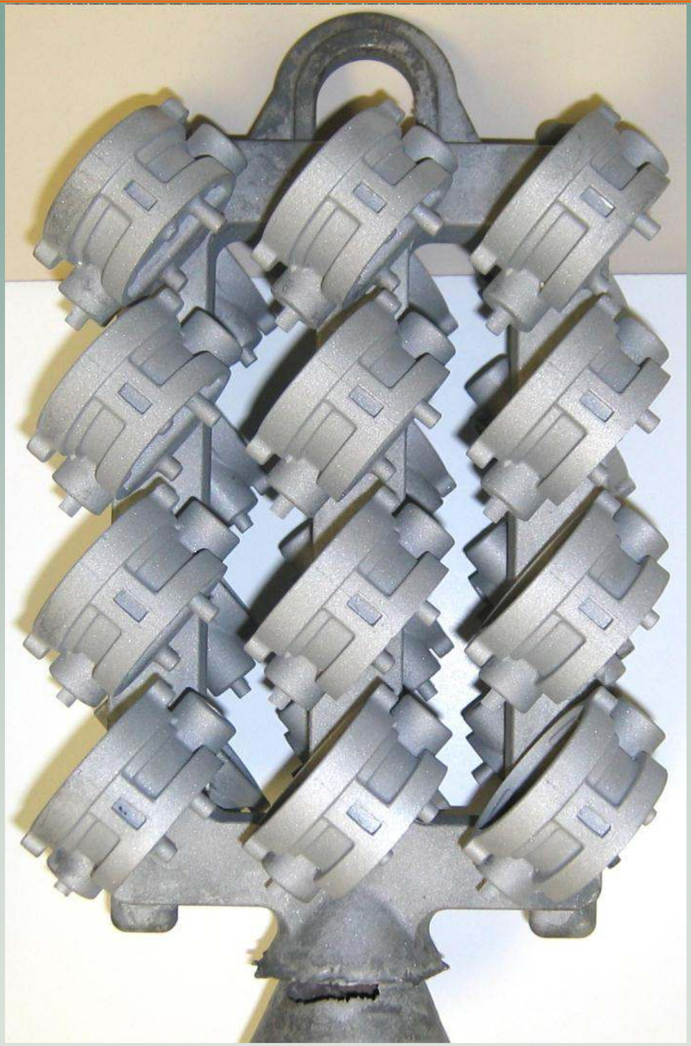

This all adds up to improved

casting yields!

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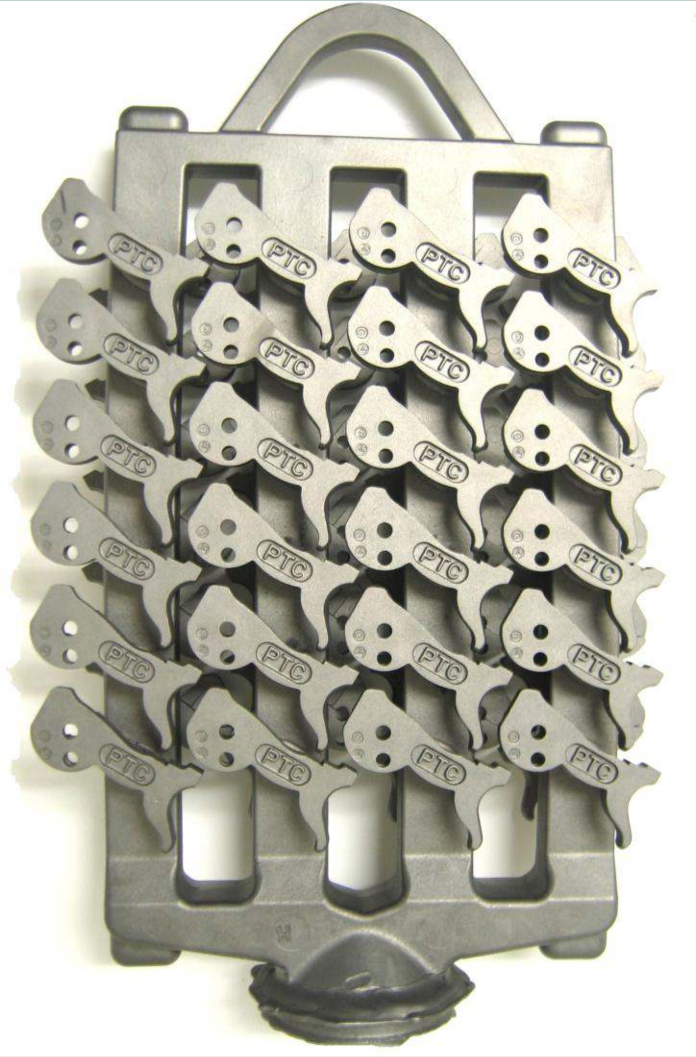

This is an example of an assembly that has had the pattern spacing reduced from 0.400” to 0.100” (10mm to 2.5mm). This new spacing allows for 8 more parts per assembly, from 40 to 48. That’s a 20% casting yield gain.

I would like to thank the following companies for contributing to the content of this paper;

Pine Tree Castings

Lamothermic Corporation

Hitchiner Manufacturing

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20-10 APAS Automated Pattern Assembly System

Turbine Nozzle Guide Vane

Golf Club

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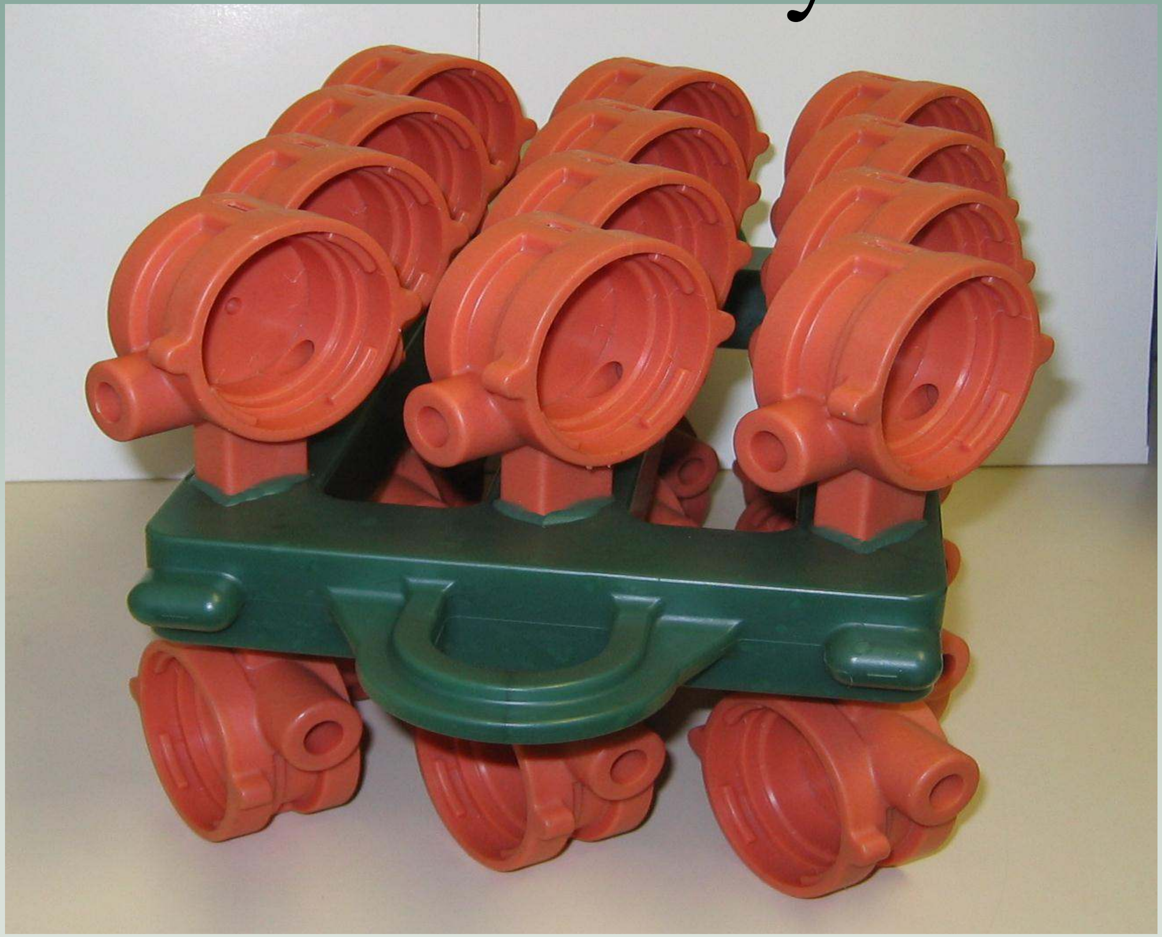
Flow Body



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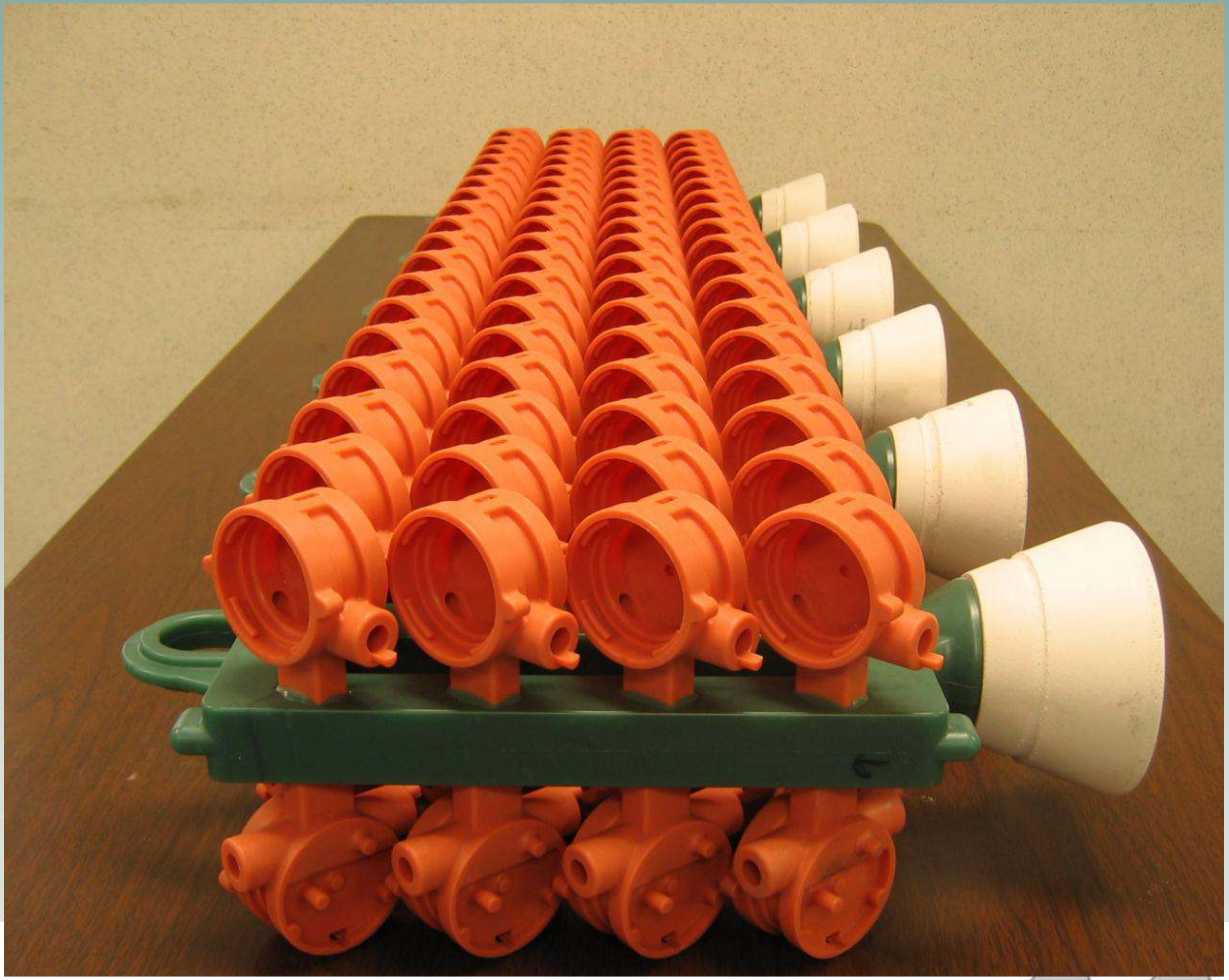
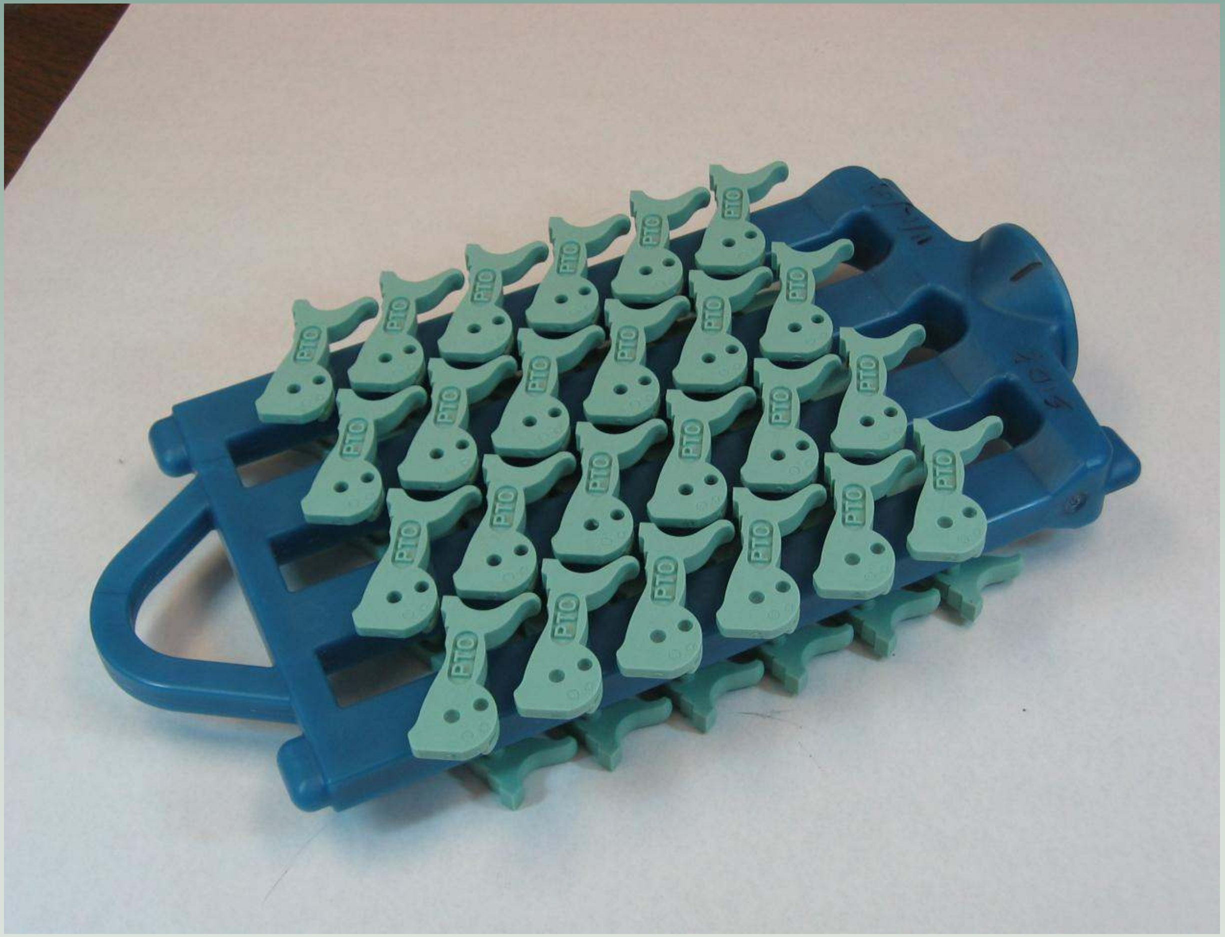
Cast Flow Body

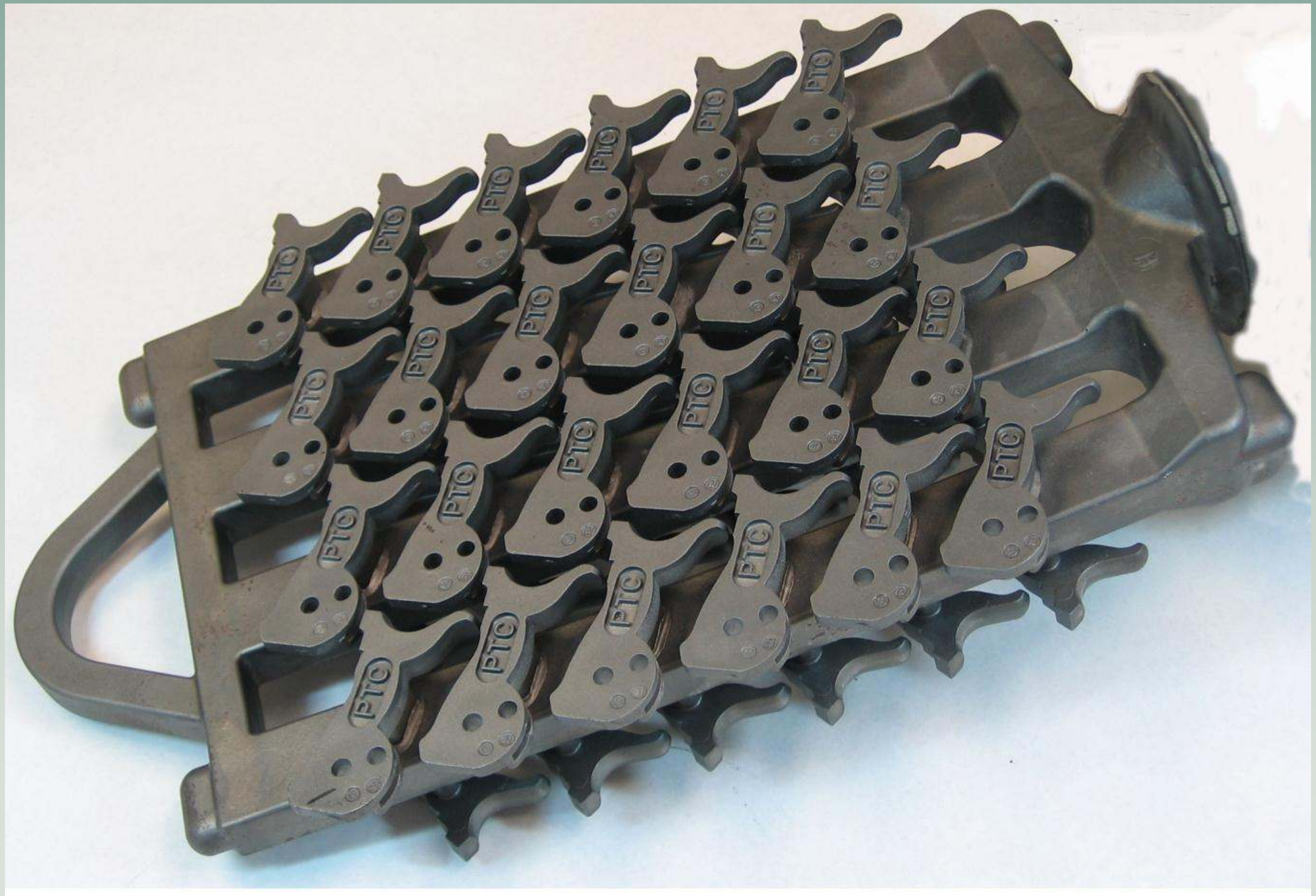
Flow Body



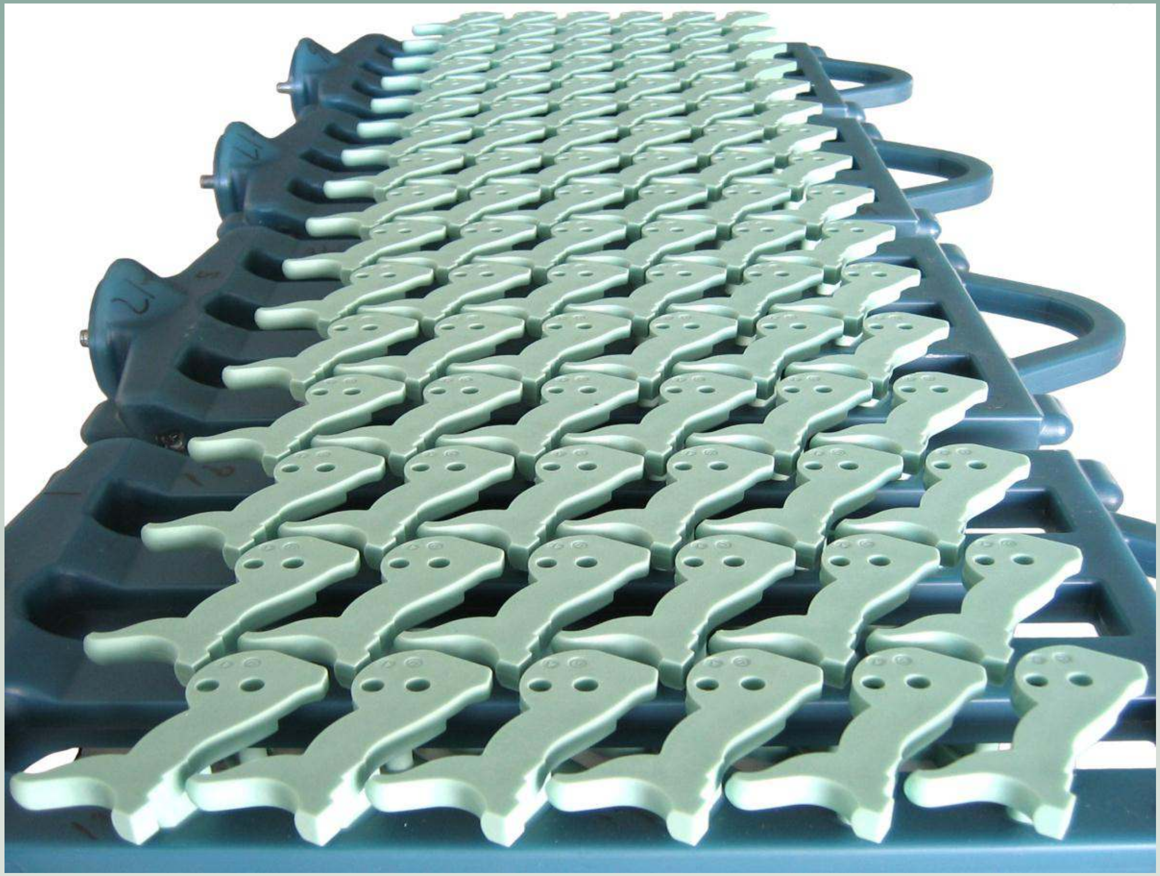
Revolver Hammer



Cast Revolver Hammer



Revolver Hammer



MPI 20-10 APAS Automated Pattern Assembly System

Click picture to play video

Thank You