Visi-Trak®

SENSE, MONITOR, CONTROL

SENSE, MONITOR, CONTROL

AHRESTY, WILMINGTON

Ahresty Wilmington Corporation (AWC)

- founded in 1988 and is
- located in Wilmington, Ohio.
- die-casting, finishing, machining, and assembly operation
- just-in-time production
- expertise is highly valued by automotive customers in North America who have recognized them with several Quality, Delivery and Productivity improvement awards.

Visi-Trak®
SENSE, MONITOR, CONTROL

Fast Facts:

- **Established**: June 1989
- **Employees**: 525 as of March 2007
- **Sales** $135 million (2006FY)
- **Products**: Aluminum Die Castings
- **Certifications**: ISO-9001, ISO-14001, TS 16949

Engine and Transmission Components

Customers

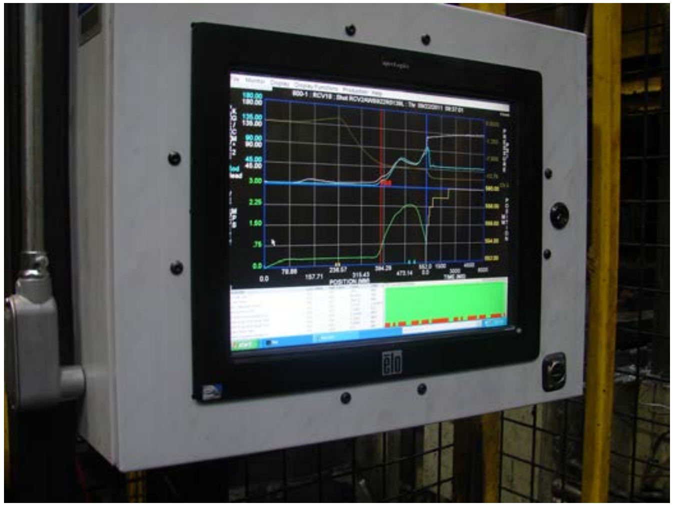
- Aisin Automotive Casting, LLC
- Aisin Drivetrain, Inc.
- DMAX, Ltd. DTR
- Honda of America Mfg., Inc.
- Honda Transmission Mfg. of America, Inc.
- Magna PowerTrain
- Nissan North America, Inc.
- YSK

Plant Overview

- **24 die casting machines**
  - 3 Prince (500-1650 ton)
  - 2 Toshiba (2250 ton)
  - 19 Ube (500-2250 ton)
- **Machining**
  - Manual load and fully automated machining lines
  - Leak test for all lines
  - Vision systems for quality confirmation checks.

Plant wide implementation

- 2004 began installation of plant wide monitoring systems
- Completed installation all 24 machines in early 2011



Plant wide monitoring

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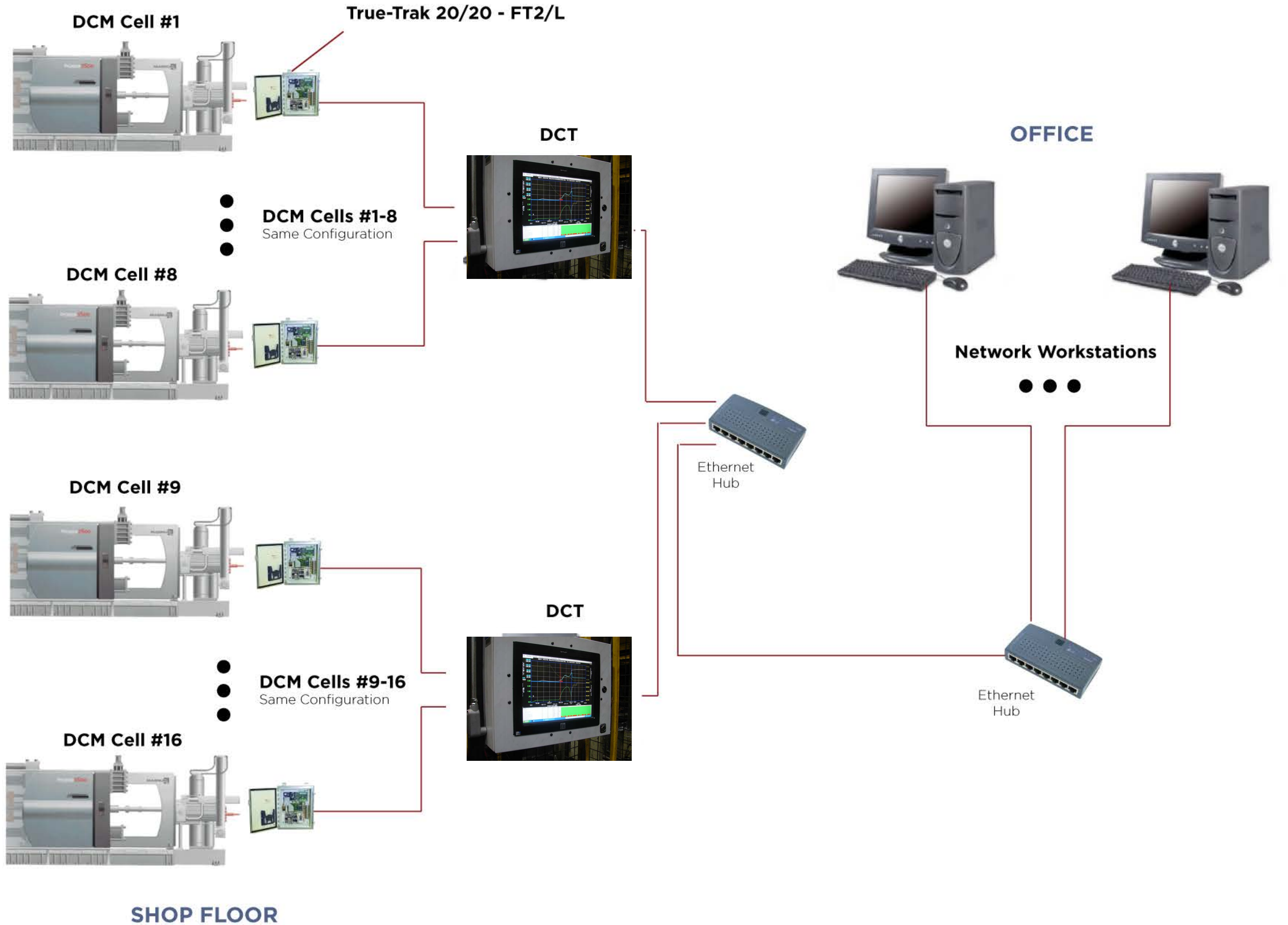
BEFORE

- Insufficient data OEM supplied monitoring systems
- Receiving data in inconsistent formats that couldn't be data mined centrally

AFTER

- Complete local and remote view of the shot event
- A complete QA picture
- Ability to automatically segregate parts on out of limit parameters
- A single format for all shot data across all manufacturers die casting machines

Monitoring at Ahresty 2011



Continuous Process Improvement

- **Engineers as product specialists**
  - 1 Senior Process Engineer
  - 9 Engineer product specialists
  - Each follow a different product group
- **Continuously Monitor product group throughout their production cycle**
  - Process engineer dedicated to one product group
  - Understand causes of product variation
  - Implement counter measures
  - Improve quality and reduce scrap

2011 Goal – Part Identification & Tracking

- **Determine cause of scrap and low quality production**
- **Implement on one machine running high volume part**
  - 60,000 parts per month
- **Bring down high scrap rates**
  - Parts experienced 1% scrap rate
  - with occasional spikes to 5% scrap rate
- **Parts required high rate of secondary processing**
  - 6.5% of parts required impregnation to pass leak test
  - Spikes as high as 15% were experienced

First Implementation of Traceability 'Lite'

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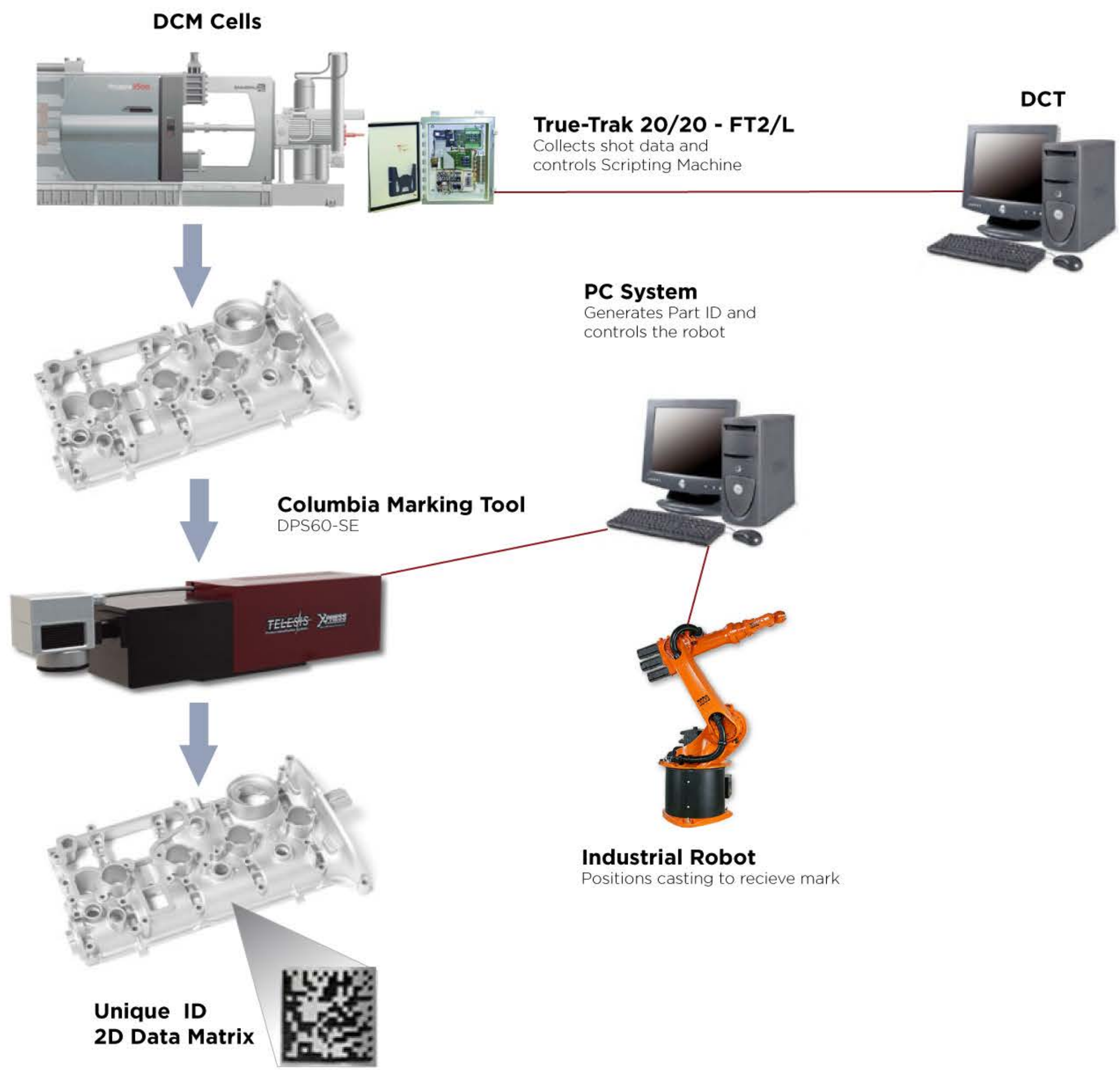
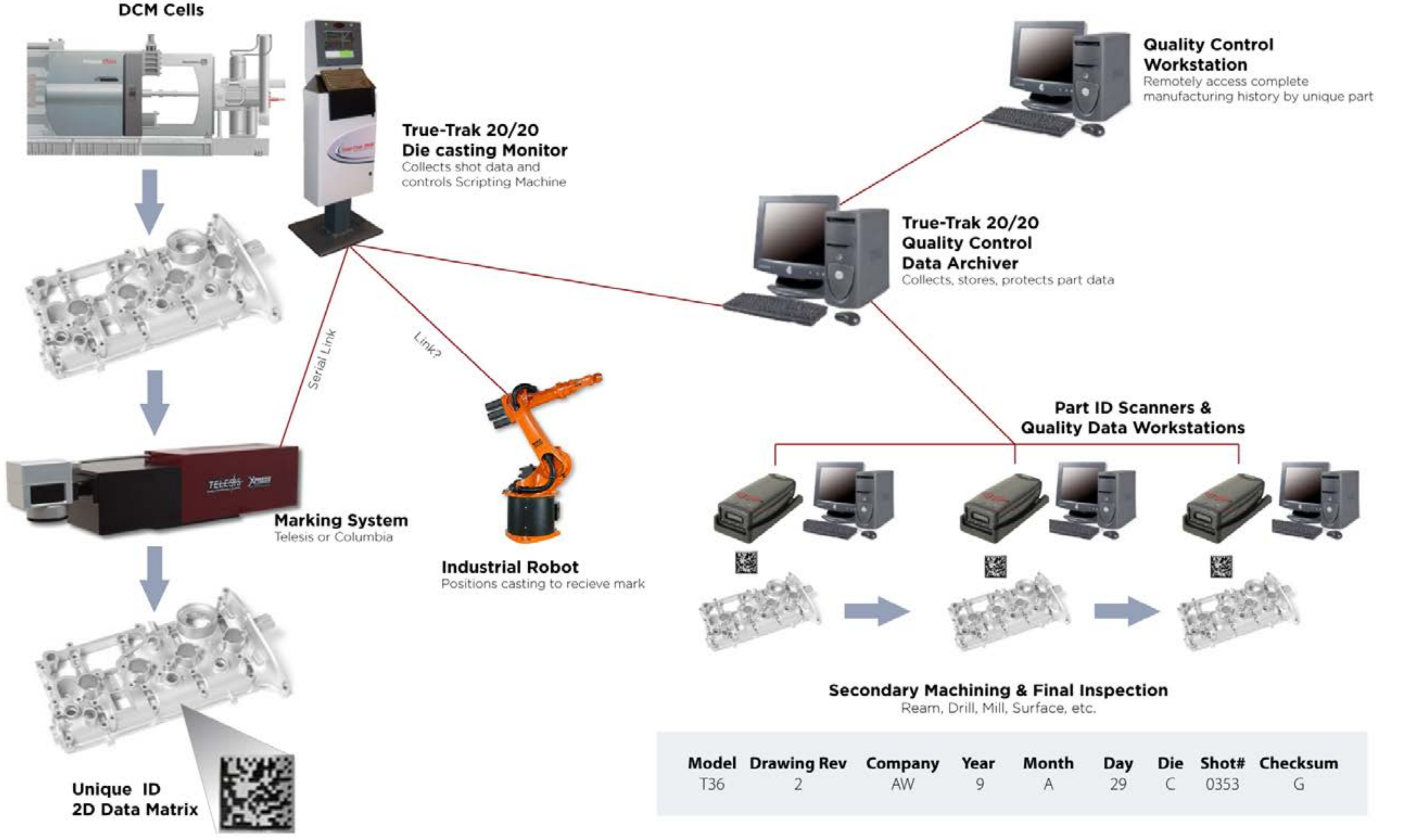


The Pitch

- **Presentation made to management** regarding expanding to complete part identification traceability
- **One-to-one database** of part ID, shot profile and parameter info, secondary test and processing
- **True Traceability**



Model	Drawing Rev	Company	Year	Month	Day	Die	Shot#	Checksum
T36	2	AW	9	A	29	C	0353	G

Uniquely Identify, Track, and Store QC Data for Every Part

What is Traceability

Key Features:

- Automatically **collect and archive valuable shot data** for each part.
- **Uniquely identify each part** you produce.
- Capture and **link important secondary test and machining data**.
- Analyze your data to
  - **Determine cause of variation**
  - **inform your customers and improve quality**.
- **Archive your information** for future access.

Network Data Archiver

Archival Process:

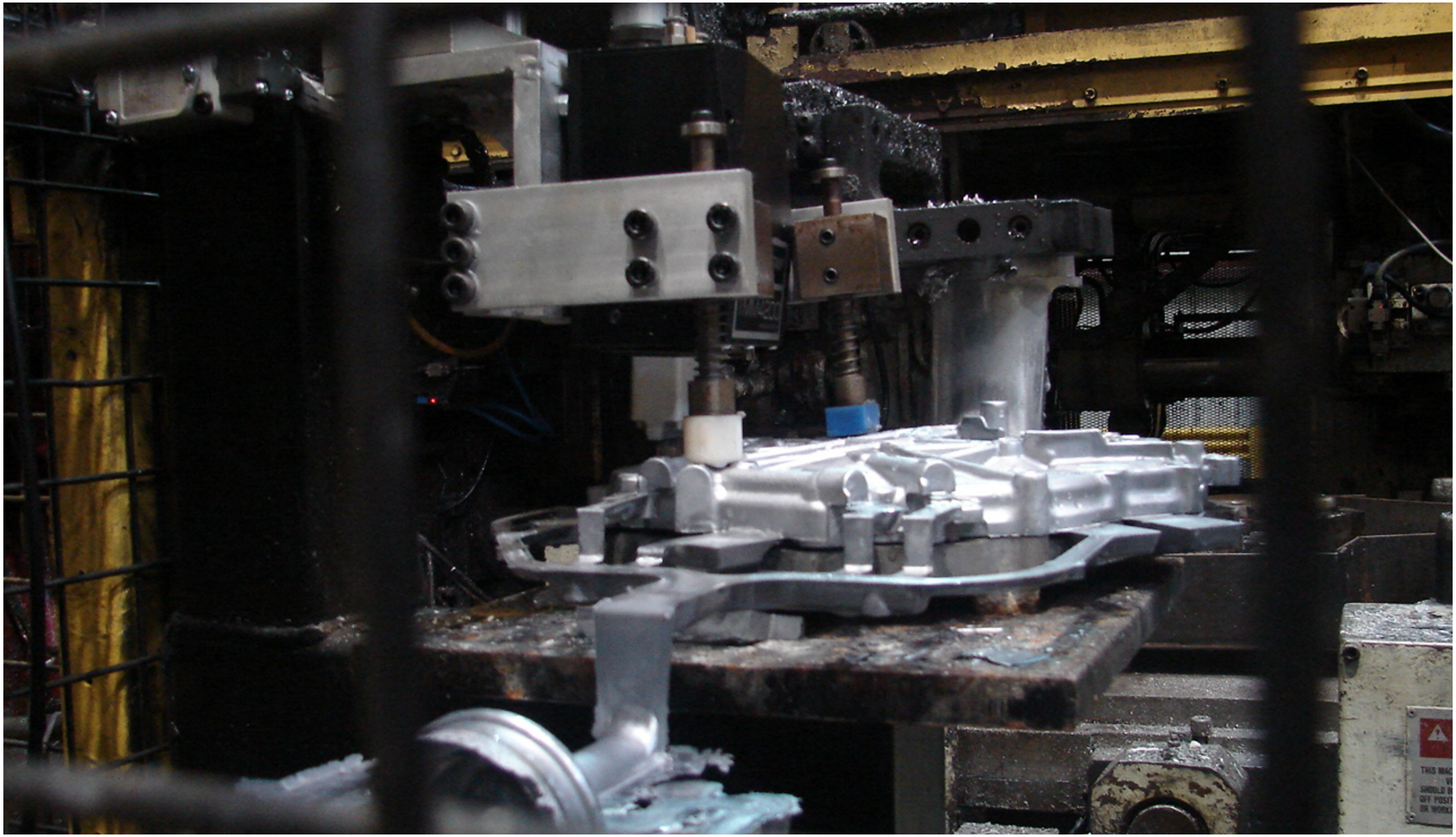
- Automatic Back-up and compress data
- Stored in database
- Compress to Directory for archival

Retrieval Process:

- Data decompresses
- Select and Restore Data
- Access Historical Data for Analysis
- Merge Historic Data

New Traceability Process Approved

- Engineering presented concept to management
- One month later the management came back with a mandate to go ahead
- Software updates made to accommodate additional data points for each part



6.5 seconds to imprint bar code and human readable code – 8.5 seconds clamp to unclamp

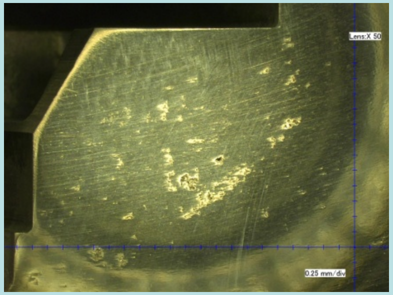
Compliments of Charlie Goldfuss,
Senior Process Engineer Ahresty, Wilmington

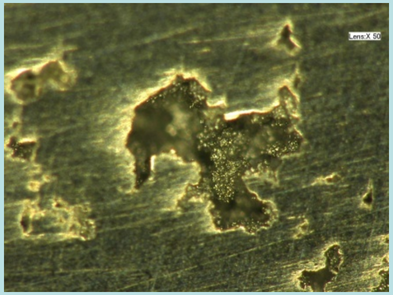
WHAT DID THEY FIND?

Root Cause Analysis

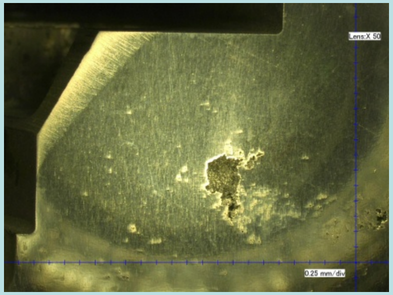
1. Evaluation of porosity in this area indicates mainly shrinkage, but some gas porosity is also present.
2. The thick section where porosity is found is in a flow shadow of an inner-core resulting in shrinkage and gas porosity.

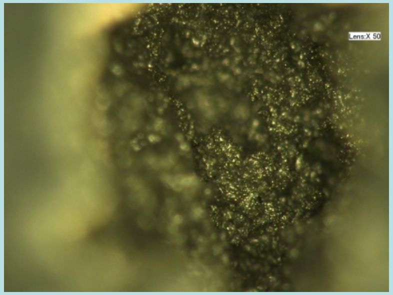
No Leaker (Good casting)



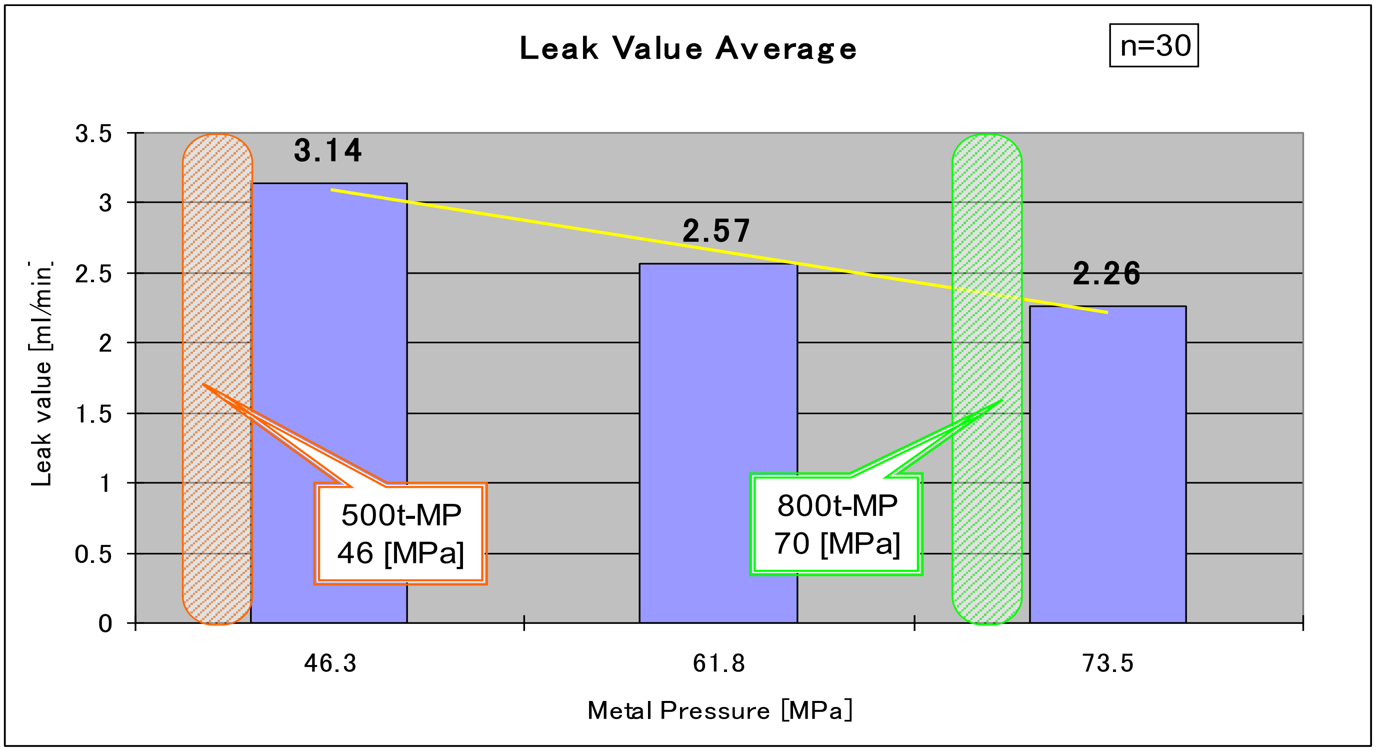


Leaker *(NG casting)*





Understanding shrinkage as the root cause for this defect we decided a detailed study was needed to understand which process parameter settings were critical in reducing this defect. We compared metal pressure to leak rate data.



This simple study took two days to complete using many engineering man hours to track these 120 castings through our system and document the related data

In order to make these detailed engineering studies more efficient and timely we decided to implement a data tracking system using a 2D bar code applied in the casting cell.

AWC negotiated with the customer to allow an optional part mark for the purpose of data tracking through the manufacturing and inspection processes

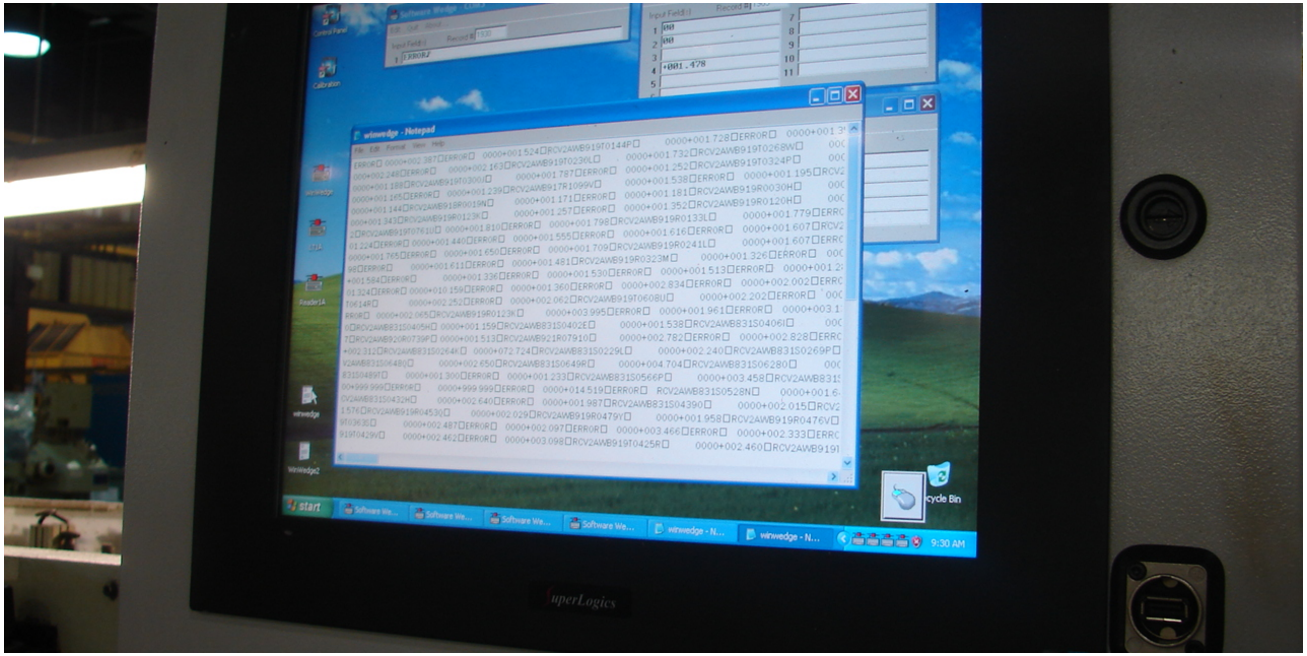
Visi-Trak
Generates 2D code serial # while storing process data with identical file name

Telesis
4 pin marking head writes 2D code data sent from Visi-Trak in under 8 Sec.

Keyence
2D code reader sends serial # to computer which also stores leak test results

Inspection and Test

Keyence Reading Station

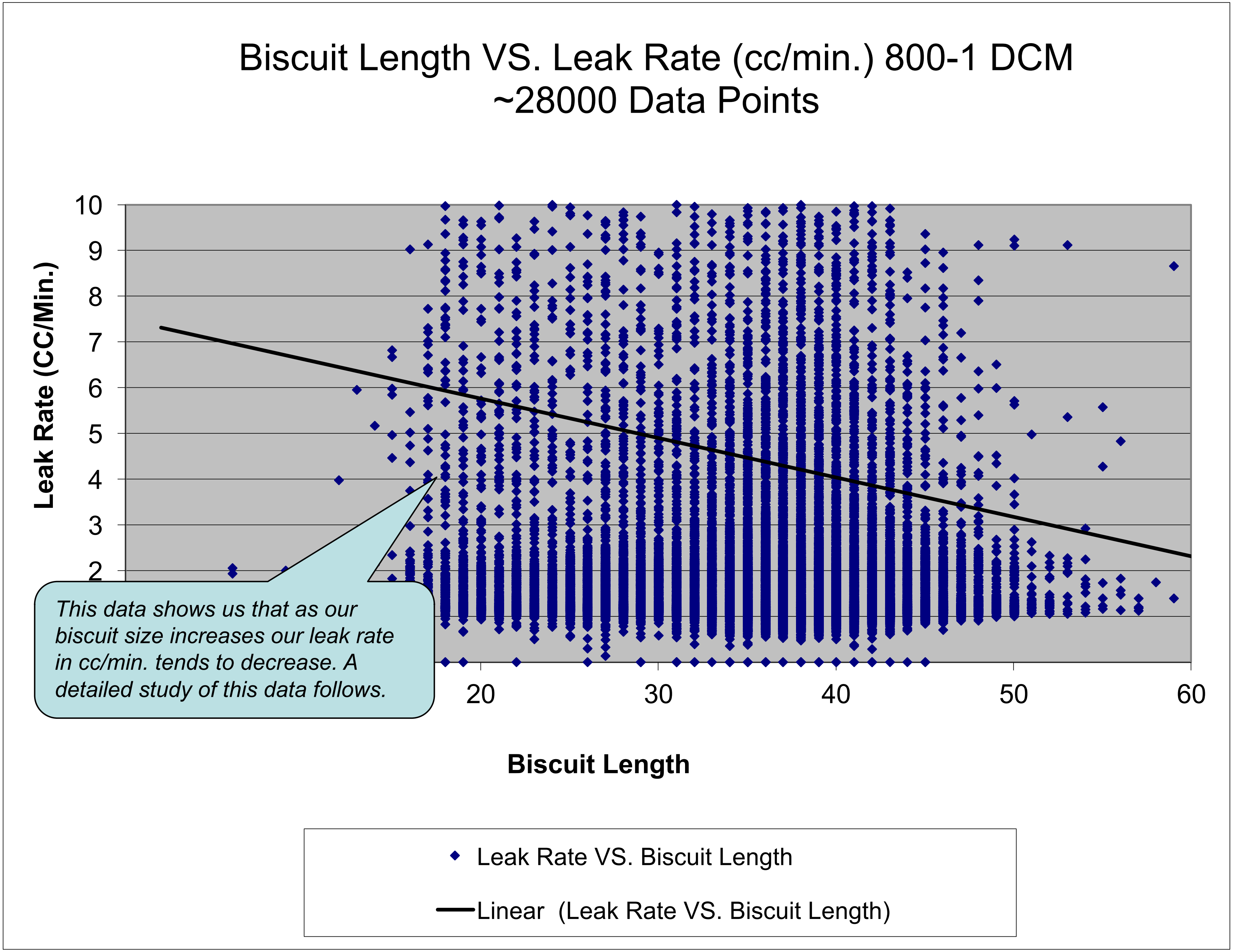


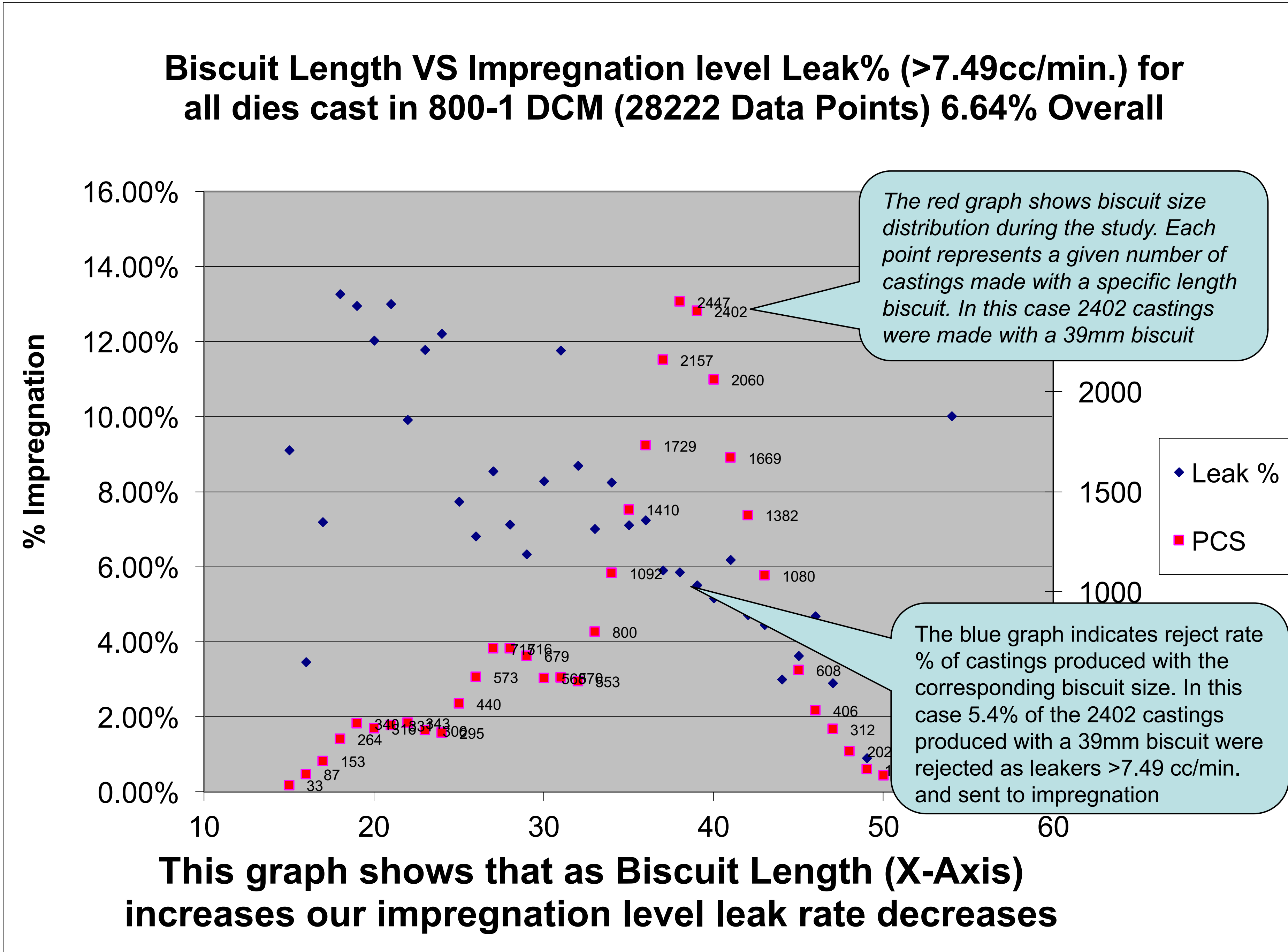
At pressure test – identifies parts, measures, and saves results to data archiver

Once a significant amount of data was collected we started data analysis by plotting simple X,Y scatter graphs to see which process parameters had most direct correlation with leak rate data. The parameters with the highest level of correlation listed in decreasing order were:

1. **Biscuit Length**
2. **Intensification Squeeze Distance**
3. **Intensification Pressure**
4. **Fast Shot Start Position**

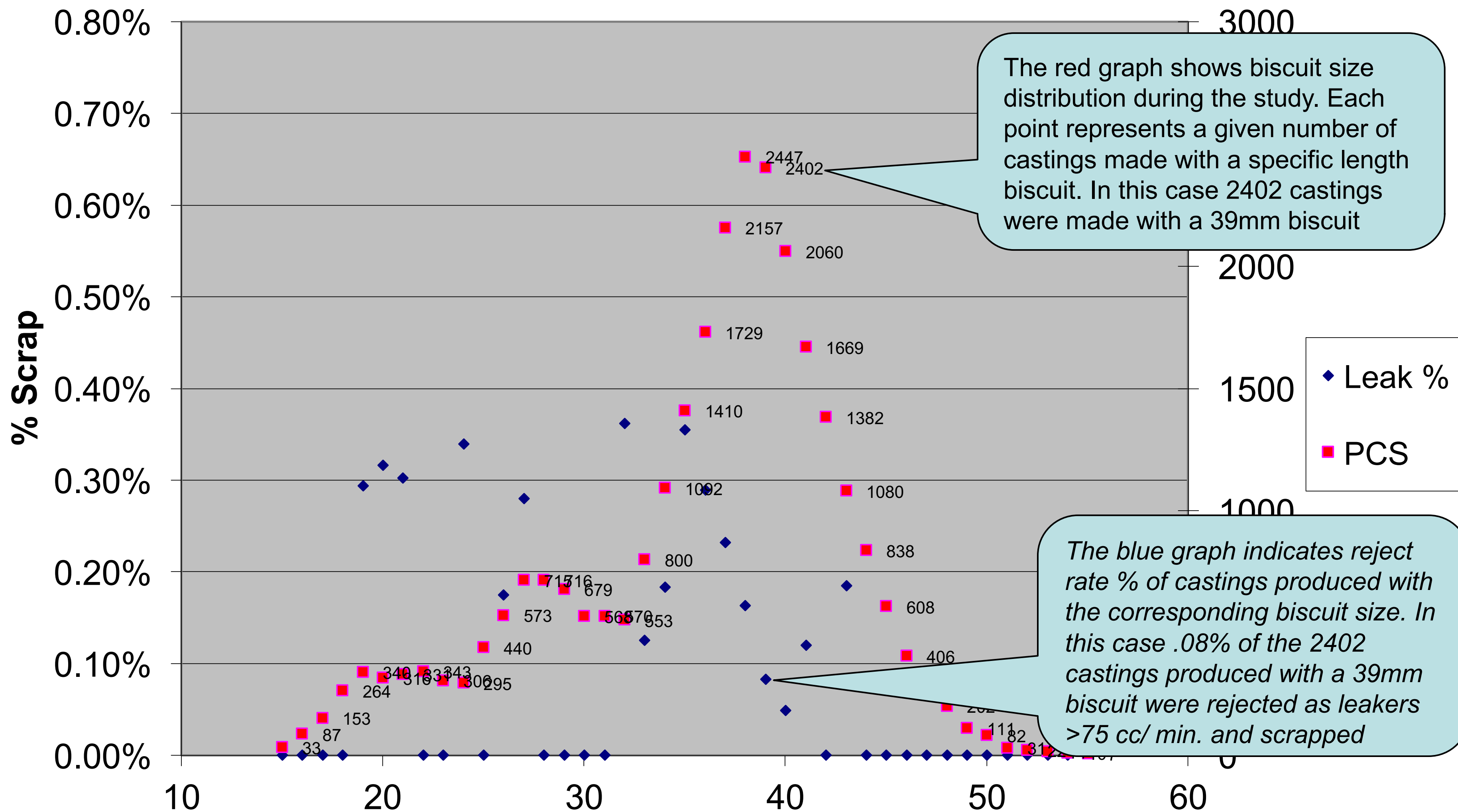
Once these high correlation process parameters were identified we conducted detailed studies on each and developed counter measure(C/M) activity to better understand and develop (O)ptimum (P)rocess (C)onditions for each critical parameter.


Biscuit Length VS. Leak Rate (cc/min.) 800-1 DCM
~28000 Data Points
Leak Rate (CC/Min.)
10
9
8
7
6
5
4
3
2
20
30
40
50
60
Biscuit Length
This data shows us that as our biscuit size increases our leak rate in cc/min. tends to decrease. A detailed study of this data follows.
Leak Rate VS. Biscuit Length
Linear (Leak Rate VS. Biscuit Length)



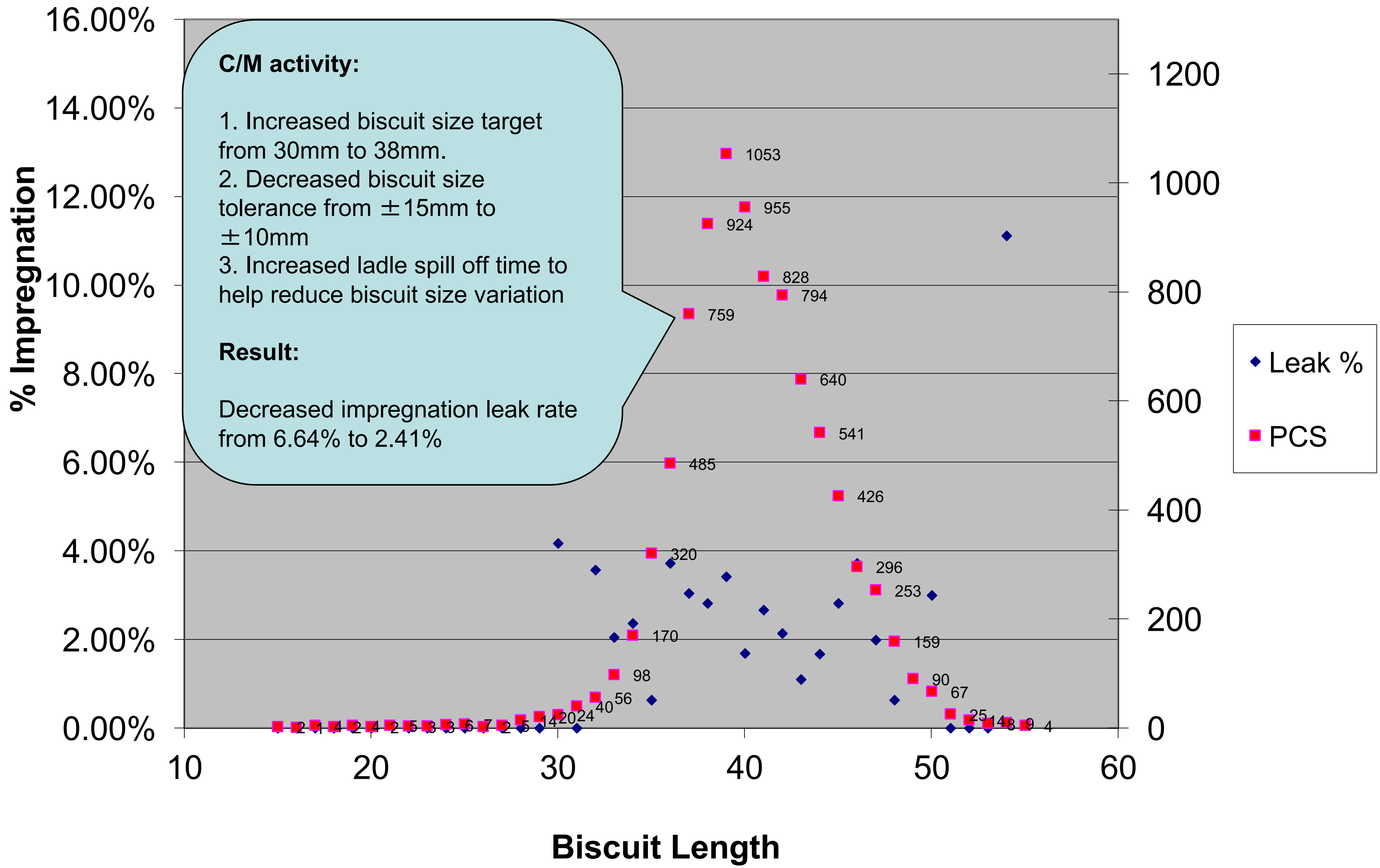
Biscuit Length VS Impregnation level Leak% (>7.49cc/min.) for all dies cast in 800-1 DCM (28222 Data Points) 6.64% Overall
% Impregnation
16.00%
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
10
20
30
40
50
60
2000
1500
1000
Leak %
PCS
The red graph shows biscuit size distribution during the study. Each point represents a given number of castings made with a specific length biscuit. In this case 2402 castings were made with a 39mm biscuit
The blue graph indicates reject rate % of castings produced with the corresponding biscuit size. In this case 5.4% of the 2402 castings produced with a 39mm biscuit were rejected as leakers >7.49 cc/min. and sent to impregnation
2447
2402
2157
2060
1729
1669
1410
1382
1092
1080
800
679
573
553
440
608
406
312
264
153
87
33
This graph shows that as Biscuit Length (X-Axis) increases our impregnation level leak rate decreases

Biscuit Size VS. Scrap level Leak % (>75cc/min.) for all dies cast in 800-1 DCM (28222 Data Points) .14% Overall

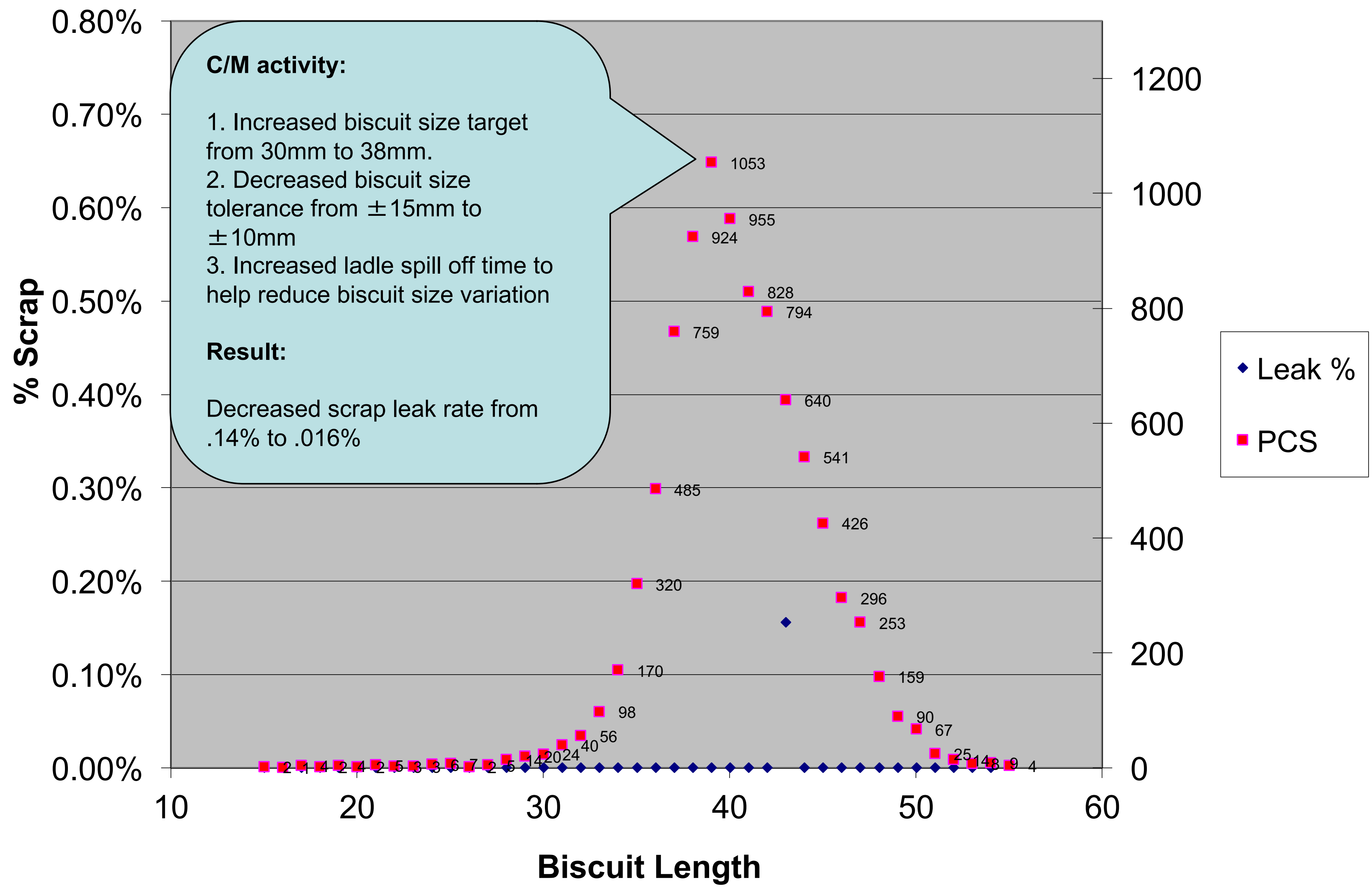


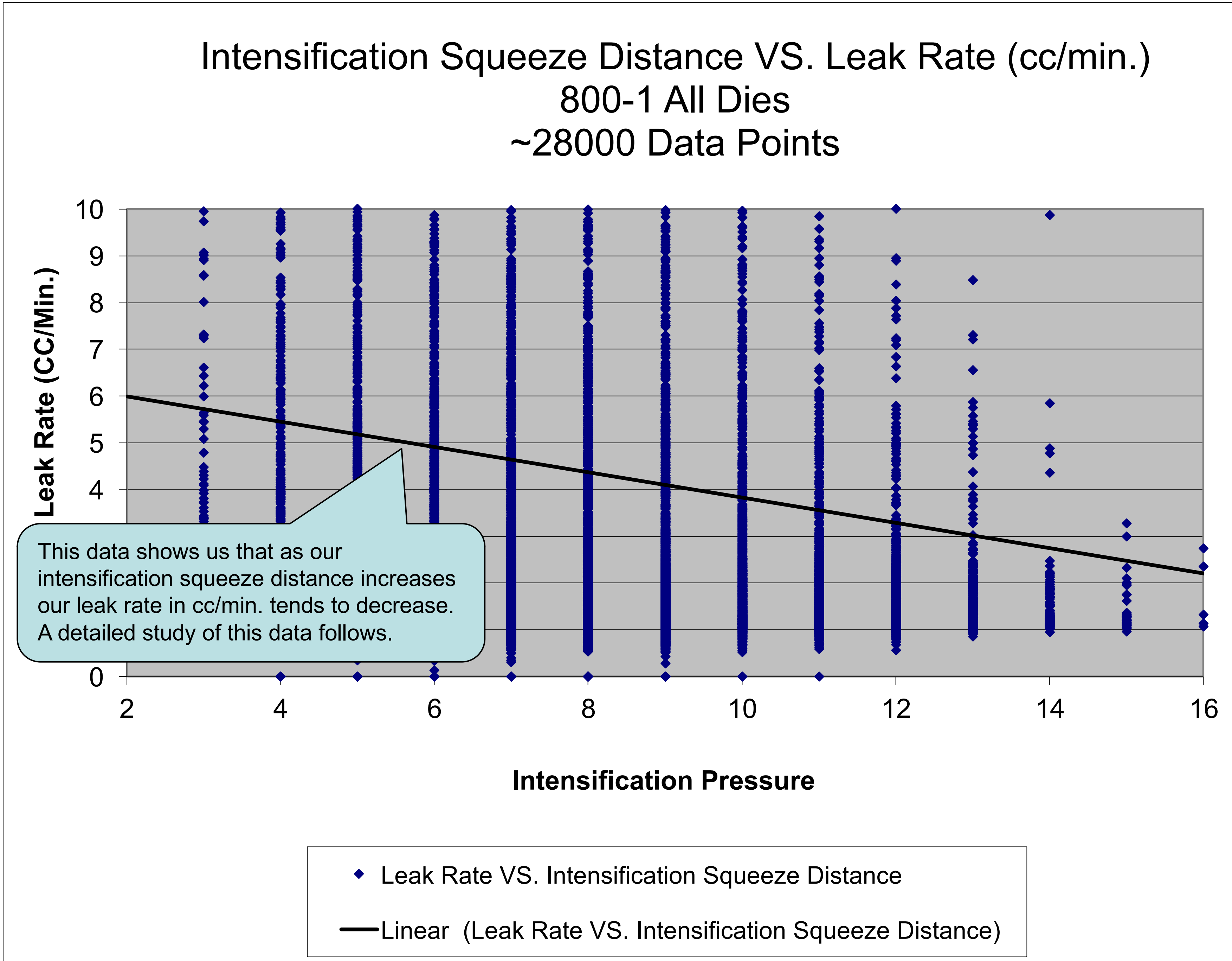
This graph shows that as Biscuit Length (X-Axis) increases our scrap level leak rate >75 cc / min. decreases

Biscuit Size VS Impregnation level Leak % for product cast after C/M activity (9134 Data Points) 2.41% impreg. rate total



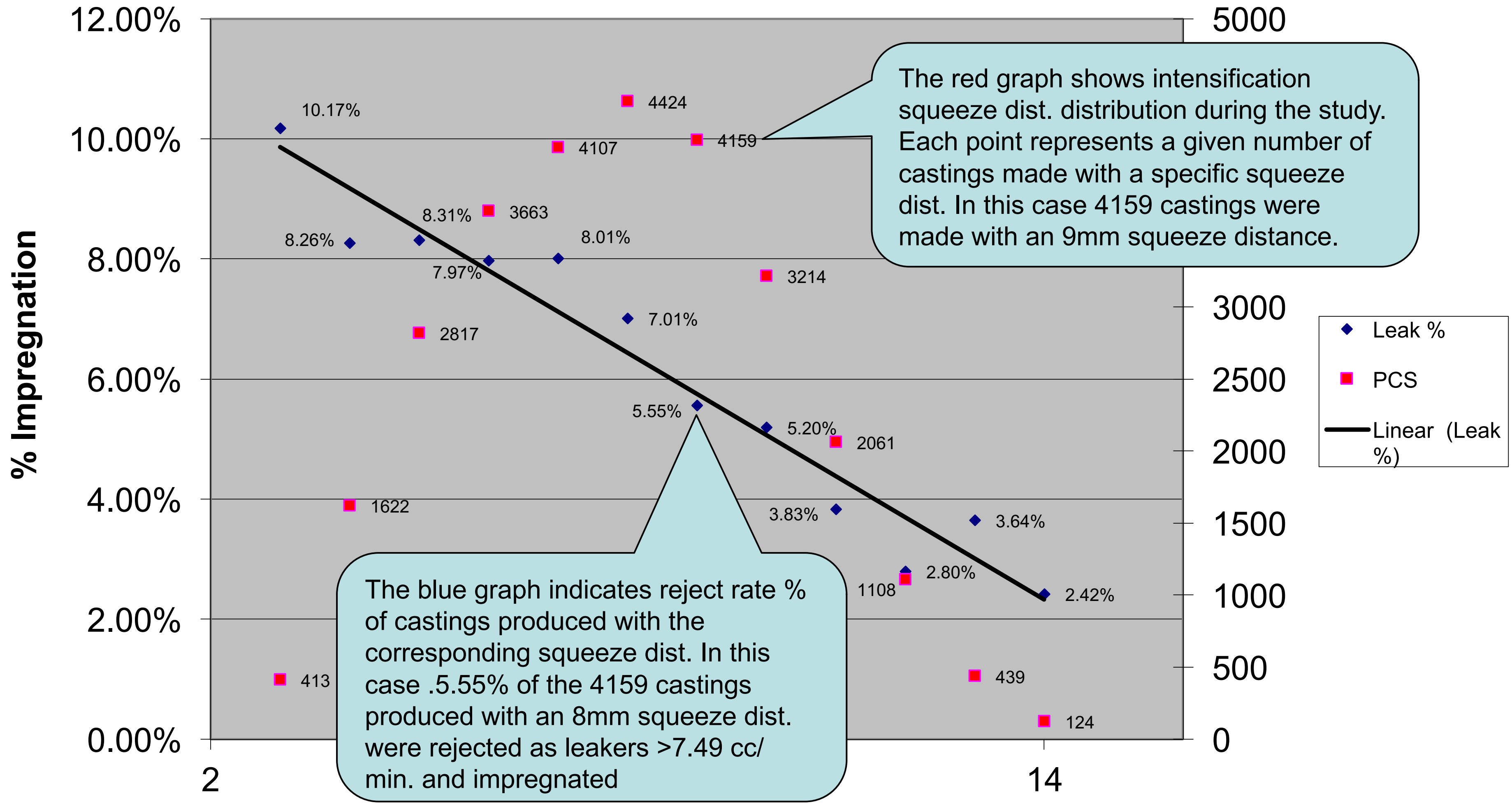
Biscuit Size VS Scrap level Leak % for product cast in 800-1 DCM (9134 Data Points) .016% Overall after C/M activity



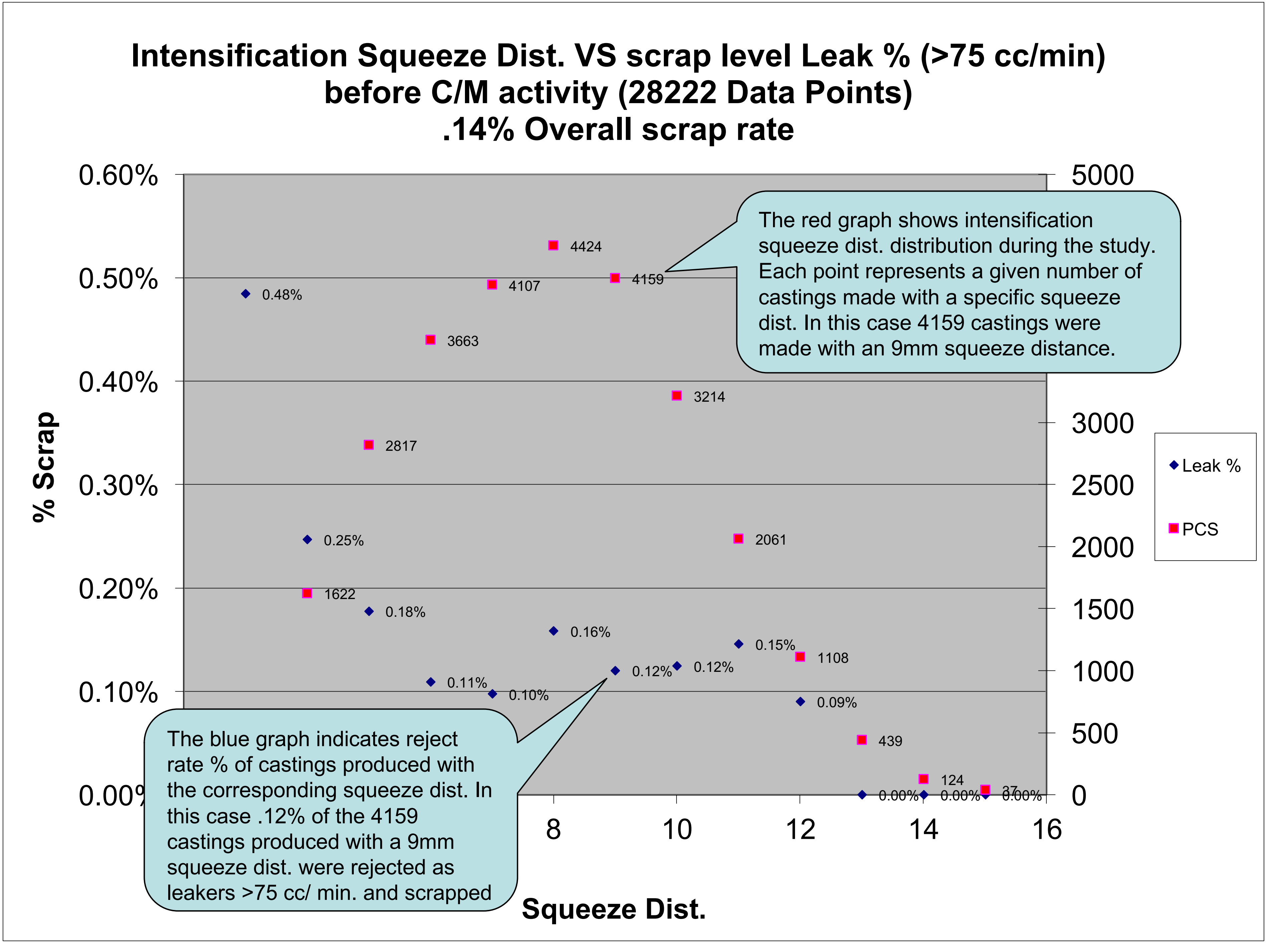


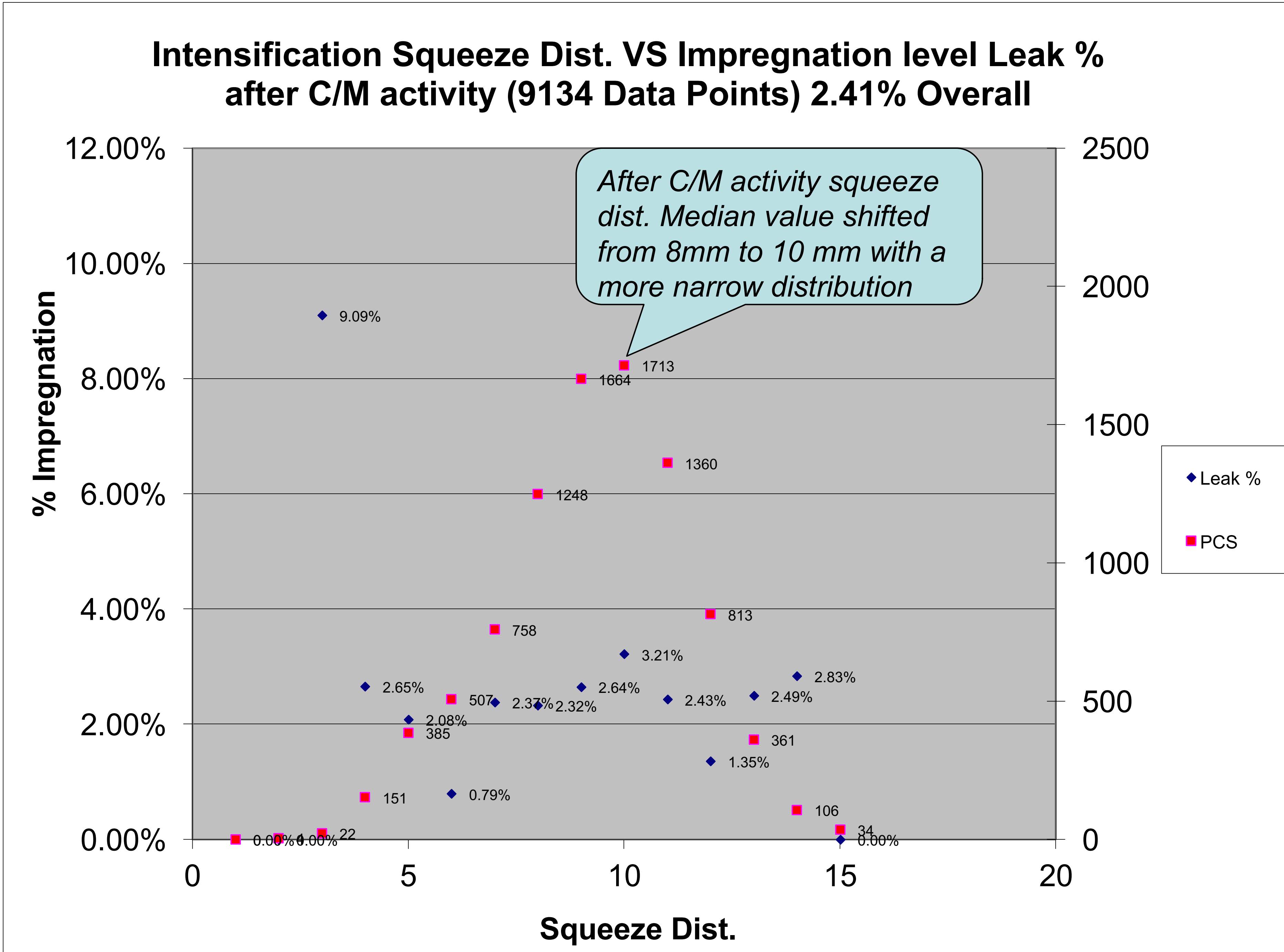
Intensification Squeeze Distance VS. Leak Rate (cc/min.)
800-1 All Dies
~28000 Data Points
Leak Rate (CC/Min.)
0
4
5
6
7
8
9
10
2
4
6
8
10
12
14
16
Intensification Pressure
This data shows us that as our intensification squeeze distance increases our leak rate in cc/min. tends to decrease. A detailed study of this data follows.
Leak Rate VS. Intensification Squeeze Distance
Linear (Leak Rate VS. Intensification Squeeze Distance)

Intensification Squeeze Dist. VS Impregnation level Leak % (>7.49 cc/min) before C/M activity (28222 Data Points) 6.64% Overall impregnation rate

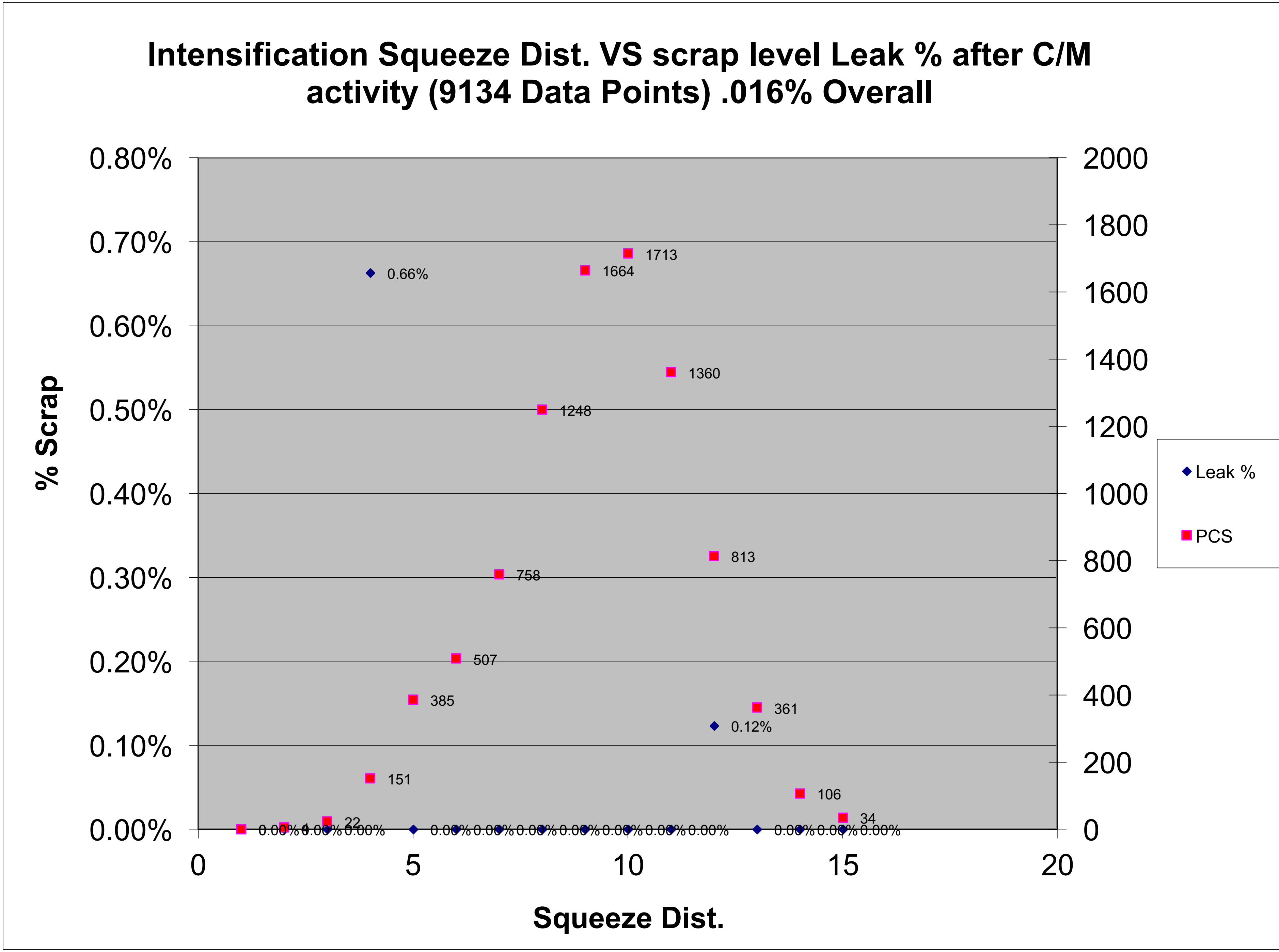


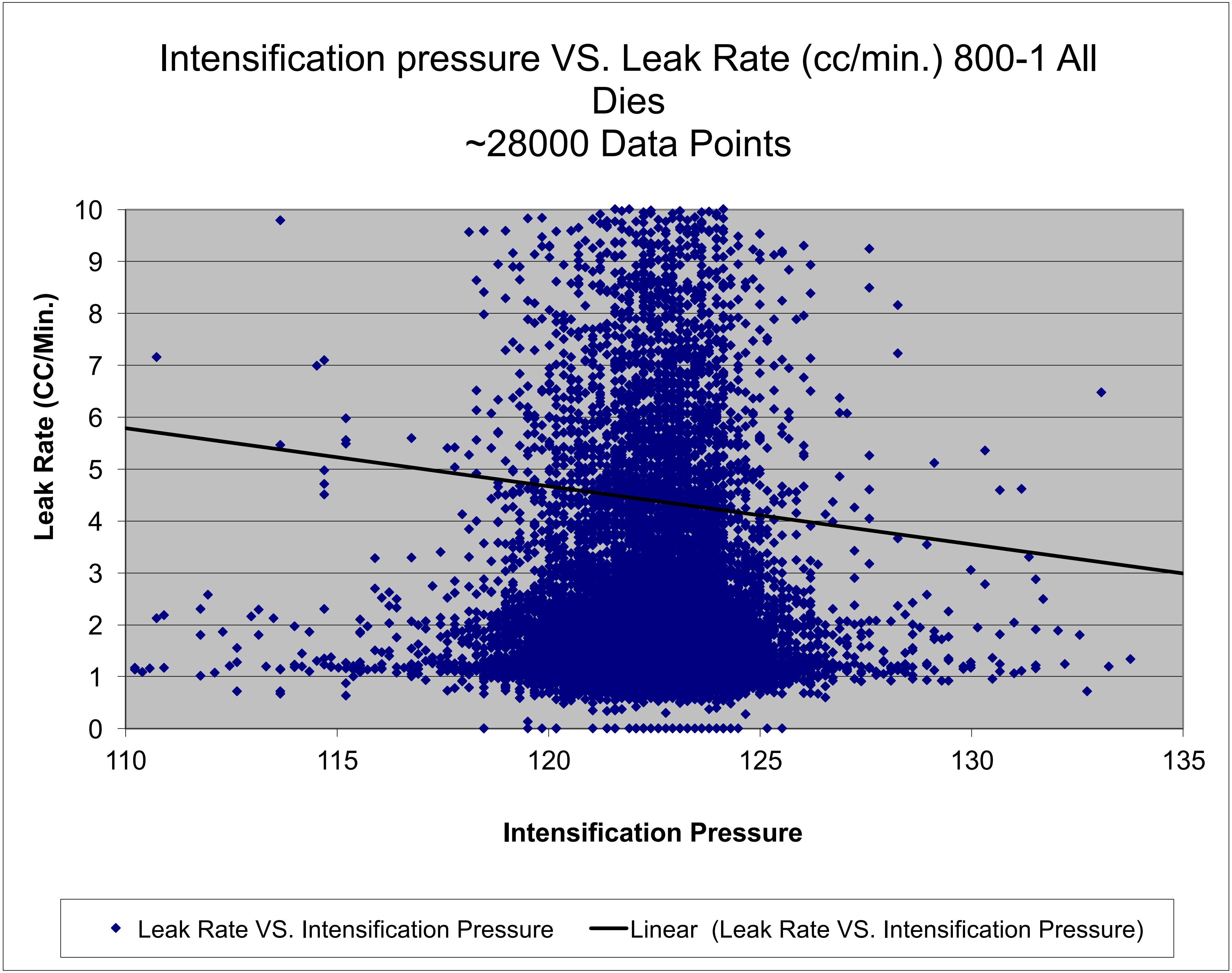
Intensification squeeze distance (X-Axis) Is the distance the shot piston moves during the high pressure phase of the casting injection cycle (post impact). This data shows the larger our squeeze dist. reading the lower our leak rate tends to be. Squeeze


Intensification Squeeze Dist. VS scrap level Leak % (>75 cc/min)
before C/M activity (28222 Data Points)
.14% Overall scrap rate
% Scrap
Squeeze Dist.
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
5000
3000
2500
2000
1500
1000
500
0
8
10
12
14
16
0.48%
0.25%
0.18%
0.11%
0.10%
0.16%
0.12%
0.12%
0.15%
0.09%
0.00%
0.00%
0.00%
4424
4107
4159
3663
3214
2817
2061
1622
1108
439
124
37
Leak %
PCS
The red graph shows intensification squeeze dist. distribution during the study. Each point represents a given number of castings made with a specific squeeze dist. In this case 4159 castings were made with an 9mm squeeze distance.
The blue graph indicates reject rate % of castings produced with the corresponding squeeze dist. In this case .12% of the 4159 castings produced with a 9mm squeeze dist. were rejected as leakers >75 cc/ min. and scrapped

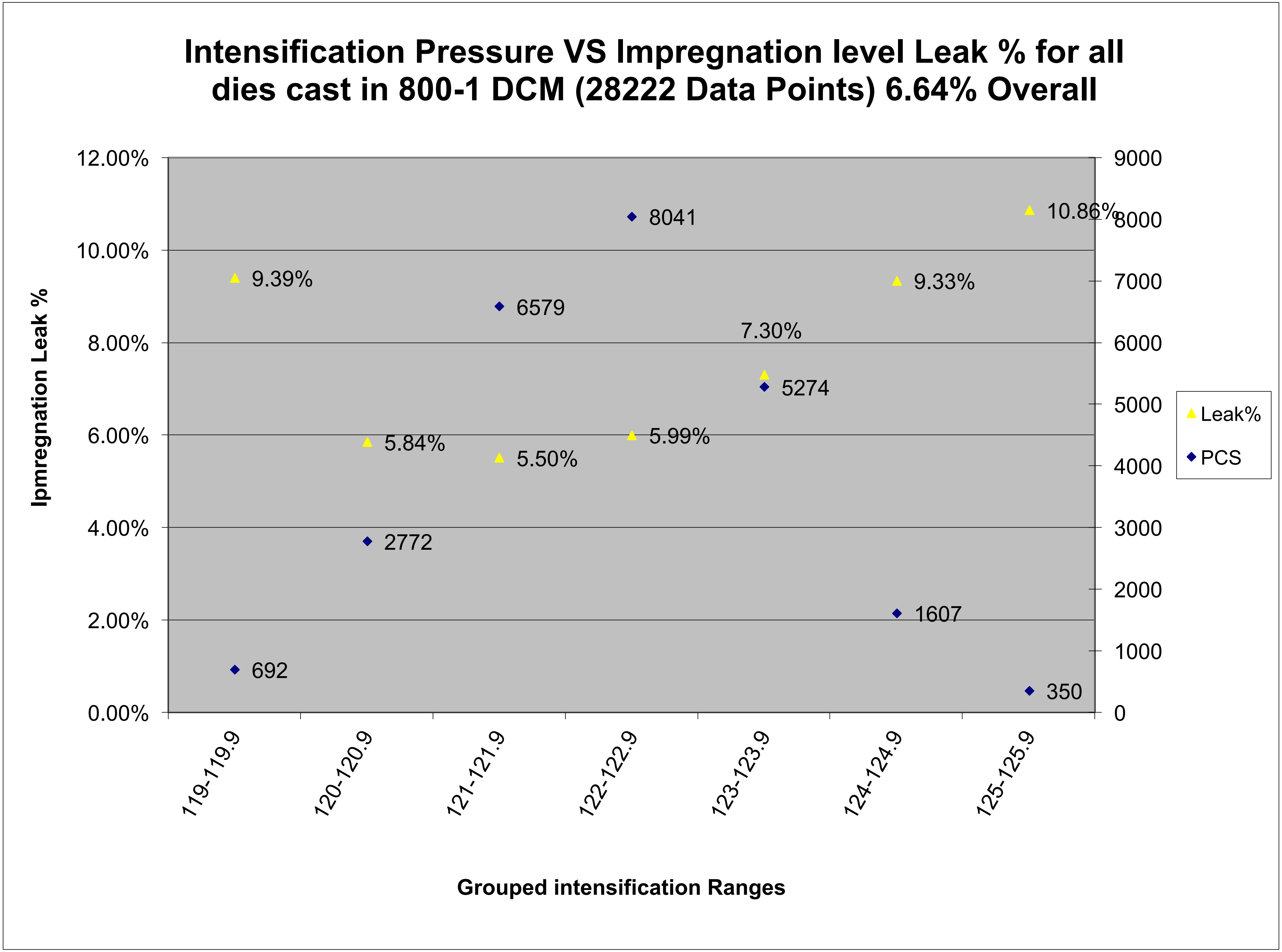


Intensification Squeeze Dist. VS Impregnation level Leak % after C/M activity (9134 Data Points) 2.41% Overall
After C/M activity squeeze dist. Median value shifted from 8mm to 10 mm with a more narrow distribution
% Impregnation
Squeeze Dist.
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
2500
2000
1500
1000
500
0
0
5
10
15
20
9.09%
1713
1664
1360
1248
813
758
3.21%
2.65%
2.64%
2.83%
507
2.37%
2.32%
2.43%
2.49%
2.08%
385
361
1.35%
151
0.79%
106
0.00%
22
34
Leak %
PCS

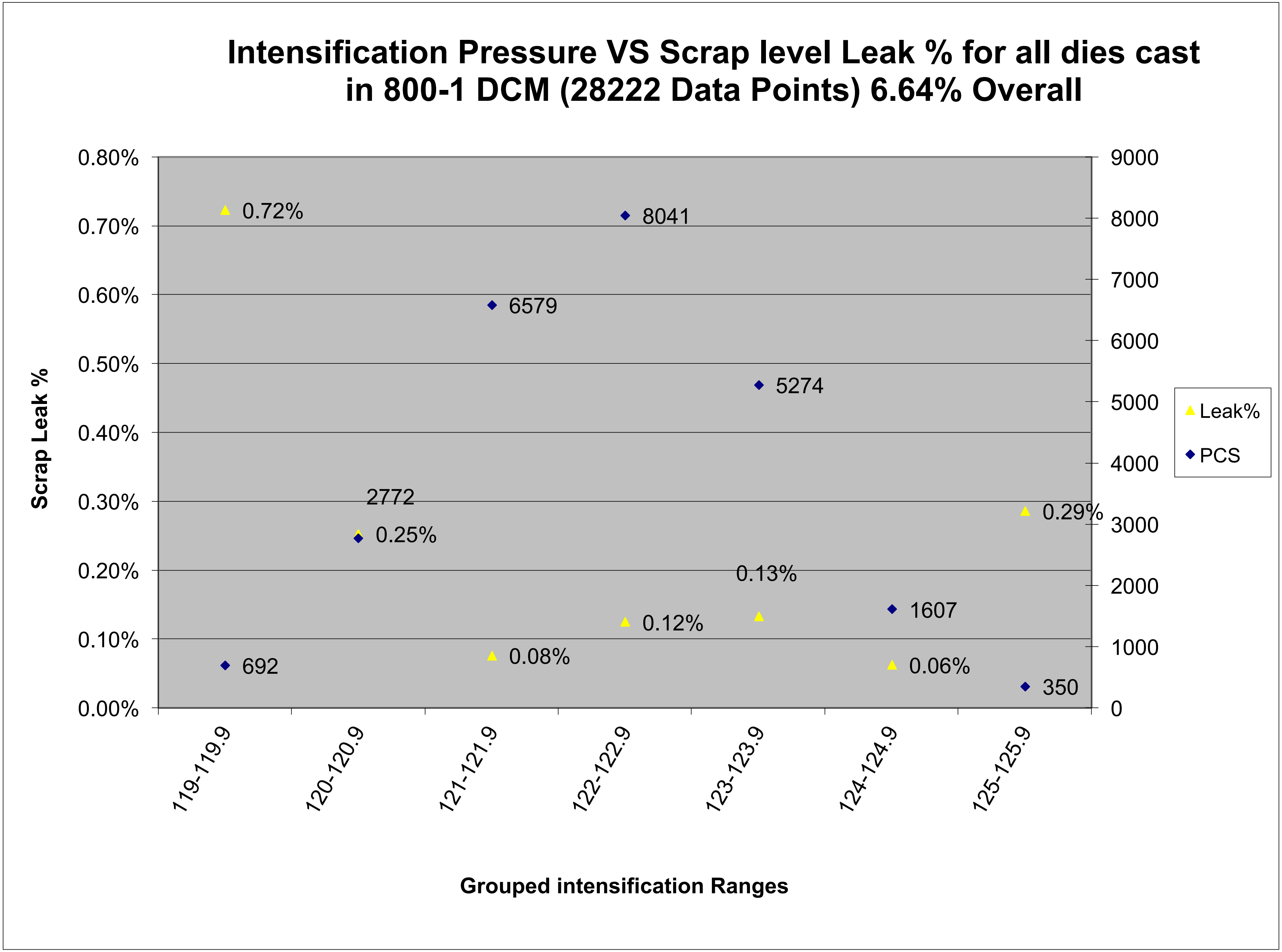

Intensification Squeeze Dist. VS scrap level Leak % after C/M activity (9134 Data Points) .016% Overall
% Scrap
0.80%
0.70%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
Squeeze Dist.
Leak %
PCS
0.66%
0.12%
1713
1664
1360
1248
813
758
507
385
361
151
106
34
22
0.00%

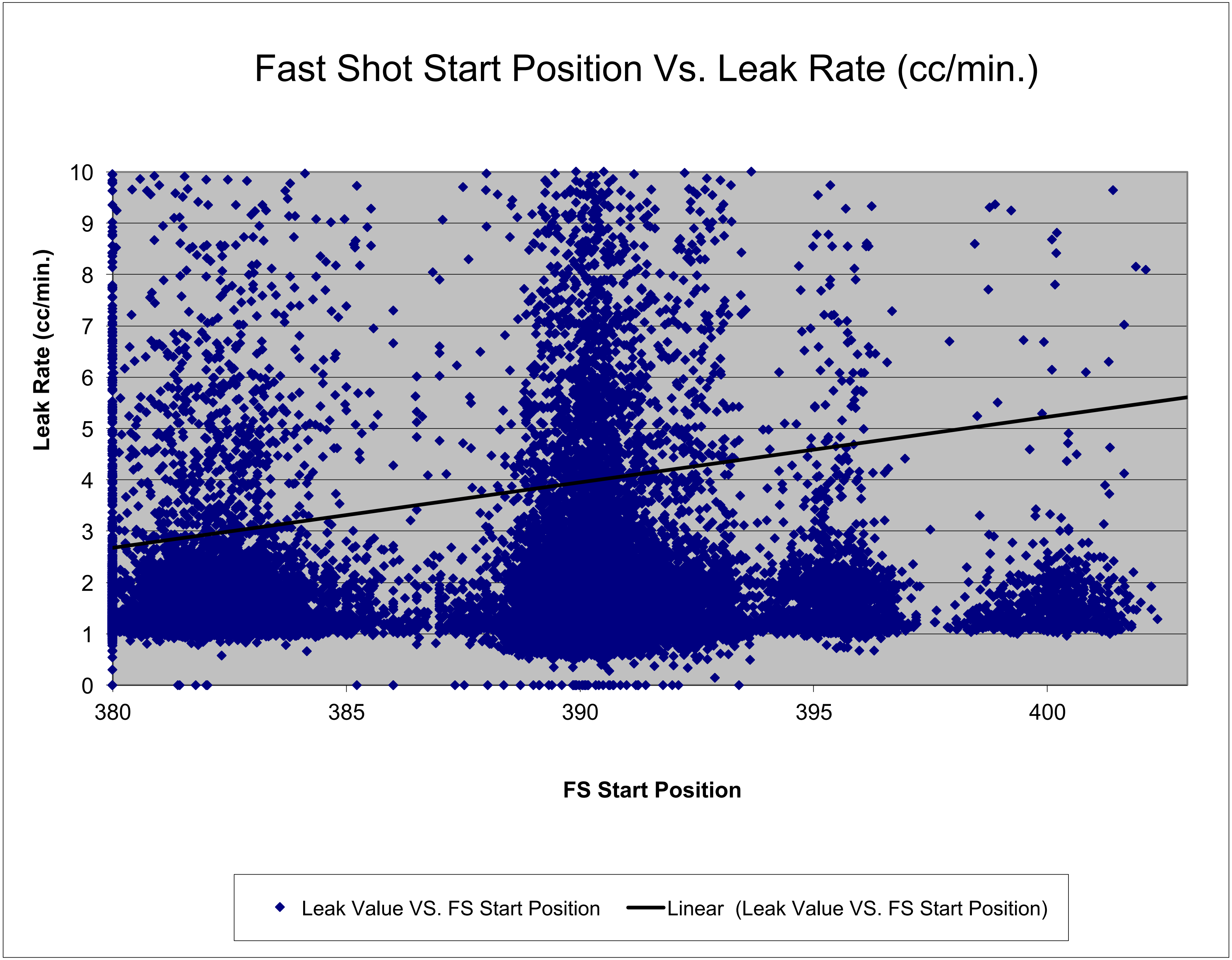


Intensification pressure VS. Leak Rate (cc/min.) 800-1 All Dies
~28000 Data Points
Leak Rate (CC/Min.)
0
1
2
3
4
5
6
7
8
9
10
110
115
120
125
130
135
Intensification Pressure
Leak Rate VS. Intensification Pressure
Linear (Leak Rate VS. Intensification Pressure)



Intensification Pressure VS Impregnation level Leak % for all dies cast in 800-1 DCM (28222 Data Points) 6.64% Overall
Ipmregnation Leak %
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
9.39%
5.84%
5.50%
5.99%
7.30%
9.33%
10.86%
692
2772
6579
8041
5274
1607
350
119-119.9
120-120.9
121-121.9
122-122.9
123-123.9
124-124.9
125-125.9
Grouped intensification Ranges
Leak%
PCS


Intensification Pressure VS Scrap level Leak % for all dies cast in 800-1 DCM (28222 Data Points) 6.64% Overall
Scrap Leak %
0.80%
0.70%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0.72%
692
2772
0.25%
6579
0.08%
8041
0.12%
5274
0.13%
1607
0.06%
0.29%
350
119-119.9
120-120.9
121-121.9
122-122.9
123-123.9
124-124.9
125-125.9
Grouped intensification Ranges
Leak%
PCS


Fast Shot Start Position Vs. Leak Rate (cc/min.)
Leak Rate (cc/min.)
10
9
8
7
6
5
4
3
2
1
0
380
385
390
395
400
FS Start Position
Leak Value VS. FS Start Position
Linear (Leak Value VS. FS Start Position)

RESULTS

Visi-Trak®
SENSE, MONITOR, CONTROL

BEFORE

- Impregnation Rate 6.5%
  - (15-20% spikes)
  - Adds $0.20 to $0.30 per casting
- Scrap Rate 1% - 5%

AFTER

- Impregnation Rate 2.2%
- Scrap Rate .07%

Visi-Trak®
SENSE, MONITOR, CONTROL

Results after counter measures

- $10k annual savings in impregnation costs
- 6,700 less scrapped parts
  - $5 opportunity cost for scrap
  - $33,500 savings

$43,500 payback in hard cost in first year on one part!

Visi-Trak®
SENSE, MONITOR, CONTROL

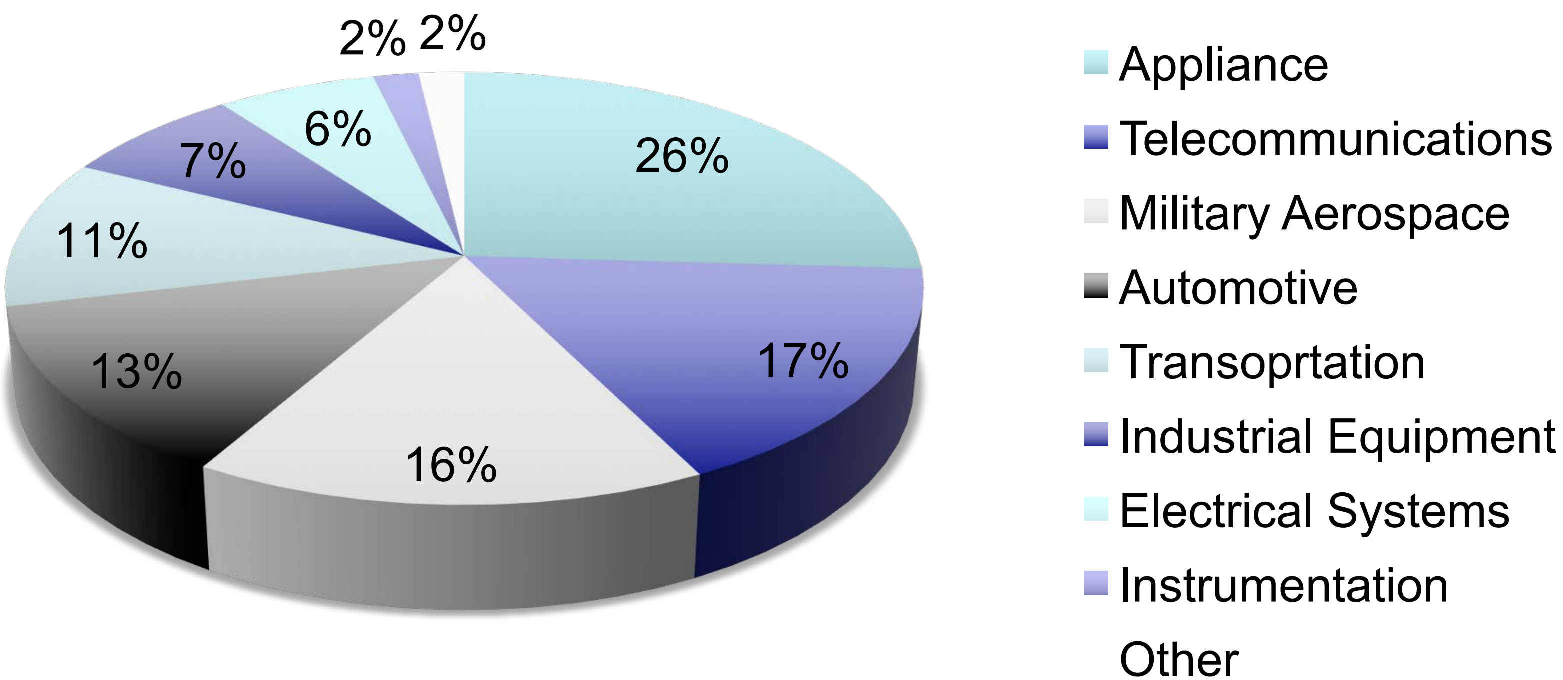
CASE STUDY

PHB, Inc.

PHB, Inc.

- Over 100 years in business
- Privately owned
- 300+ Employees
- Highly diversified customer base

Customer Base



Visi-Trak®
SENSE, MONITOR, CONTROL

Capabilities

- **Engineering and Product Development**
  - Reduce Costs and Development Time
  - Increase Productivity and Quality
- **Manufacturing**
  - Die casting
  - CNC machining
  - Tool & Die Manufacturing
  - Injection molding
- **ISO 9001 + ISO/TS16949**

Still expanding zinc operation

Equipment

- **Over 50 machines**
- **34 Machines**
  - Bühler, Prince, Birch
  - All with electronic monitoring
- Computer Imaging
- Robotics
- CNC
- ProE and CAD/CAM

PHB recognizes that technology investment is drives increased value for their customers

How PHB's business works

- Customers demand both low cost and the highest levels of quality, reliability, and on-time delivery.
- PHB recognizes that technology investment is drives increased value for their customers

"Our quality assurance philosophy is based on **defect prevention, not detection**... plant wide process monitoring across all 34 of our machines is the only way to assure our level of quality."

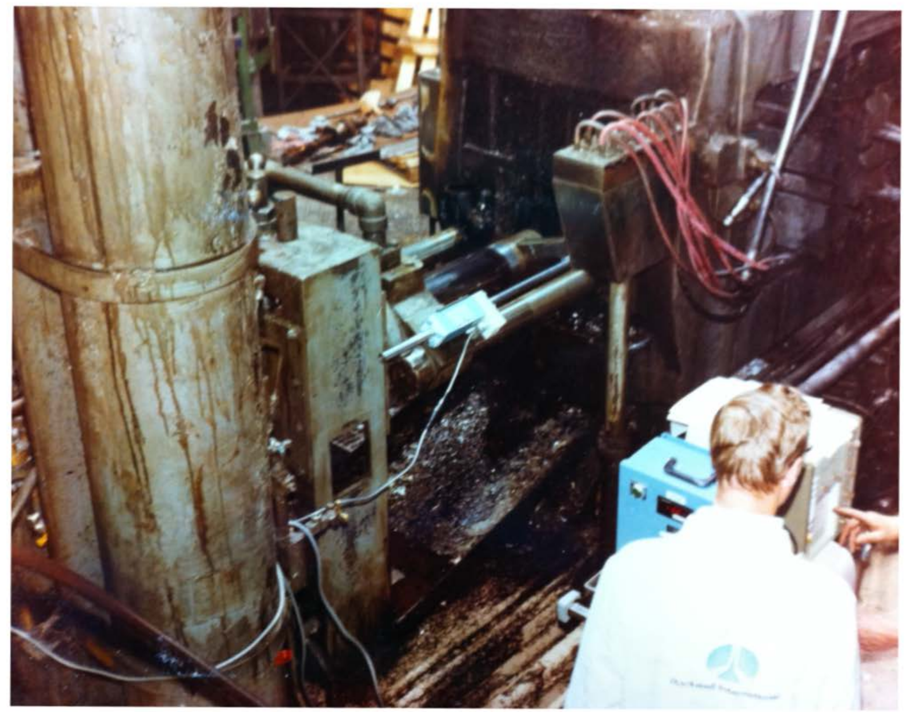
JOE COMSTOCK

Process Control Manager
PHB Die Casting, Fairview, Pa.

Implementing Plant wide Process Monitoring

A short history

- In the 70's started with Gould chart recorder




WAIT A MINUTE! SOMEWHERE HERE I SAW A GOOD SHOT PROFILE. HOW MANY VOLTS PER DIVISION WAS THAT AGAIN?

Implementing Plant wide Process Monitoring

A short history

- Evolved to **portable PC system** in early 80's
- **In 1988 -** Developed own system based on IBM hardware and OS/2 operating system software
- **Early 2000's -** became impossible to support internally + required constant care and support by primary developer
- **Engineers understood the value but needed a well supported, affordable solution**
- **Management reluctant to spend the $$$**

Reluctant Management

- COO thought that monitoring was a “show-and-tell” device with little real payback
- Owner was more supportive but challenged process control manager with the following…
  - “Are you willing to bet your job on it?”
  - He answered, “If we don’t we are all putting our jobs on the line”
- **DECISION** – Invest in excess of $500,000 over two years

Goal

- Replace all obsolete systems as soon as possible and provide state of the art capabilities that set them apart from their competition

MANAGEMENT BOUGHT INTO THE VALUE!

- **Differentiate yourself** in today's competitive environment.
- **Improve quality, efficiency and competitiveness**.
- **Make better decisions, better parts, and better margins**.

Implementing Plant wide Process Monitoring

A Sustainable Solution

- **2003 -** PHB chose an affordable, well - supported system which provided high speed data collection
- They started with **8 Buhler machines** already equipped with OEM supplied monitors
- **Alarms** were placed on each machine.

Implementing Plant wide Process Monitoring

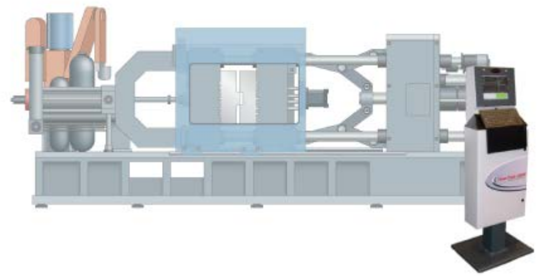
Plant wide Expansion

- 26 machines had no OEM supplied monitors
- These were retrofitted with fully integrated monitoring system with local display of process data

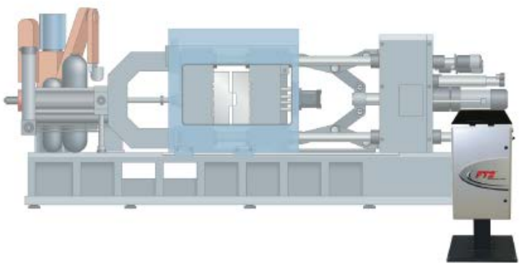
Implementing Plant wide Process Monitoring

Networked Solution

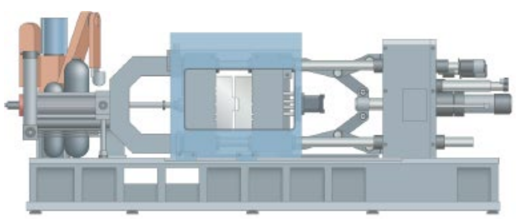
- The systems were connected via an Ethernet network
- Data collection computer on the shop floor
- Workstations computers in the process control office…
- Data Archiver for back-up and recall
- and to other work stations throughout the plant



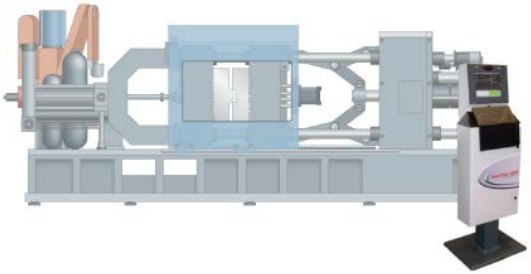
22 Machines
with fully Integrated
True-Trak 20/20



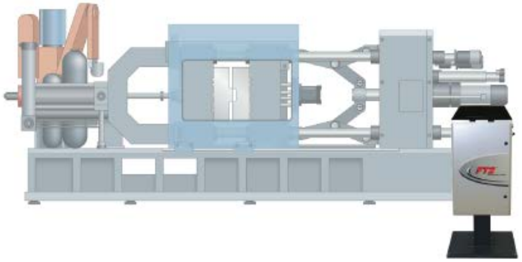
8 Machines
with OEM monitors
fitted with FT2
connected
via to DCT



4 Zinc Machines
with OEM monitors
fitted with data
collection unit linked
to a DCT
(2 more being added)



22 Machines
with fully Integrated
True-Trak 20/20



8 Machines
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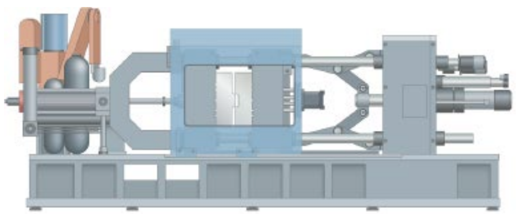

4 Zinc Machines
with OEM monitors
fitted with data
collection unit linked
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(2 more being added)

Quality Control Data Archiver
Collects, stores, protects part data

Quality Control Workstation
Remotely access complete manufacturing history by unique part

Organization

- Senior Process Control Engineer
- 2 Process Control Engineers on each shift

How they use it

- Manufacturing engineering **calculates optimal set-ups** from process simulation software

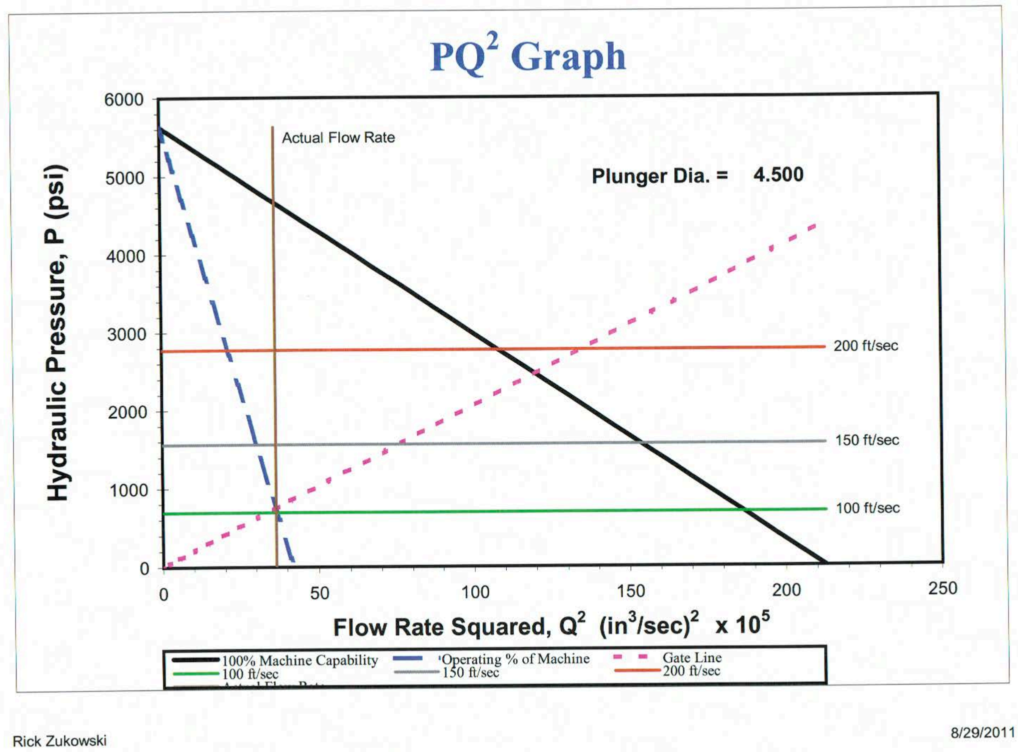
Gate Analysis Template G.A.T.L.

Machine		
Shot Cylinder **Piston** dia.	6.89	in.
Shot Cylinder **Rod** dia.	3.74	in.
Maximum Dry Shot Velocity	290	in./sec.
Maximum Flow Rate	4,612	in.^{3}/sec
Hyd. Pressure @ Max. Dry Shot	2,400	psi
Max Metal Pressure @ Dry Shot	5,626	psi
Discharge Coefficient	.500	
Projected Area of the Shot	350	in.^{2}
Head Side Pressure non-int.	1,690	psi
Rod Side Pressure non-int.	278	psi
Metal Pressure non-int.	3,770	psi
Required Locking Force non-int.	660	tons
Head Side Pressure intensified	4,608	psi
Rod Side Pressure intensified	2,950	psi
Final Metal Pressure intensified	8,765	psi
Required Locking Force intensified	1,534	tons
Shot Sleeve Length	36	in.
% Fill of Sleeve	37	%
Critical Slow Shot Velocity	30	in./sec.
Fill Length: Overflows + Vents	1.55	in.
Fill Length: Metal Through Gate	10.88	in.

Die No.		
Weight of Casting(s) Only	13.80	lbs.
Weight of Metal Through Gate	16.10	lbs.
Weight of Total Shot	19.34	lbs.
Metal Density, Liquid	.093	lbs./in.^{3}
Metal Density, Solid	.099	lbs./in.^{3}
Alloy Name	380	Alum.
Gate Length	20.400	in.
Gate Thickness	.075	in.
Total Gate Area	1.530	in.^{2}
Ratio, $W_{mtg} : A_g$	10.52	
Overflow Area for 1/2 A_g	.77	in.^{2}
Vent Area for 2026 mbar	.073	in.^{2}
Plunger Diameter	4.500	in.
Actual Plunger Velocity	120	in./sec.
Actual Cavity Fill Time	.091	sec.
Actual Gate Velocity	104	ft./sec.
Actual Flow Rate	1,909	in.^{3}/sec
Required Flow Rate	2,050	in.^{3}/sec
% of Machine Capability	44	%
Gate Velocity, Start of Atomized Flow	76	ft./sec.
Efficiency	93	%

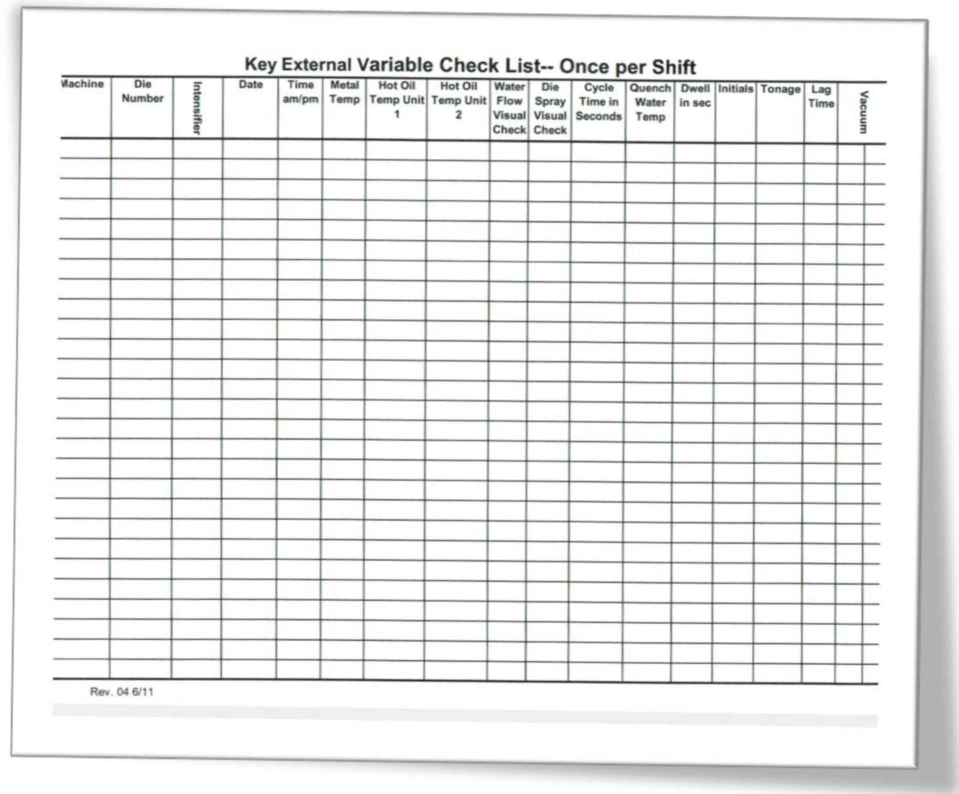
How they use it

- Choice of machine made by capability analysis



How they use it

- Process **technicians execute set-ups** at appropriate machines
- **Determine causes of machine and process problems** to maximize OEE
- Informs maintenance of **issues before they become a problem** by looking at variation in process and machine data
- **Quality control accesses data** on separate workstation for detailed statistical process control analysis



Key External Variable Check List-- Once per Shift

Machine	Die Number	Intensifier	Date	Time am/pm	Metal Temp	Hot Oil Temp Unit 1	Hot Oil Temp Unit 2	Water Flow Visual Check	Die Spray Visual Check	Cycle Time in Seconds	Quench Water Temp	Dwell in sec	Initials	Tonage	Lag Time	Vacuum

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How they use it

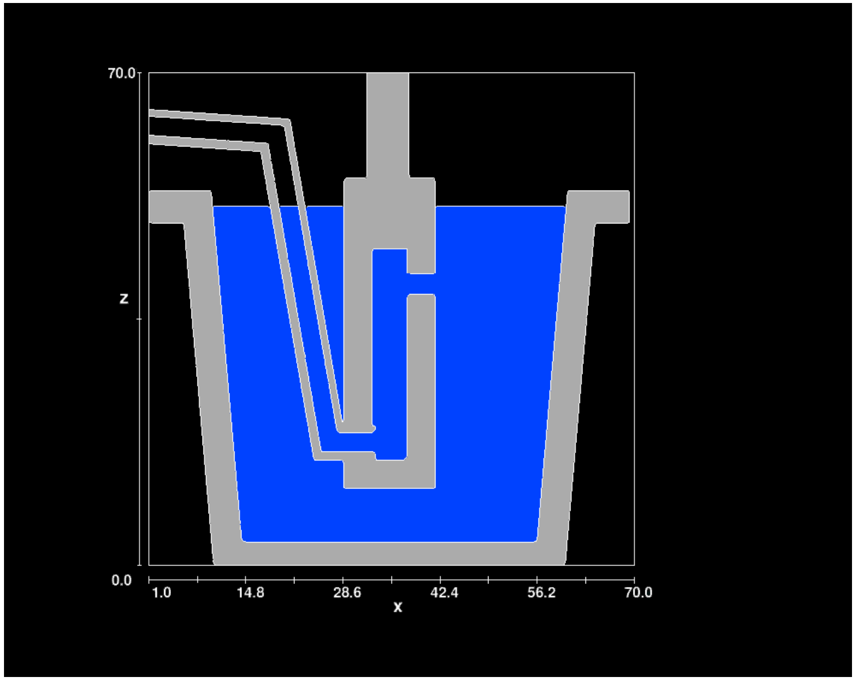
- Determine key parameters effecting quality
- Alarms – robot segregates parts

Success Story #1 – Cold Chamber Application

- **Heavy Section Part** experiencing abnormally **high scrap** due to **excessive porosity**
- **Extended post filling phase sampling** to 20 seconds to see intensification during the entire cycle interval
- They saw that the **intensifier was turned off before the end of the dwell period**
- They discovered that **the operator was opening the safety door before the end of the cycle** which killed the intensifier
- This was the **cause of the excess porosity** in the heaviest sections

Success Story #2 – Hot Chamber Application

- Experienced problems with plunger seizing in the goose-neck on multiple machines.
- Measured plunger position during extension and retraction they determined the exact position of the plunger when the seizing occurred.
- The cause inaccurate honing during re-work – creating a taper in the goose-neck.
- Fired the vendor and fixed the problem.



Payback Evaluation

- Understood the value of a system like this in **diagnosing probable causes of scrap and low quality** production
- Valued **defect prevention** as a way of business
- Critical to remain competitive and meet customer requirements.
- **Key paybacks:**
  - Repeatability
  - Diagnose machine & process problems
  - Reduces start-up time
  - Increased Quality Certifications
  - Maintained Key Customers Base

Compliments of Joe Comstock, Senior Process Engineer, PHB, Inc.

CASE STUDY

THE TORO COMPANY

The Customer

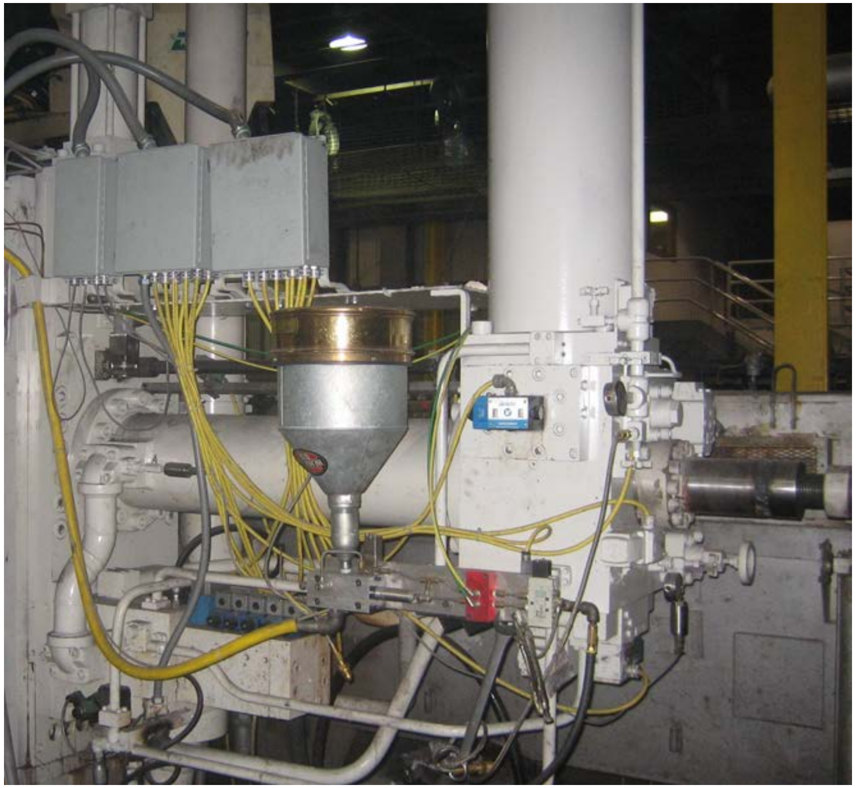
- Large captive supplier of lawn and garden equipment
- Neat & clean facility
- Over 20 years in operation
- Continuous change and improvement with an eye to the future

The Team - Fabrication Group

- Project Engineer
- Tooling Engineer
- Injection Molding Process Engineer
- Production Scheduler
- Shift Supervisors (3)
- Department Head

The Equipment

- Injection Molding Machines (7)
- Die-casting Machines (5)
- Automated cells
- Largest Machine: 1,600-ton Prince



Prince 1600-ton with Binary II shot valve

Visi-Trak
SENSE, MONITOR, CONTROL

The Production Environment

- Available production on machine typically sold out from October-June (summer season production)
- A dozen different lawn mower decks are run
- Post-cast trim, clean, and painting on site.
- **Lean staff + High volumes = Highly Automated**

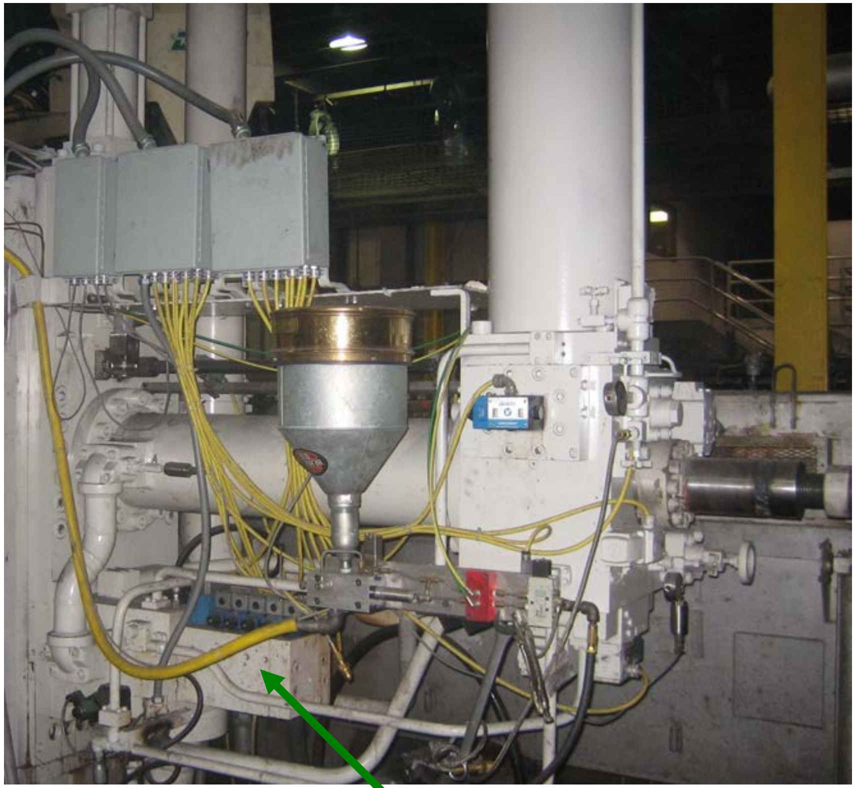
Robust, Repeatability, and Low Scrap Rates

The Challenge

- Mower deck designs increased in size
- New designs require a process that approaches the clamp tonnage
- Decks are center shot so limited area is available for the ingate.
- Long metal travel distance requires consistent shot performance.

The Shotend - Before

- 1600-ton Binary II three-speed shot system.
- Upgraded with ramping capability for the slow and intermediate velocities.
- No low impact system.



Binary II shot valve

Recurring maintenance issues

- **Binary II shot valve developed leakage issue**
  - Occasional cracked segment on the valve – changed the velocity profile and caused scrap.
- **Binary II shot valve segments not collapsing properly**
  - Caused inconsistent shot speeds in fast shot
  - Caused scrap castings from where poor fill resulted from increasing fill times.
  - Operators frequently adjusting the shot control settings trying to maintain filling velocity.
  - **Variation caused scrap rate climb and need to make a change!**

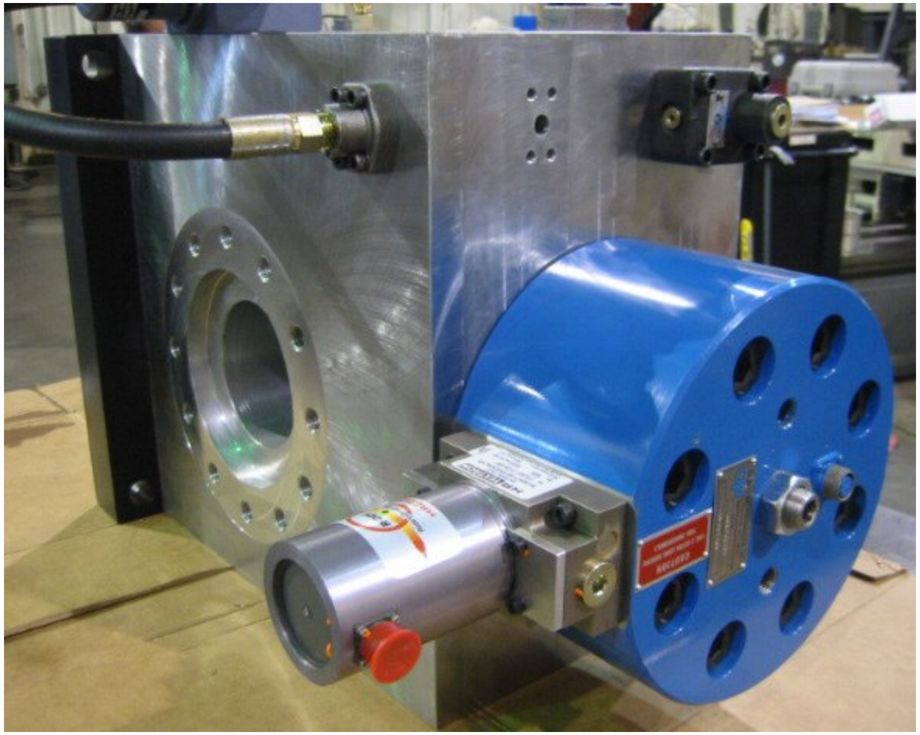
Changing Needs

- More speed required to accommodate castings that were now challenging the original performance specifications
- Various alternative shotend options considered
- Buying a new shotend taken off the table – the current shotend was well designed and mechanically solid.

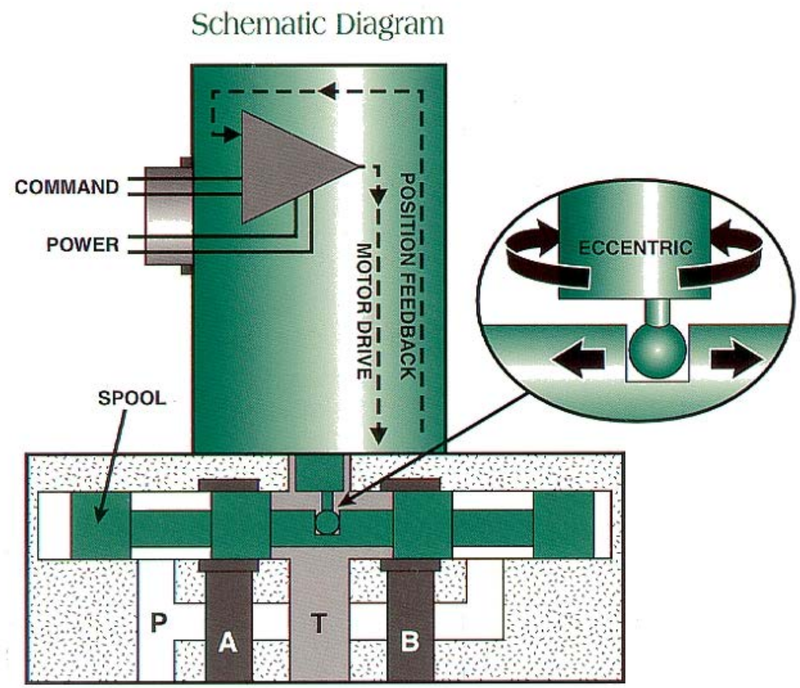
DECISION:
A robust velocity control system
and more speed were required.

Solution

- Remove Binary II shot valve and manifold block
- Direct bolt-in replacement with:
  - Olmsted 80mm two-way, servo-piloted throttling valve slip-in cartridge format
  - Piloted by an H.R. Textron R-DDV servo pilot valve
  - PO check valve releases oil to retract the shot cylinder
  - Cartridge valve develops pressure to retract the shot cylinder
  - Cartridge filter ensures a clean oil supply



HR Textron R-DDV Direct Drive



R-DDV® Servovalve

Has been successfully proven over many years in the rugged die casting environment

Installation

Start: Tuesday Morning Delivery

Finish: Thursday Afternoon

- Manifold bolted-in
- Original connections replaced with new fittings
- 3” high pressure pipe moved 3” to accommodate new block
- Rotary rack and pinion encoder replaced by a Visi-Trak Sensor in 1” tail rod.

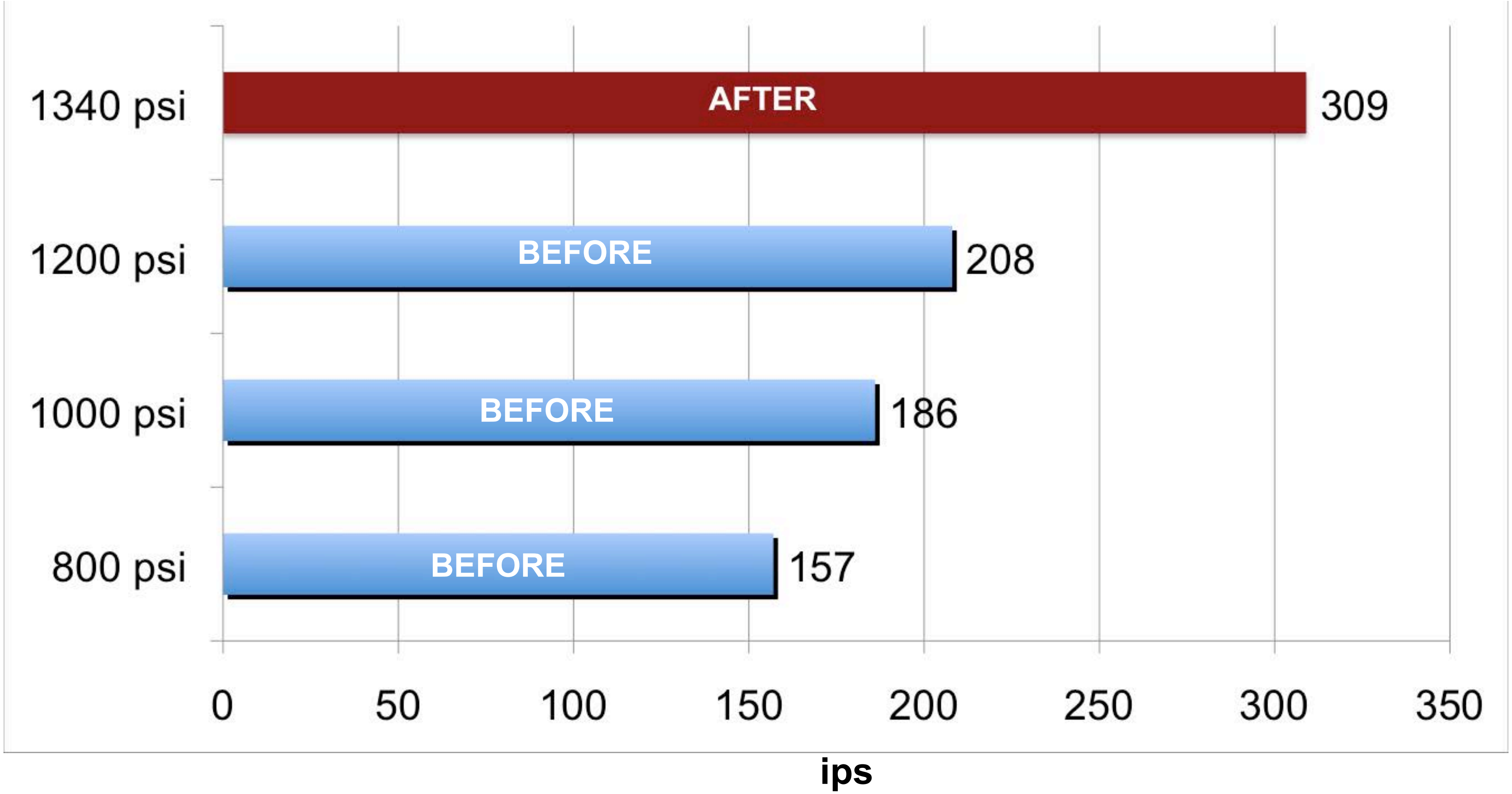
Total install < 3 days

"The new valve **increased our top speed by over 100" per second** and has made it possible to continue creating cost-effective castings even after we outgrew the original capability of the machine."

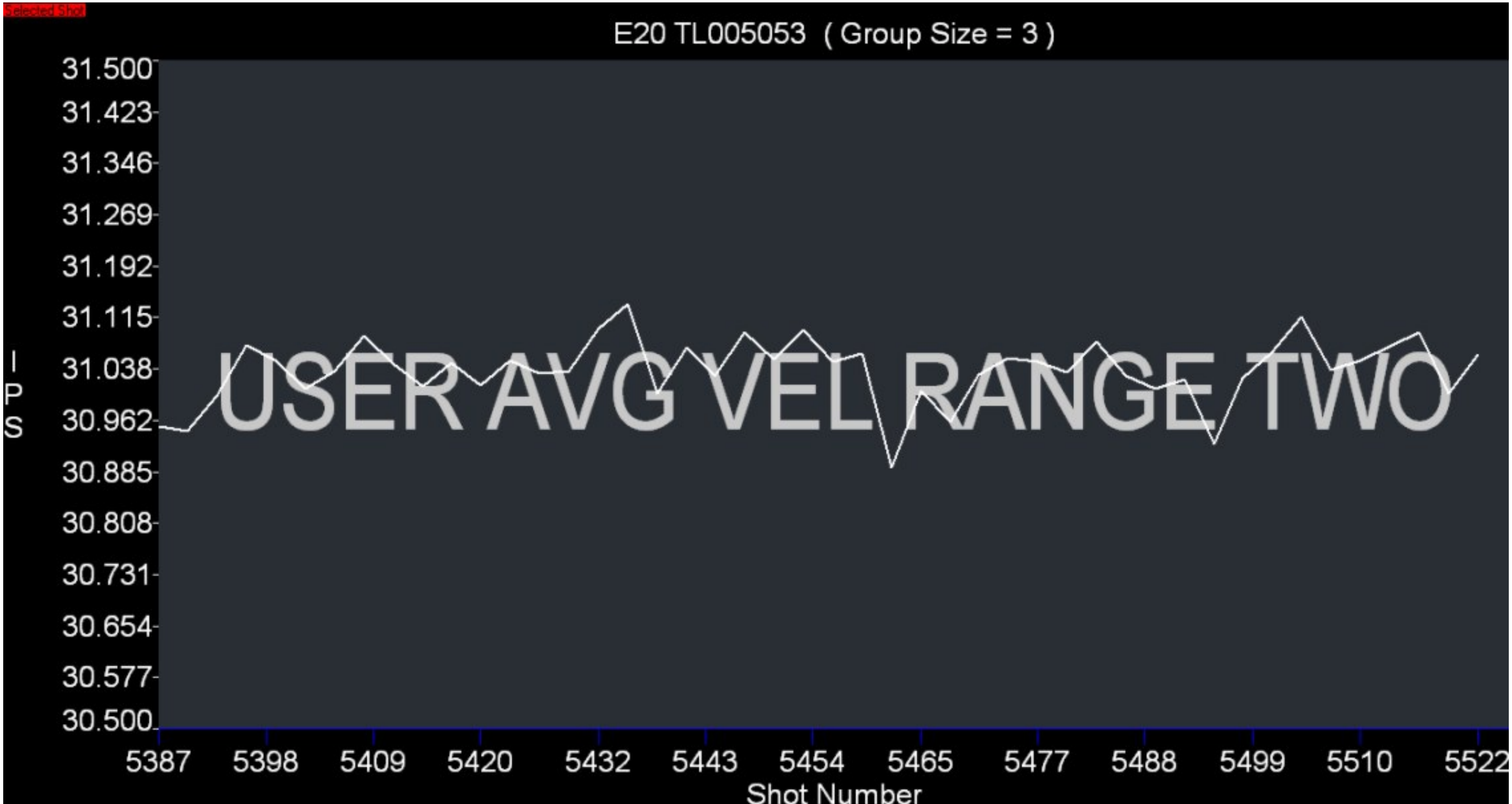
DAVE BROCKMAN

Senior Fabrication Project Engineer
The Toro Company, Windom, MN

Performance Results

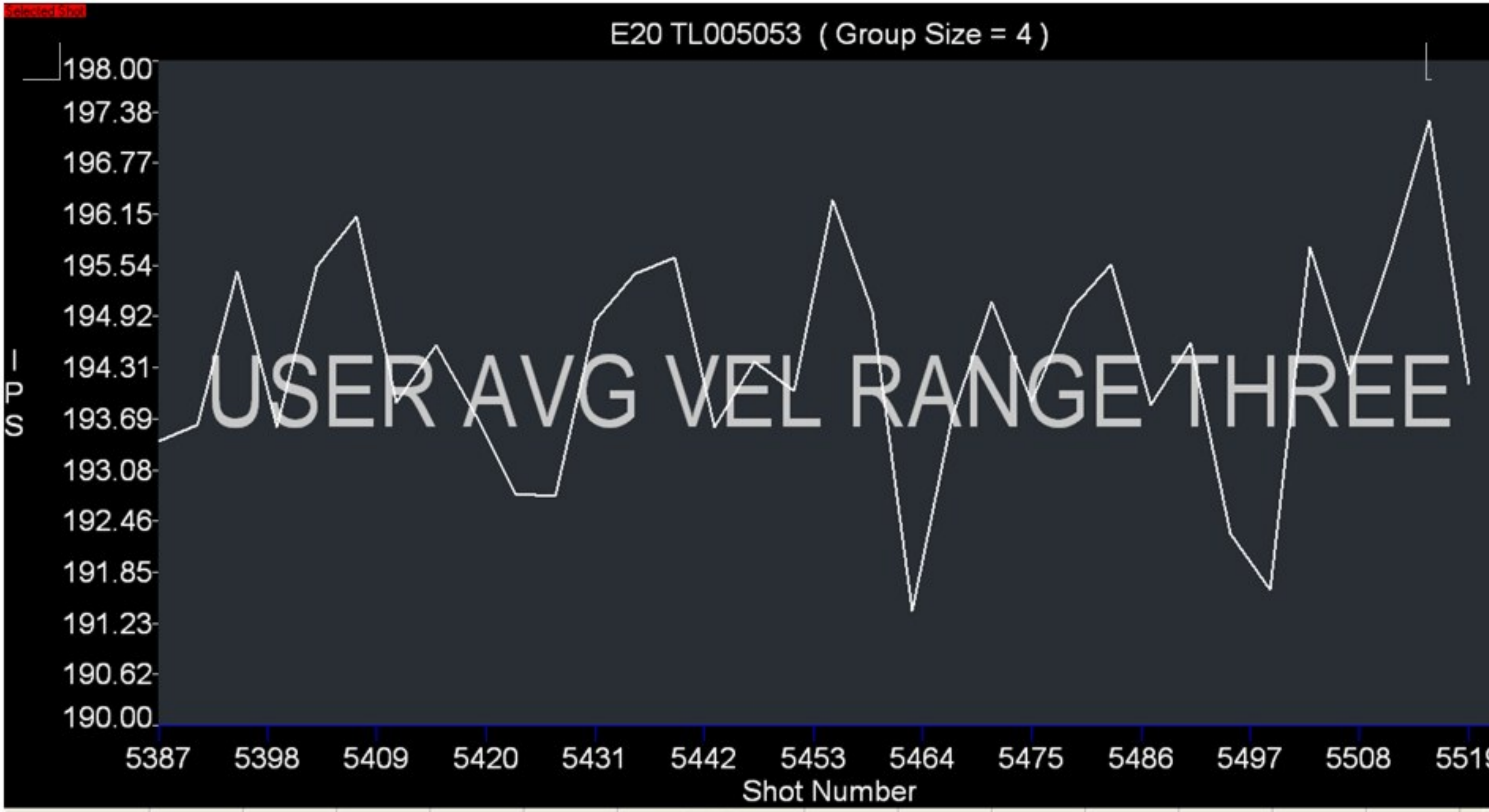


Shot Profile – New Throttling Manifold



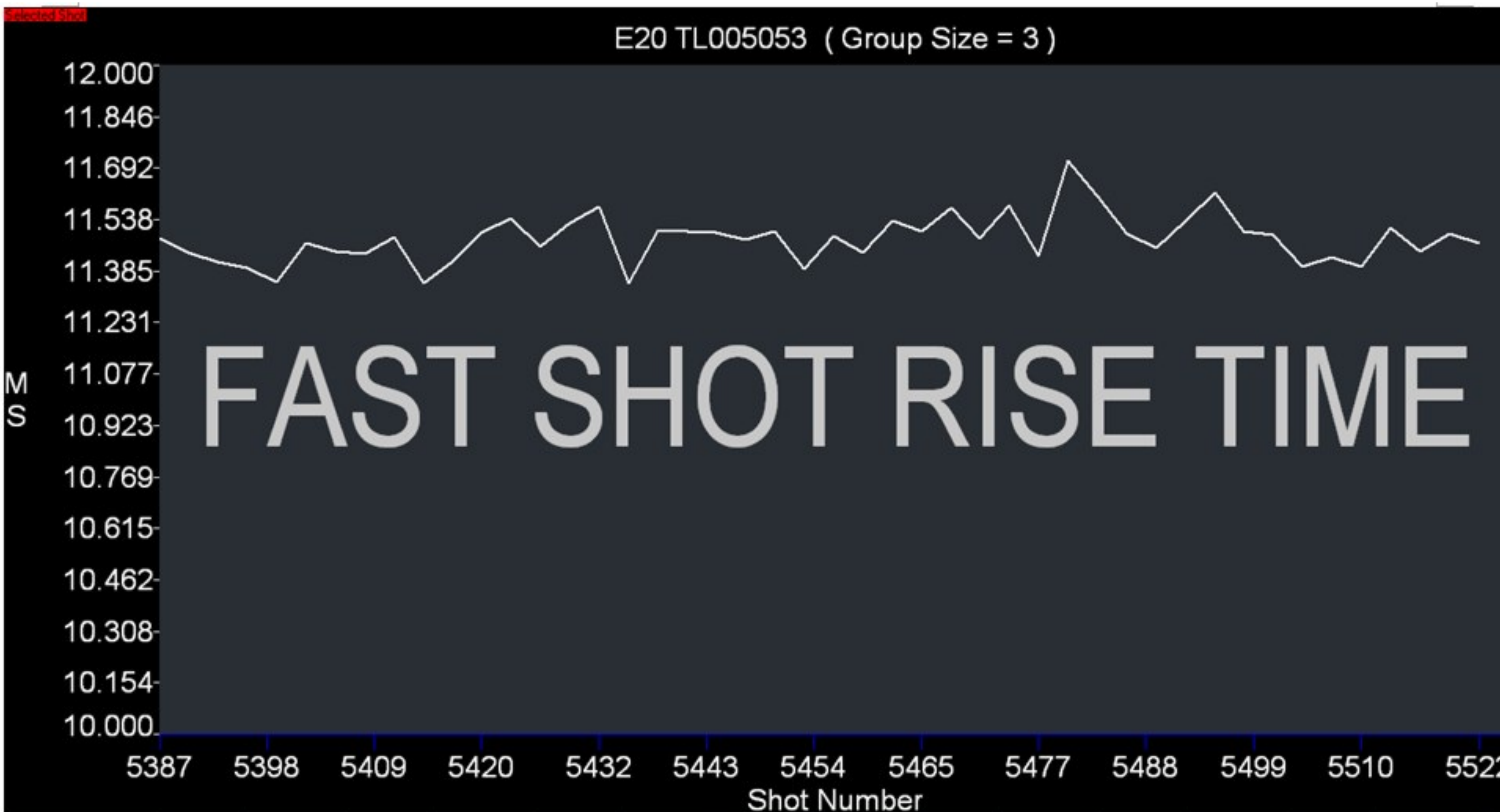
N = 138 Group Size = 3						Alarm Limits								
	Max	Min	Average	Range	Std.Dev	Low	High	LCL	UCL	Zlcl	Zucl	Zmin	Cpk	%Out
User Avg Vel Range Two	31.17	30.68	31.04	0.49	0.01	30.00	31.20	30.00	31.20	172.27	27.15	27.15	9.05	0.00

X-Bar Chart – Avg. velocity from 10-15” stroke



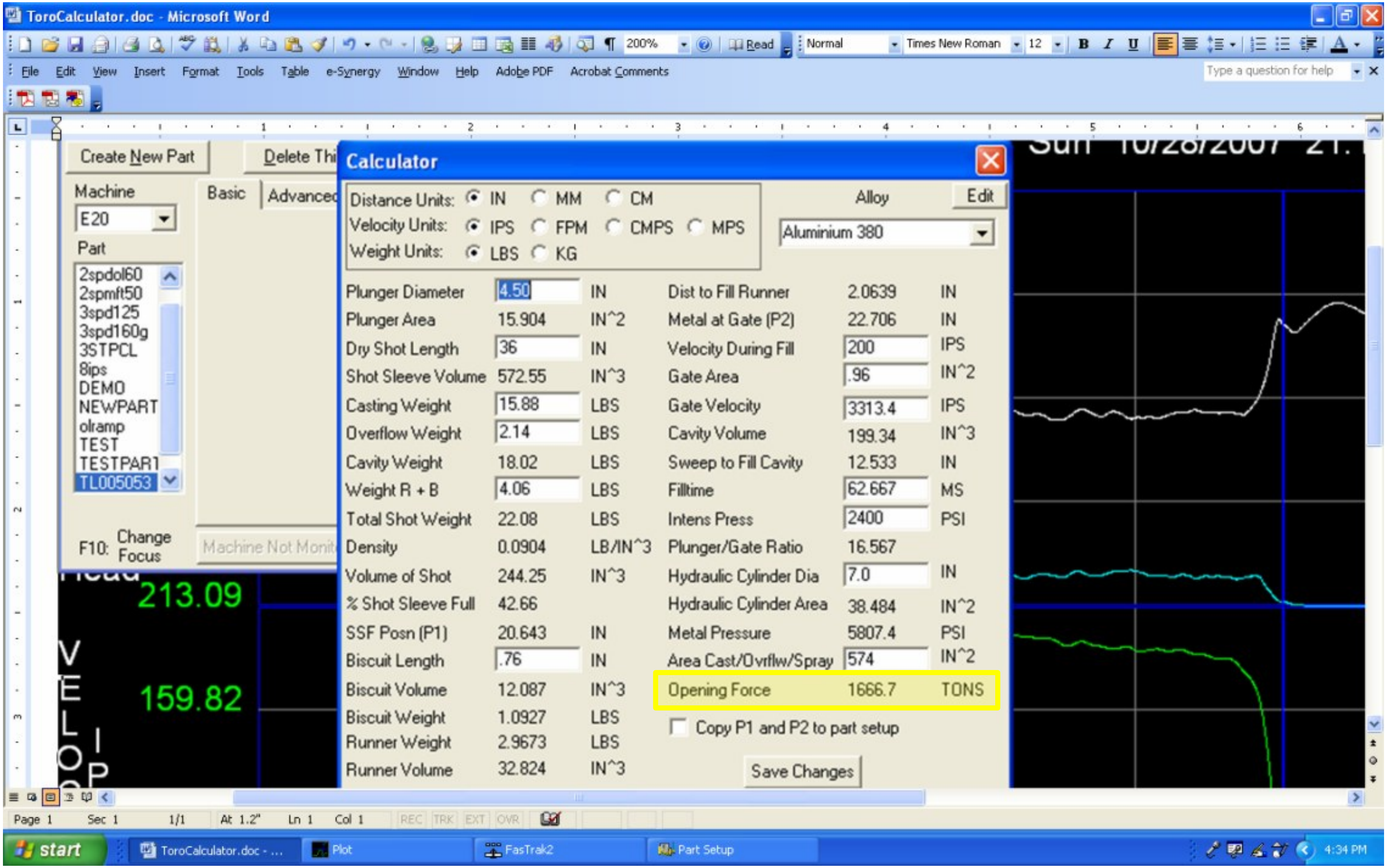
N = 136 Group Size = 4						Alarm Limits								
	Max	Min	Average	Range	Std.Dev	Low	High	LCL	UCL	Zlcl	Zucl	Zmin	Cpk	%Out
User Avg Vel Range Three	199.1	185.6	194.4	13.5	2.6	190.0	198.0	190.0	198.0	1.69	1.40	1.40	0.47	12.50

X-Bar Chart – Repeatability from 25-30” of stroke



N = 138 Group Size = 3						Alarm Limits								
	Max	Min	Average	Range	Std.Dev	Low	High	LCL	UCL	Zlcl	Zucl	Zmin	Cpk	%Out
Fast Shot Rise Time	11.94	11.07	11.48	0.87	0.12	10.00	12.00	10.00	12.00	12.25	4.30	4.30	1.43	0.00

X-Bar - Fast Shot Rise Time



Calculator – 1667 tons of clamp pressure required

Visi-Trak®
SENSE, MONITOR, CONTROL

Internal Audit Results

- **Challenging castings now easily accomplished**
- **Outstanding velocity control** capability throughout the shot
- **Overall equipment efficiency (OEE) increased by 15.5%**
- **Scrap rate reduced by 28.5%**
- **Significant flash reduction** using low impact capability
- **Total integration cost:** ~40% of new a shotend.

"The retrofit control and valve package, has given us a shot system with **outstanding control & performance**. This economical solution extended the service life of the machine and helps us continue to make cost-effective castings after they have outgrown the clamp tonnage capacity of the machine. **Its a lot of bang for the buck.**"

DAVE BROCKMAN

Senior Fabrication Project Engineer
The Toro Company, Windom, MN

QUESTIONS AND ANSWERS

Thank you!