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MPI Inc.

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Versatility and Cost Savings Through the Modernization of the wax room

A Comprehensive look in the reduction of material, defects, and resources through Improved processes in the wax room

In collaboration with:

TECH CAST

lamothermic Corp.
precision investment castings

&

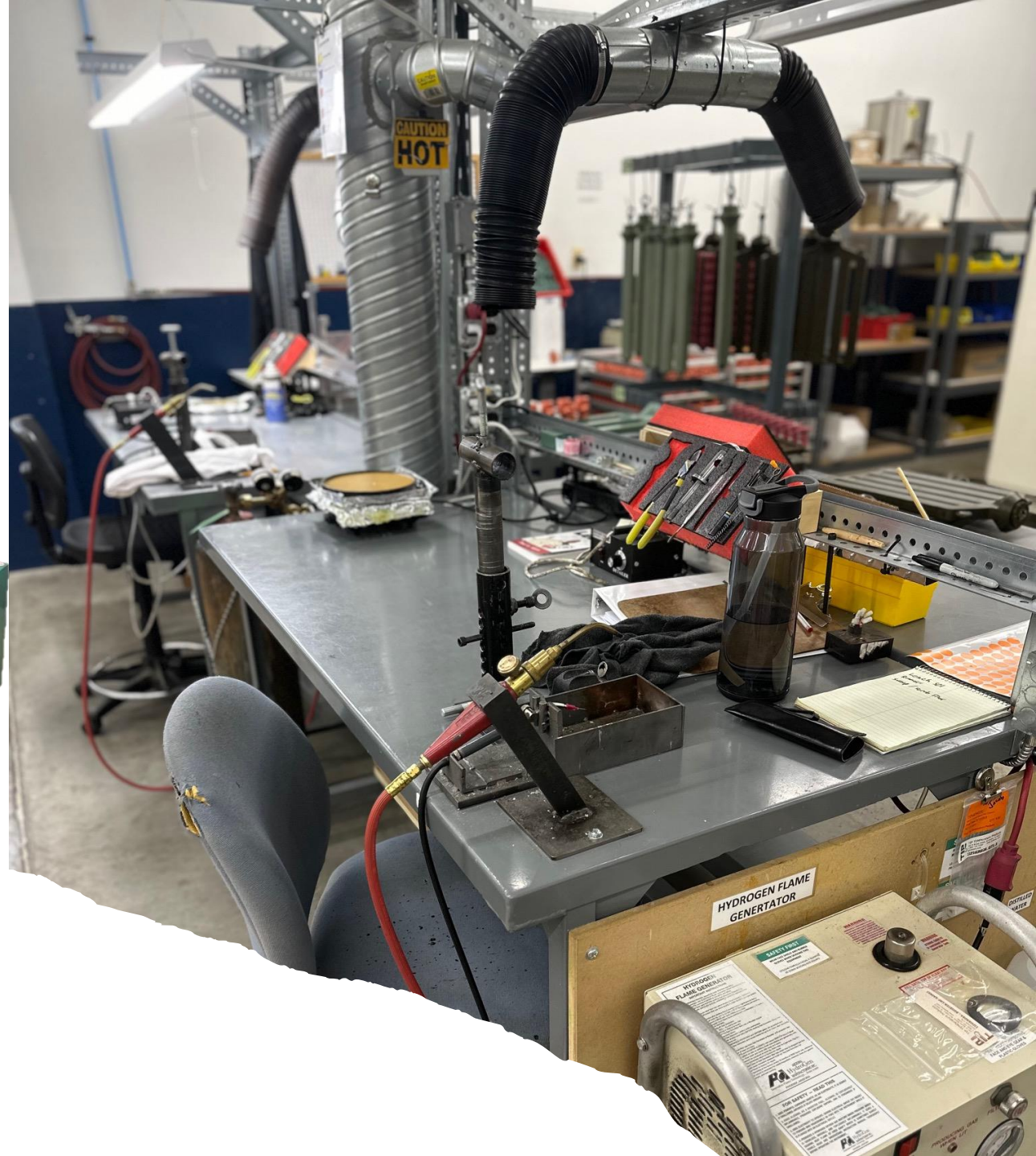
1 Unnamed investment Casting Foundrie
Evaluating 5 parts

Purpose

As our customers demand more of us. It is critical for businesses to evolve with these increasing demands.

Utilizing flexible Automation, in this presentation we will quantify gains in labor, and opportunities for cost reduction for producing a finished casting. This is achieved through improved processes and consistency starting in the wax room.

- Demonstrate how it is possible to:
  - Increase injection capacity between 20-50%
  - Reduce the # of assemblies required by 20%
  - Reduce the amount of metal required
  - Reduce the amount of shell material required
  - Improve operator efficiencies throughout the foundry
- Reduce cost per casting



Existing Process

- In collaboration with our customer
  - Bring existing tool on to our equipment
  - Update to align with our die handling standards
  - Optimize injection process
  - Quantify Scrap & Rework
  - Clean, repair Dies according to requirements

- Automate Assembly
- Eliminate Rework
- Increase Assembly Density & Consistency
- Insert into Customers Down stream processes

Gains in Wax Injection

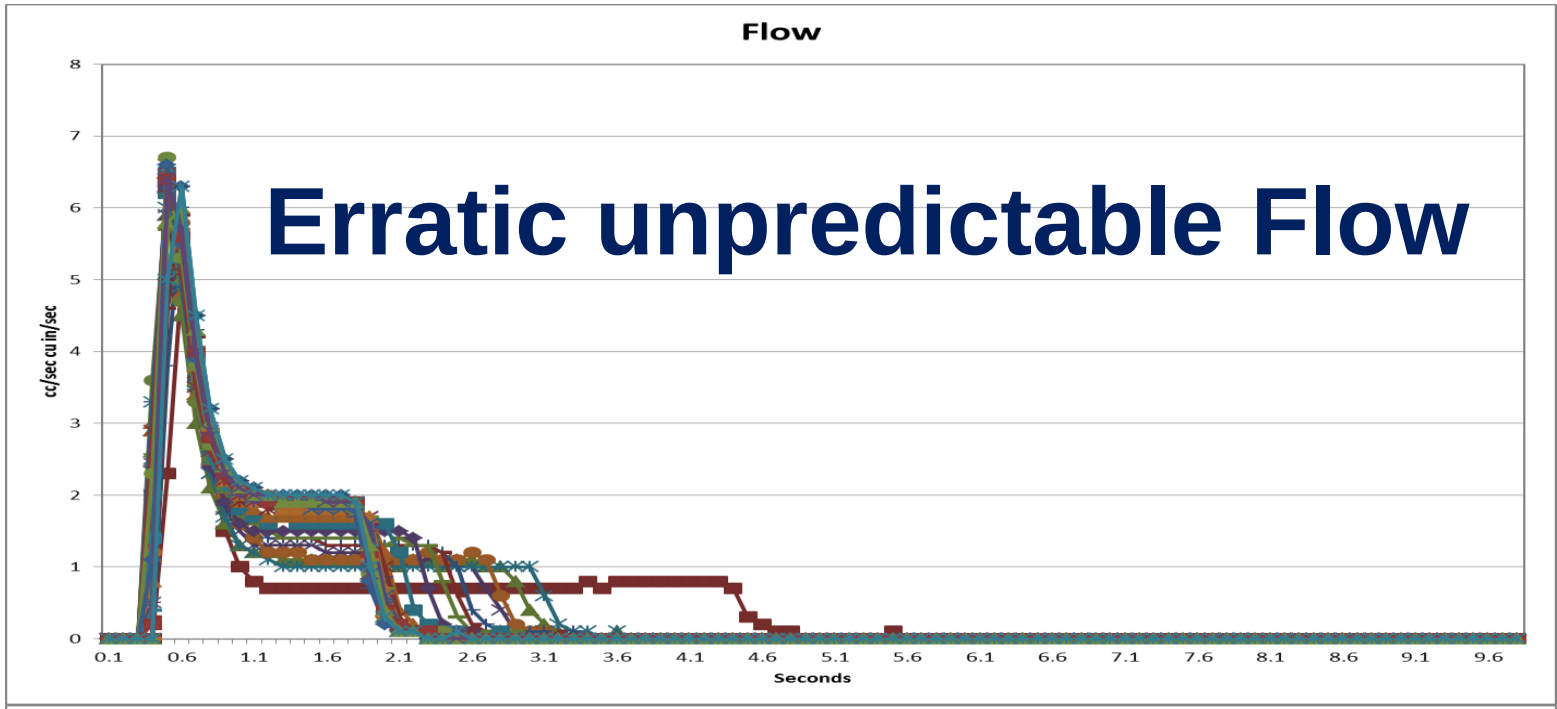
Capable
Process defined
by operator

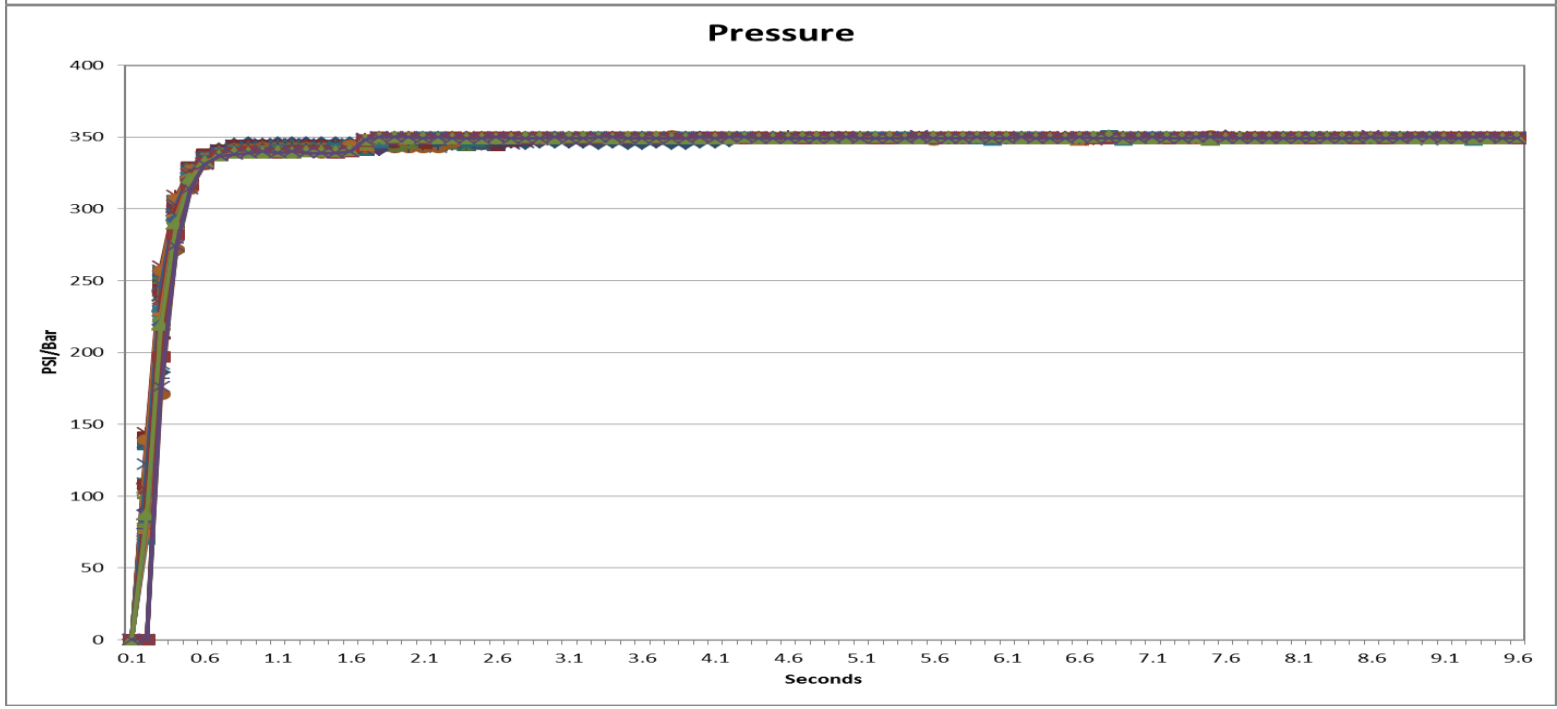
Process lives in the machine
Modern technology

+ **MPI's Comprehensive Standards**

Pressure Limited Flow:

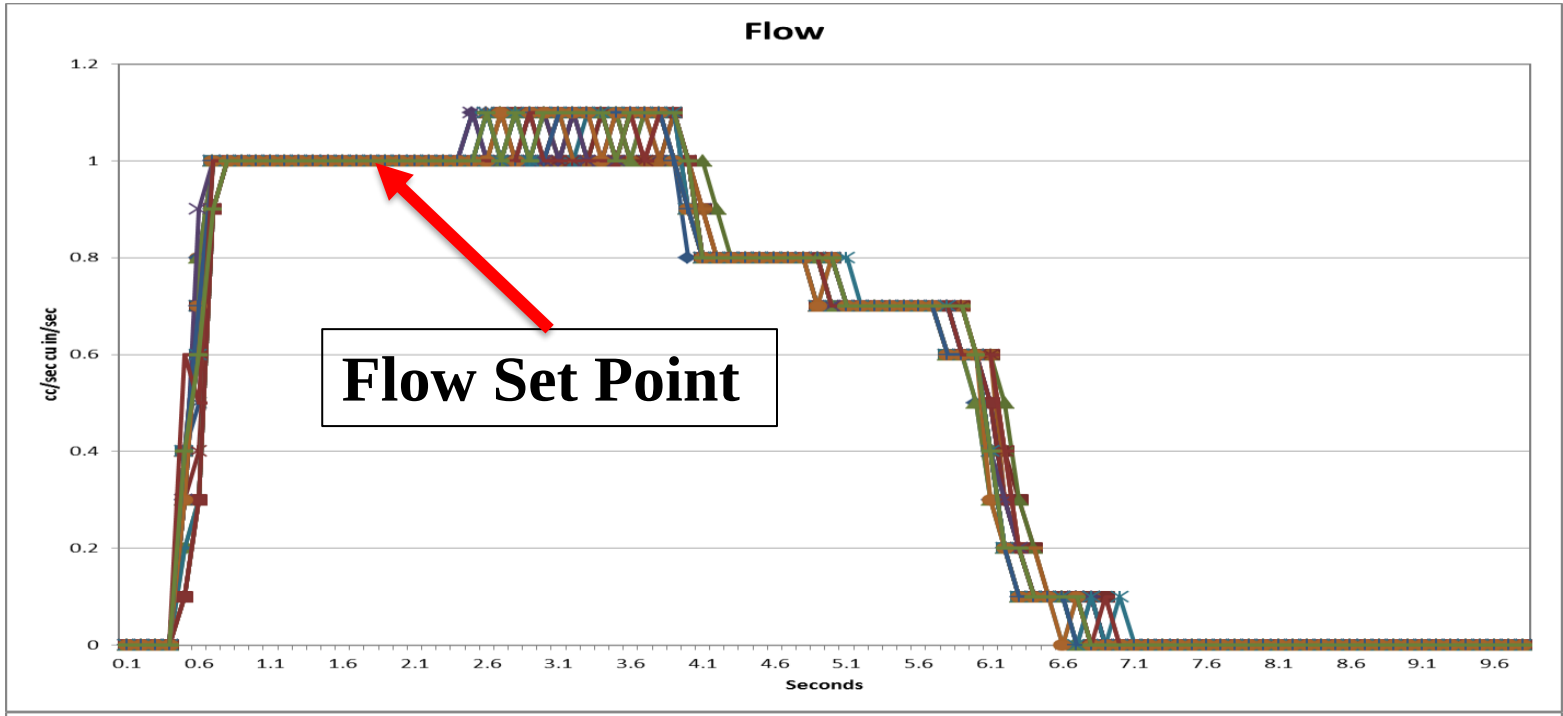
- Incapable machine
- Improper set up

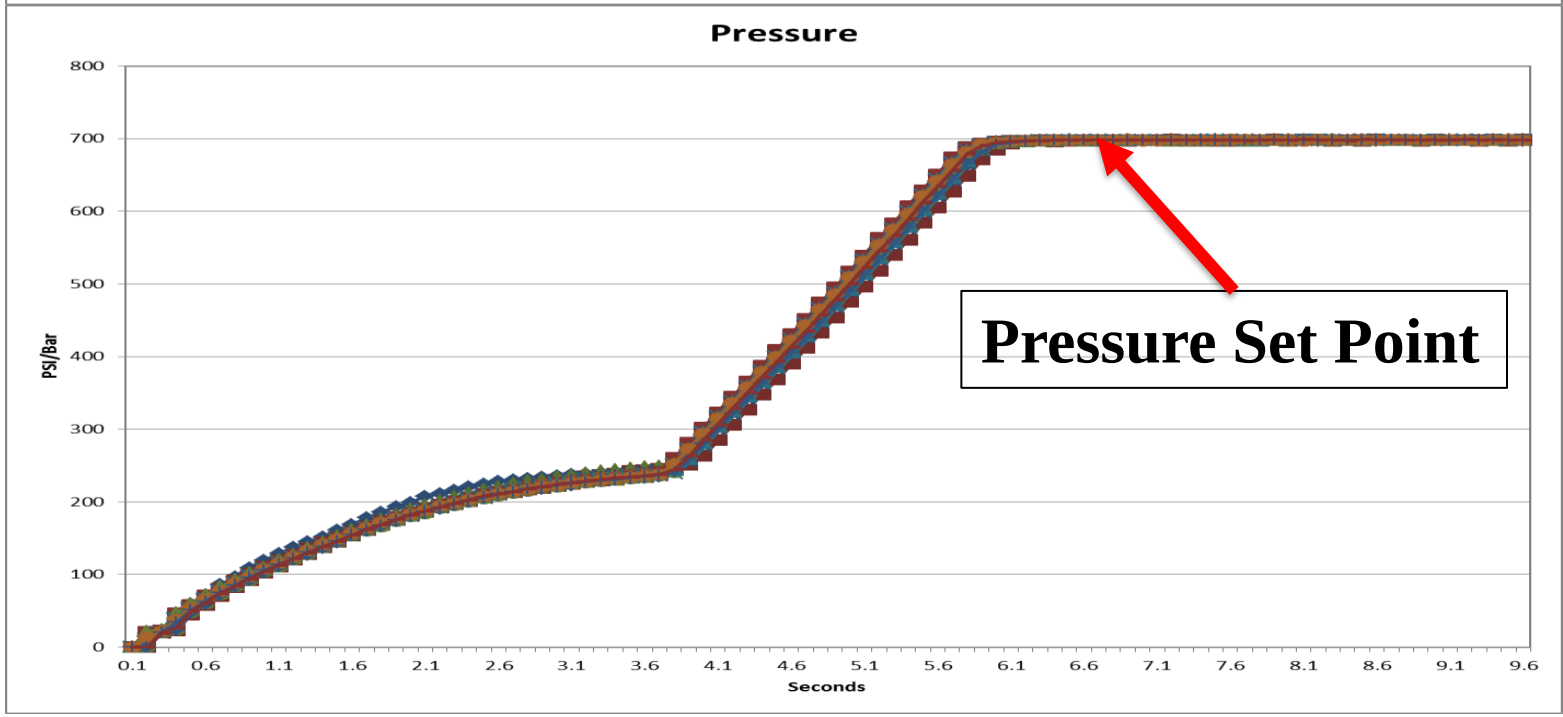




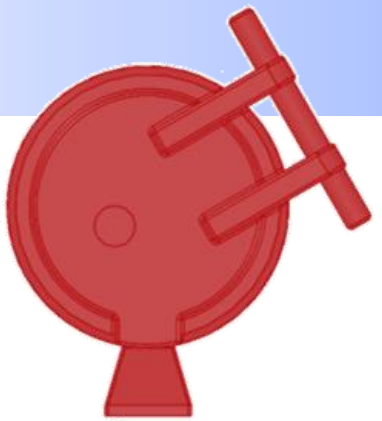
Flow Control,

- proper set up of a capable machine





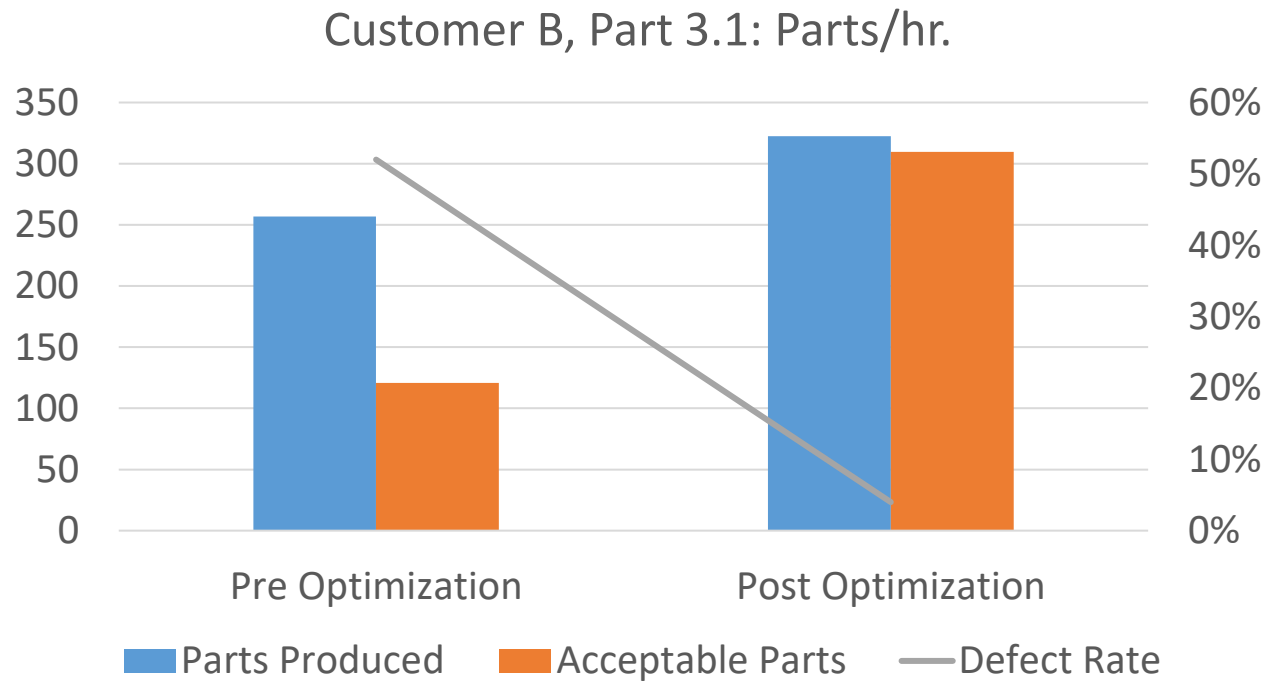
The parts



- Small Commercial parts
- Production Volume between
  - 250 to 15,000 parts
- Part Size between
  - 0.2lb to 0.6lb

Gains in Wax Injection

Parts Produced in 1hr.		
8 Cavity Tool	Pre-Optimized	Post-Optimized
Defective	52%	4%
Acceptable	48%	96%
Parts Produced	257	322
Acceptable Parts	121	310



- 8 Cavity tool
- Reduced number of injections by over 40%
  - Or 1,152cycles @ 53s / cycle
  - Or **17hr**

Opportunities in Assembly:

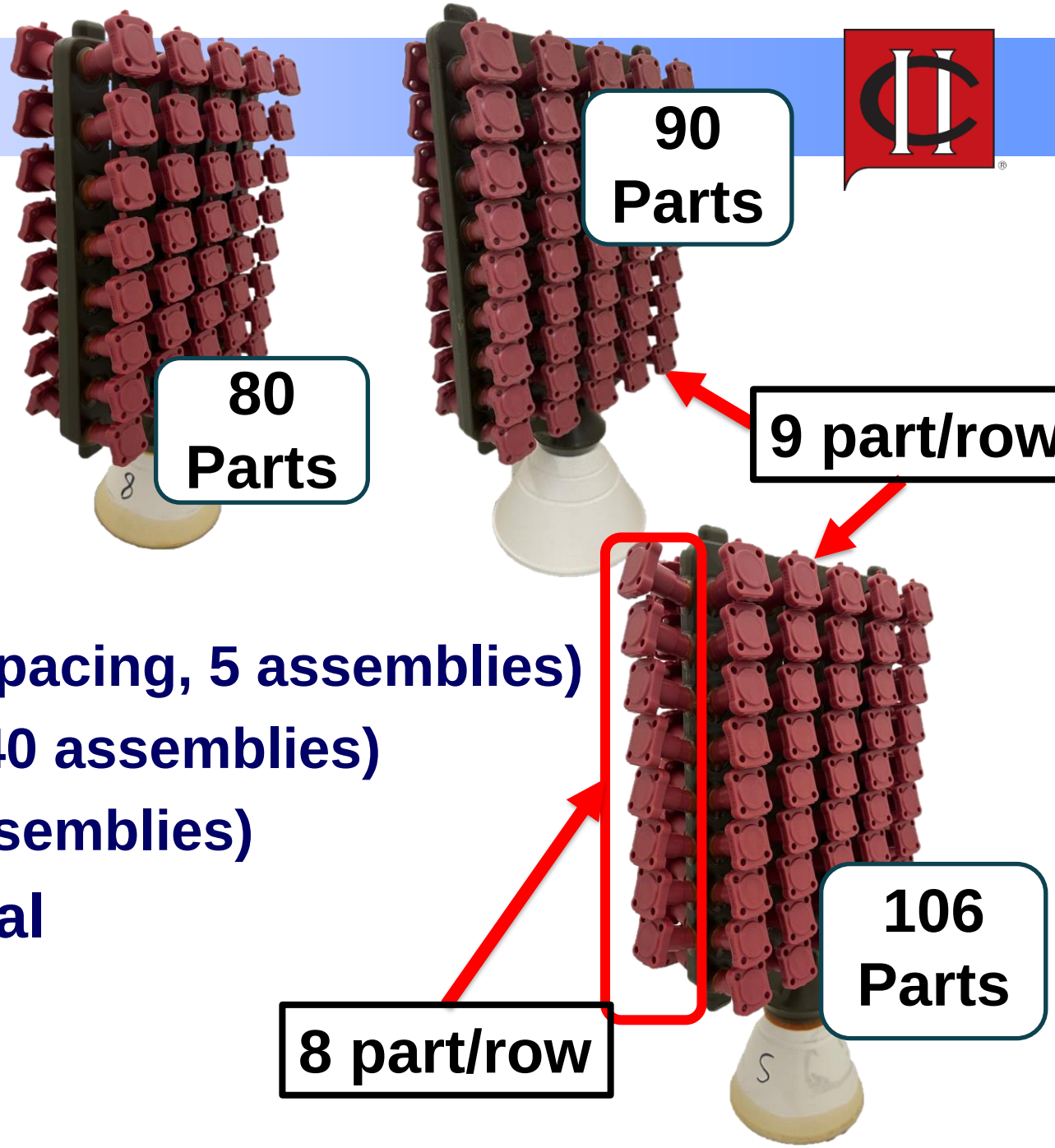
TECH CAST

Gains in: Assembly

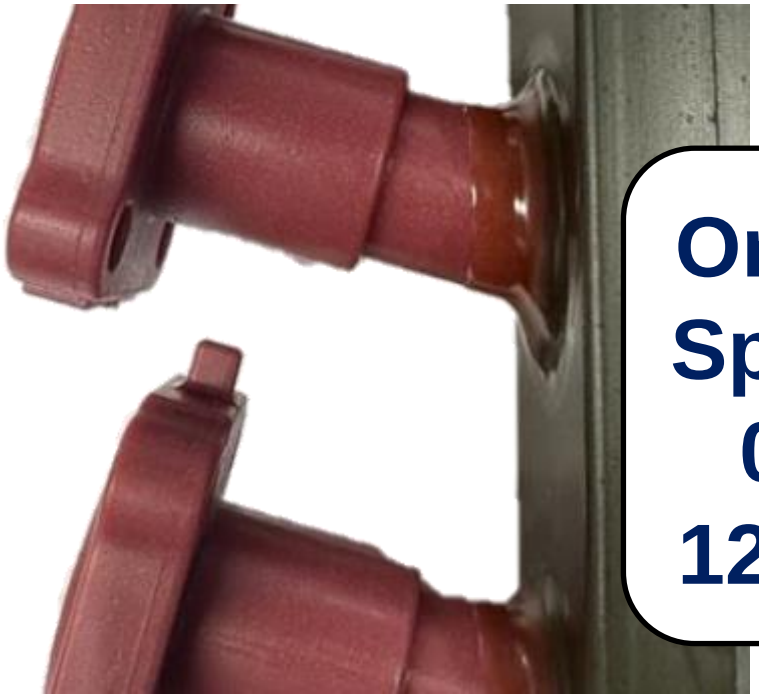
- Automation allows the process to be optimized
  - Part layout & Spacing
  - MPI Flexible Assembly enables batch size of one
  - Designed for YOUR optimal process flow, highlights scrap inefficiencies
- Increased throughput, no breaks or distractions
- Decreased Training & Improved productivity

Our Assembly Testing Process

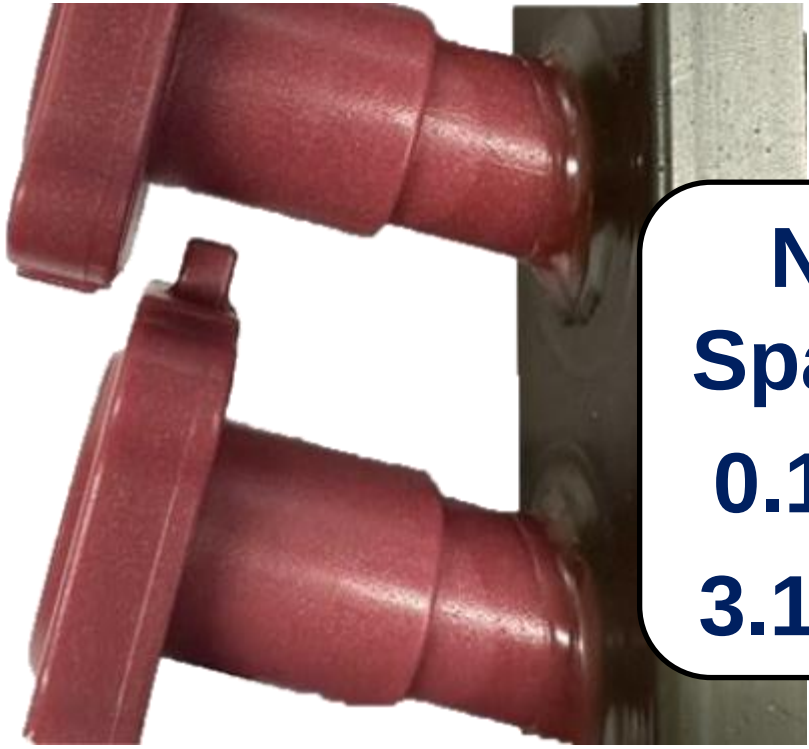
- Test
- This run was 13,500 parts
  - Multiple assembly variations
    - 80 part base line (Customer Spacing, 5 assemblies)
    - 90 part decreased spacing (140 assemblies)
    - 106 part additional rows (5 assemblies)
  - 150 assemblies shipped in total



Spacing Reduction



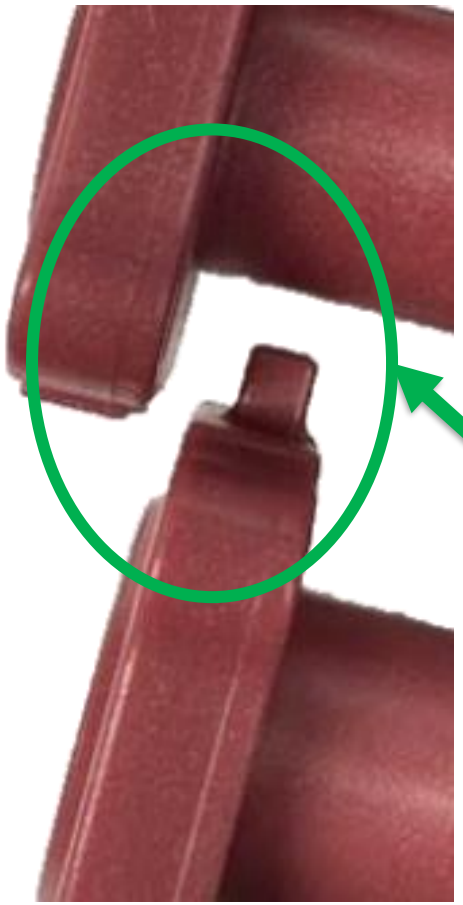
Original Spacing 0.5in 12.7mm



New Spacing 0.125in 3.18mm

Possible due to repeatability of automation

Spacing Reduction



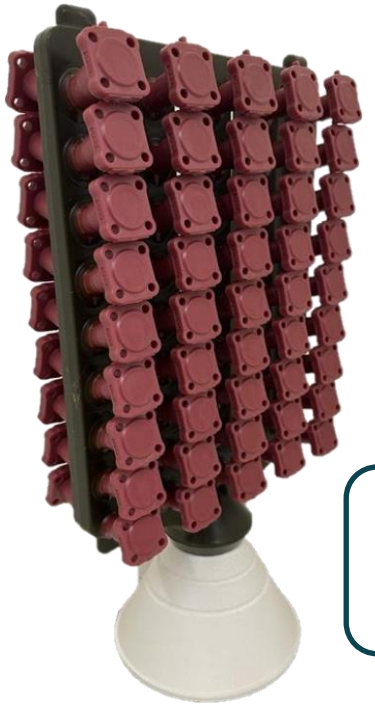
Part Geometry ???

Hole ∅ .215in 5.46mm

Possible due to repeatability of automation

Gains in Wax Assembly

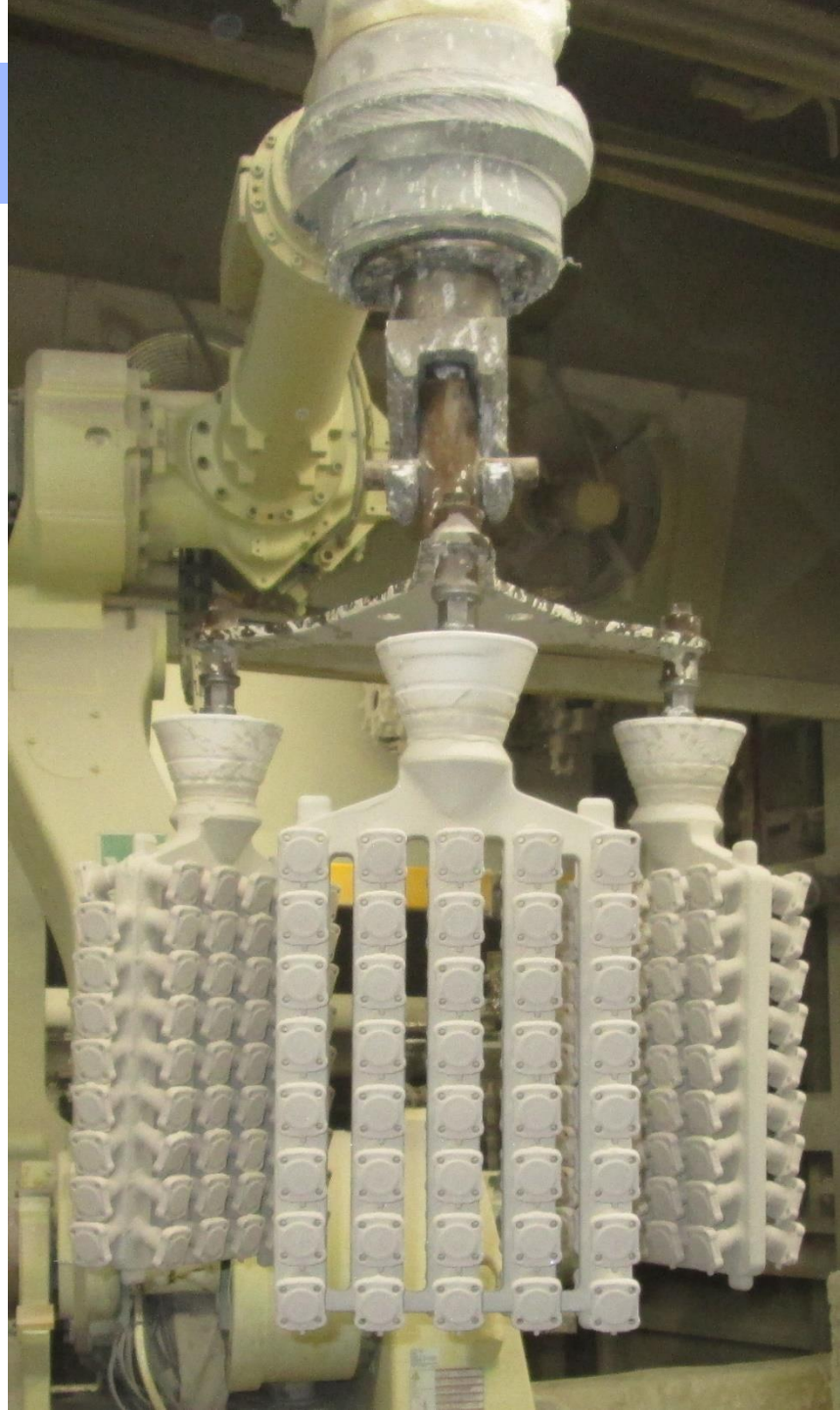
- Reduced assembly time by 53%
  - 44.5hr. SAVED
- Decreased pattern spacing,
  - Increased part Density
  - Reduced # of assemblies required by 19 or 12.5% reduction.
  - 19 less pour cups used
  - 19 less runners produced and assembled (45min)
  - Wax Savings of 29.5lb. (13.4kg)



90 Parts

Gains In Shell

- 19 * 6 = 114 Dips saved
- 11.9% increase in total shell room capability
  - 160mold capacity
- 38 min labor savings
  - assuming 1min/ load and unload of a mold
- Zero part fall out in shell



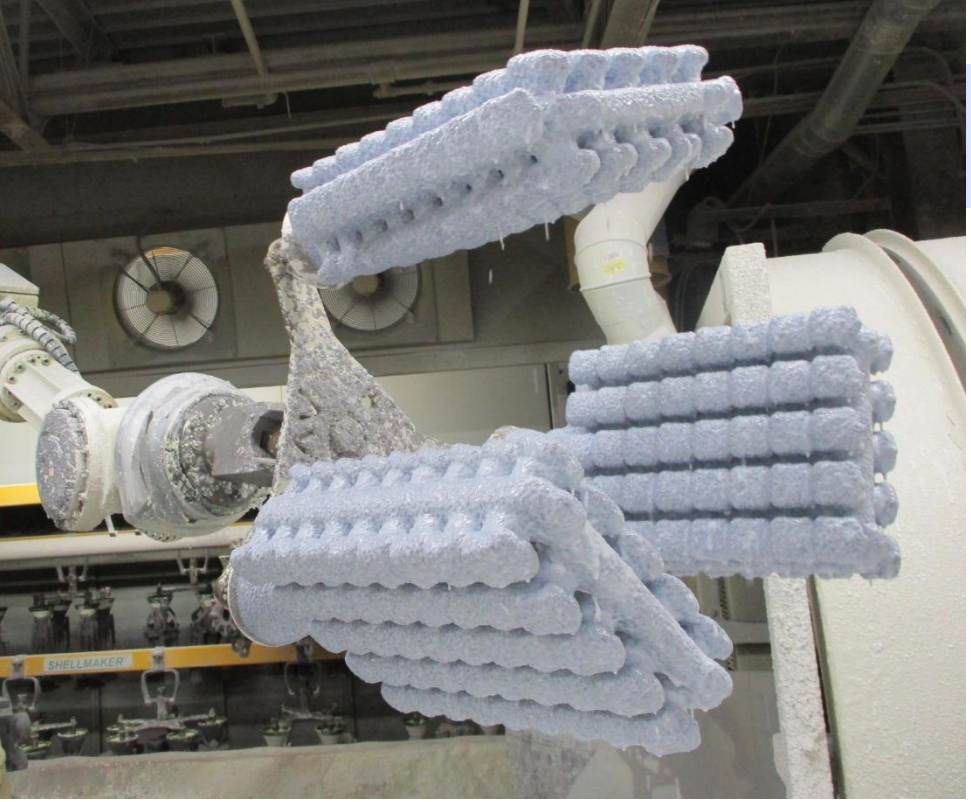
Gains In Shell: Bridging is a strength

80 parts / mold

90 parts / mold

106 parts / mold

All 3 variants produce good parts



Gains In Shell

- Increasing from 80 to 90 patterns / assembly resulted in significant reduction in shell material consumed

Trees Required	Parts / Tree	Shell (Lb.)	Shell/part (Lb.)	Total Shell used (Lb.)	Shell Savings (Lb.)
169	80	24.61	0.31	4159.09	0
150	90	22.22	0.25	3333	826.09
128	106	27.03	0.26	3459.84	699.25

Gains in Metal

- Increasing from 80 to 90 patterns increased pour ratio by 2.8% with opportunity to increase by 6.7%

Parts / Asm	Assembly Weight (kg)	Pattern Weight (kg)	Pour Ratio	Increased Ratio	Increase in patterns
80	23.86	8.71	36.5%	0	0
90	24.95	9.8	39.3%	2.8%	10
106	26.69	11.54	43.2%	6.7%	26

Gains in post processing

- 95min reduction in shell clean time
- 19 less trees to cut off, 4.75hr
  - Operators Bryan & Jeramy stated, ***“Assembly accuracy resulted in zero cutoff damage”***
- Even spacing allows closer cutoff reducing grinding and machining
- The future can now be accurate, automated cut off

Total Gains for 13,500 parts

- Reduced required injections by 40%
- Increased Assembly Capacity by 53%
- 68.4 hr. SAVED
- 826 Lb. of Shell material SAVED
- 638.9 Lb. of metal SAVED
- 11.9% shell capacity INCREASED
- Reduced defects in wax and cut off
- Improved customer delivery performance

Savings across 3 customers & 5 part #'s

Customer	Part	Assembly/ Year	Assemblies Reduced / Year		Patterns / Tree	Pattern Increase / Assembly		Metal Saved / Year	Pour Ratio (%)		Shell Savings %
			Total	(%)		Total	%		Total	Increase	
Customer A	1.1	1,371	305	22%	42	0	22.2%	0	63%	6%	24%
		1,067			54	6		6,037	68%		
Customer A	1.2	1,309	281	21%	110	0	21.4%	0	59%	6%	26%
		1,029			140	20		5,557	65%		
Lamothermic	2.1	15	3	22%	42	0	28.6%	0	52%	6%	12%
		14			48	6		21	56%		
		12			54	12		74	59%		
Customer B	3.1	2,025	497	25%	80	0	32.5%	0	37%	7%	20%
		1,800			90	10		6,368	39%		
		1,528			106	26		14,057	43%		
Customer B	3.2	900	100	11%	80	0	11.1%	0	63%	3%	5%
		800			90	10		2,830	66%		

Consolidated Results

Increased Injection capacity	Assemblies Reduced / Year		Metal Saved / Year (Lb.)	Average		
	Total	(%)		Pattern Increase / Assembly	Pour Ratio Increase	Shell Savings
20 to 50%	1,185	21%	34,944	23%	5%	17%

Future work

- Reduce # of shell coats
- Run additional part #’s with smaller batch sizes
- More Complex assemblies
- Bring automation in house
- Look to automate cut off

- If you are interested in participating in a similar type of study, please reach out.
- Or visit us in booth #407