

Speed without Haste

EtherCAT for Injection Molding Systems

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www.siemens.com/ies2006

7 3rd International
Industrial
Ethernet
Symposium

October 3-4, 2006, Chicago, IL



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Technologies

Why EtherCAT

Performances

- Sales of US\$860 million (fiscal 2005)
- 3000 employees
- Manufacturing campuses in North America, Europe and Asia
- Global, company-owned distribution network
- Technology leader

**Sales of US\$935 million
(fiscal 2006)**



Injection Molding Equipment Suppliers - 2004

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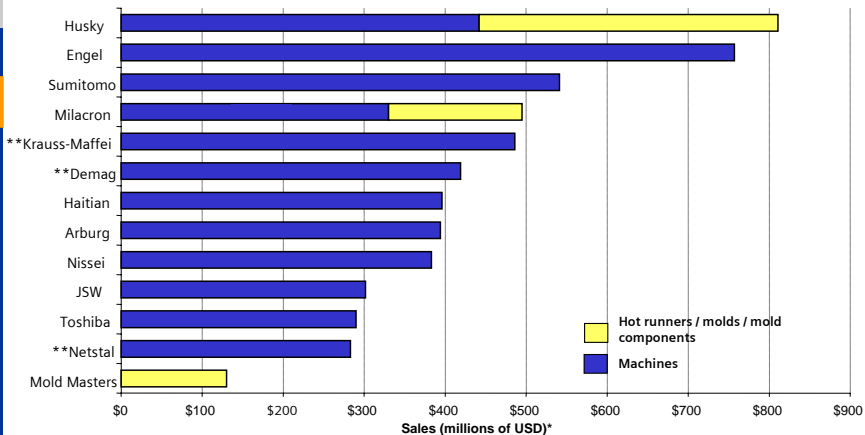
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Why EtherCAT

Performances



*Injection molding equipment sales – estimates for year ending December 31, 2004

** Part of MPM

Includes machines, molds, hot runners, parts and service, robots and value-added services

Source: Annual reports, Press reports, Husky estimates

Local Relationships - Worldwide

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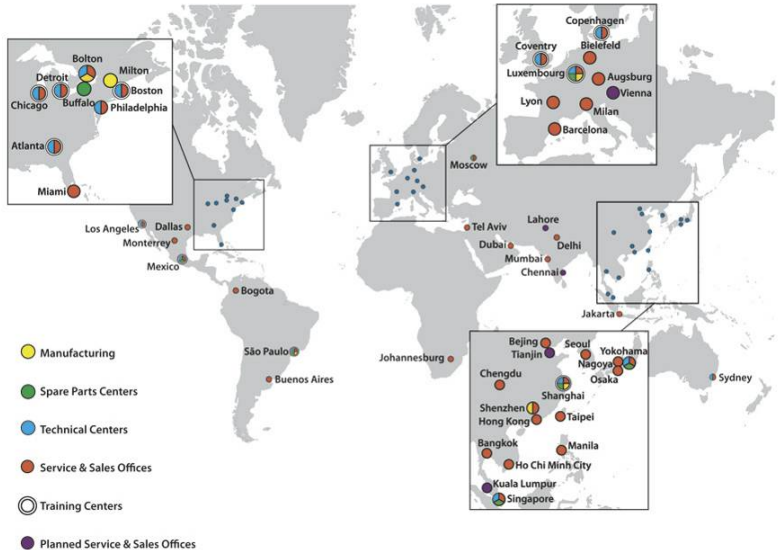
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Hot Runners

Hylectric 90-1000t



Quadloc 1350-5400t

Polaris Control



Purpose and Core Values

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Core values have been the foundation of growth and success

- Make a contribution
- Proactive environmental responsibility
- Passion for excellence
- Bold goals
- Uncompromising honesty



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Speed and Haste are not Synonymous

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Hasty actions do not produce speedy successes

because

hasty actions are not coordinated efforts.

- Adapted from General George S. Patton Jr.

Haste makes Wastes

Principle of Operation – The Four E's

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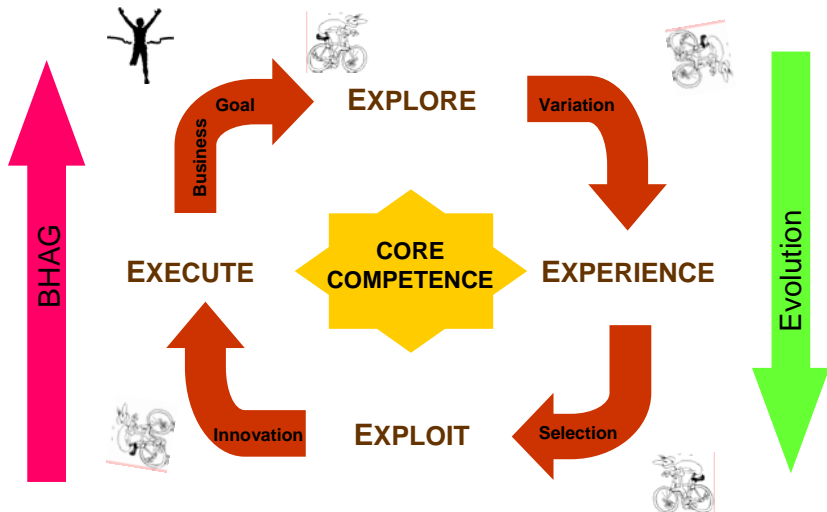
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"Try a lot of stuff & keep what works."

- J. Collins

Breaking the part cost barrier

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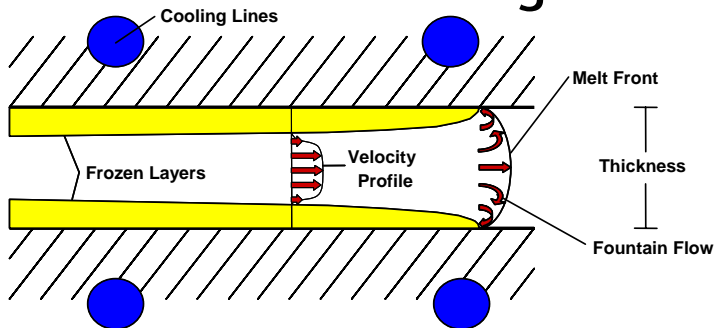


Thinner Wall Thickness

↓
Less Material

↓
Lower Cost

What are the challenges?



HyPAC - Purpose built for packaging

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Benefits to Customer

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Material Savings Example (750 gram/ 24 oz)

Part weight today (grams)	22
Part weight target (grams)	20
Cavitation	8
Annual parts	54,568,421
Annual PP savings (kg)	125,507
Annual savings (\$US)	\$182,651

Reduces Part Weight

Hydro-Mechanical clamp, Reflex and SMC

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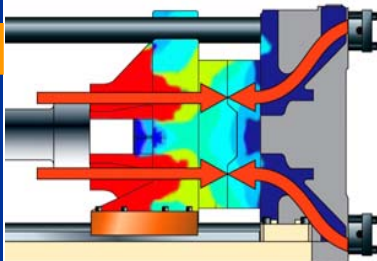
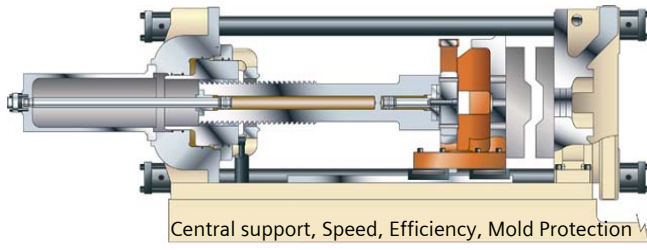
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Force distribution



Alignment and quick change

Hydro-Mechanical Clamp

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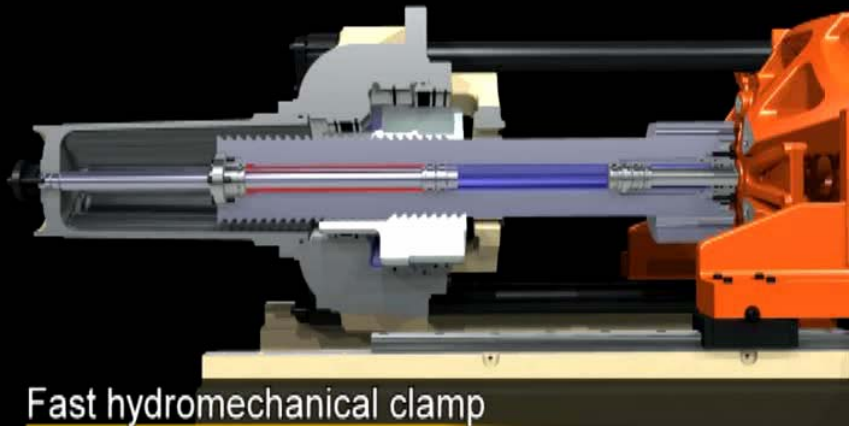
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Engineered for Performance

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With 30% more injection rate and plasticizing capability,
HyPAC spans the performance of 2 conventional units.

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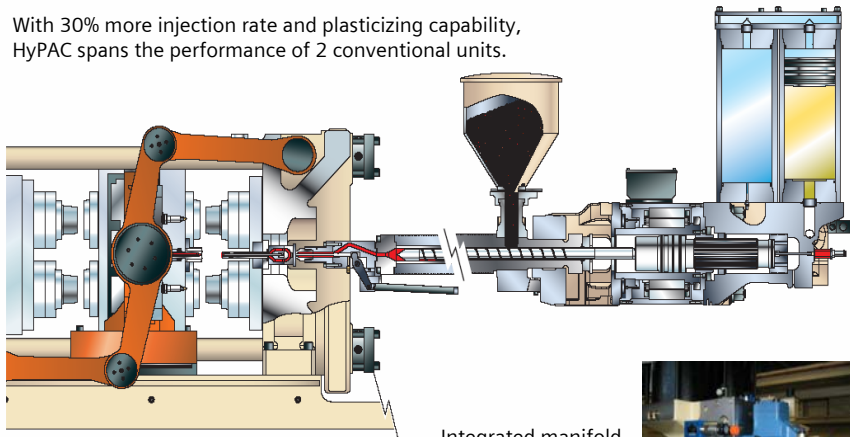
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Integrated manifold
and cylinder head
for low restriction
hydraulic circuit.



Lighter parts. Less scrap. Faster cycle.



HyPAC

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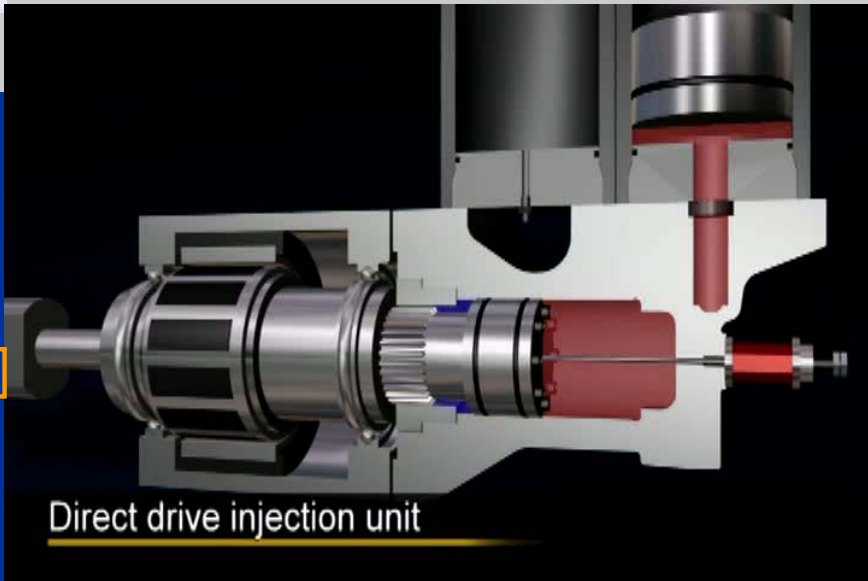
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Direct drive injection unit

+30% injection rate and plasticizing

Polaris Controls

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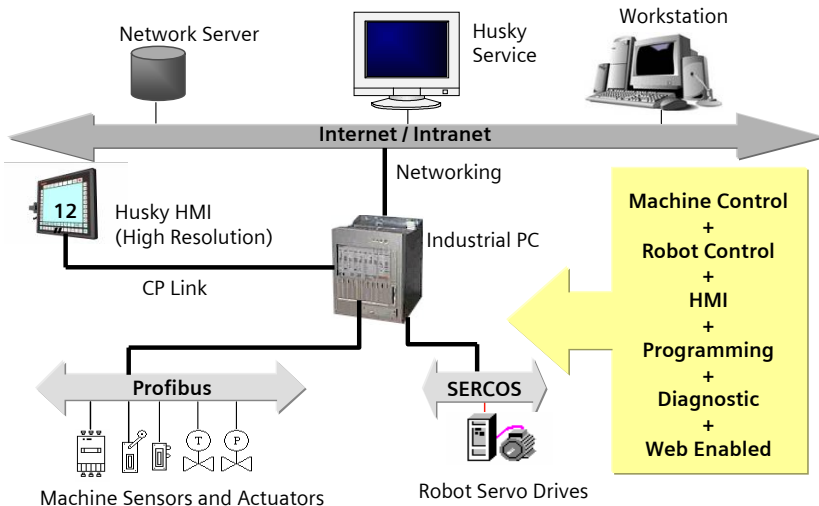
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Controls Architecture - Testing Vehicle

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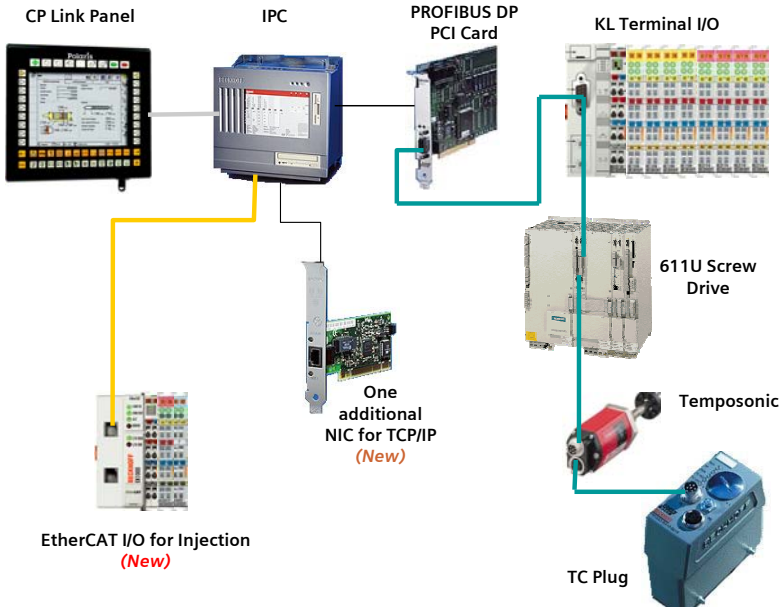
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Mapping wastes Control System Resource

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- Fieldbus system generates **physical** process image
- Mapping to **logical** process image(s) is often required

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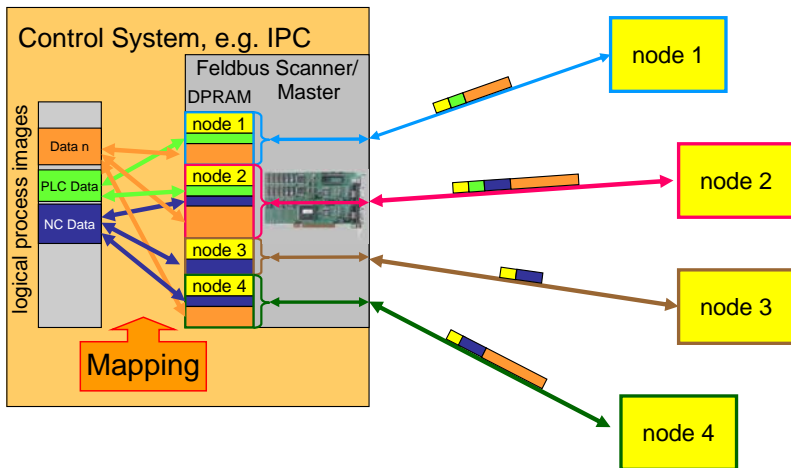
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Source: EtherCAT Technology Group

Distributed Mapping – Speed without Haste

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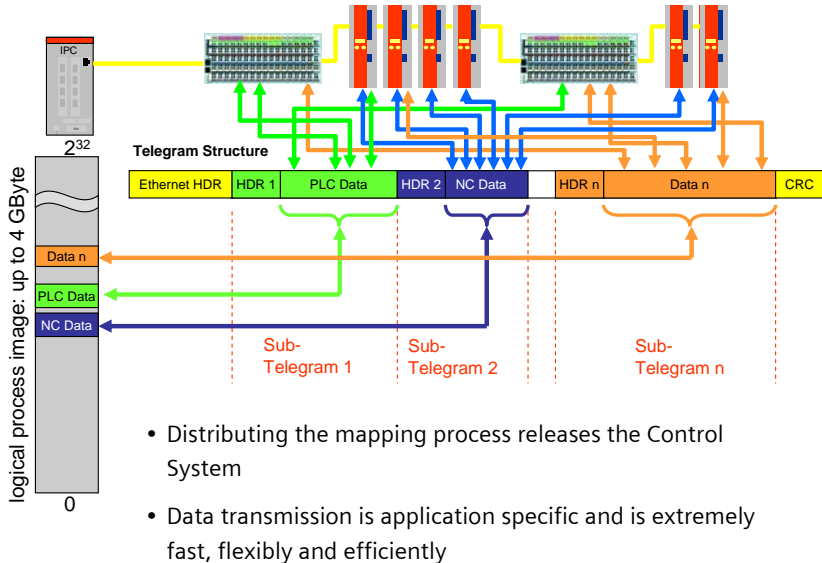
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Source: EtherCAT Technology Group

Process „on the Fly” – Speed without Haste

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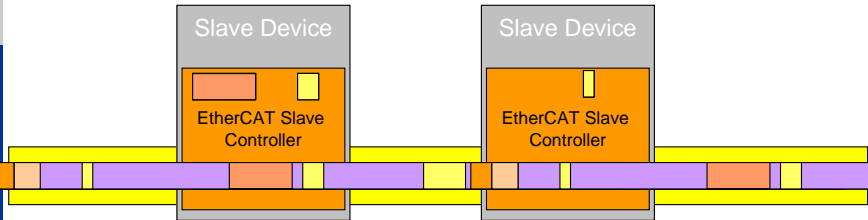
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Process data is extracted and inserted on the fly

- Process data size per slave almost unlimited
- Compilation of process data can change every cycle
- Support event triggered asynchronous communication

Source: EtherCAT Technology Group

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Direct Memory Access saves Time

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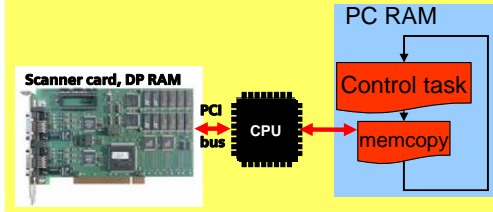
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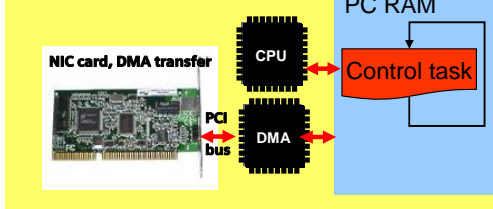
Fieldbus Cards:
waste up to 30% of
CPU's time to copy data

PC Control with Fieldbus Cards



EtherCAT:
NIC is PCI Bus Master,
moves data directly to
PC RAM by DMA:
■ CPU is relieved
■ Enables higher Performance

PC Control with EtherCAT



Source: EtherCAT Technology Group

EtherCAT has Speed without Haste

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Why EtherCAT

Performances

- **Built for Speed**
 - Leveraging the Fast Ethernet – 100Mbit/s
 - Communication completely in hardware
 - Standard NIC hardware – save CPU resource
 - Pass-through telegram without buffering
- **Built with well-thought-out Plan**
 - A fast train with pre-assigned seats
 - High bandwidth with contingency and capacity



Real Time CPU Loading

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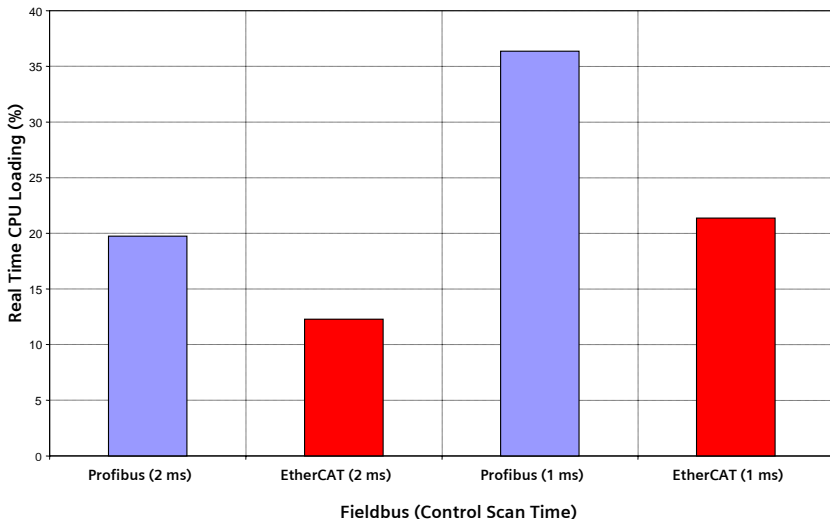
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Measured by Husky



Transition Position Repeatability

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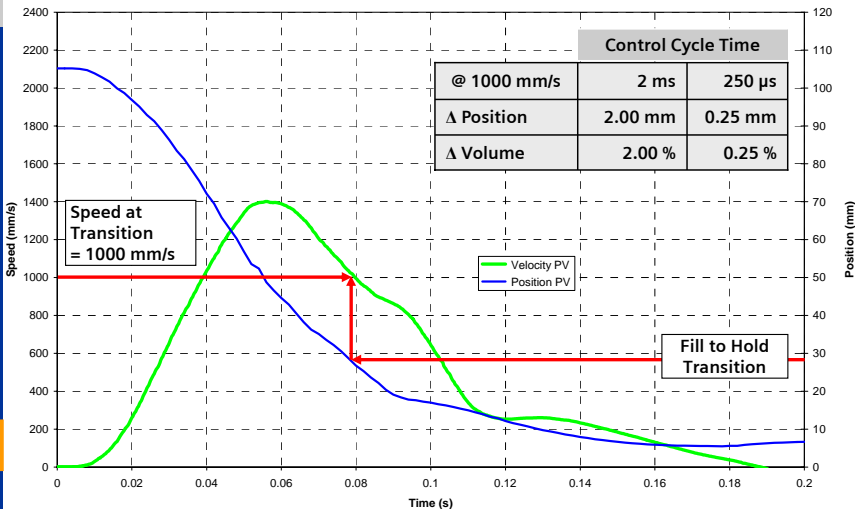
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Transition Pressure Control

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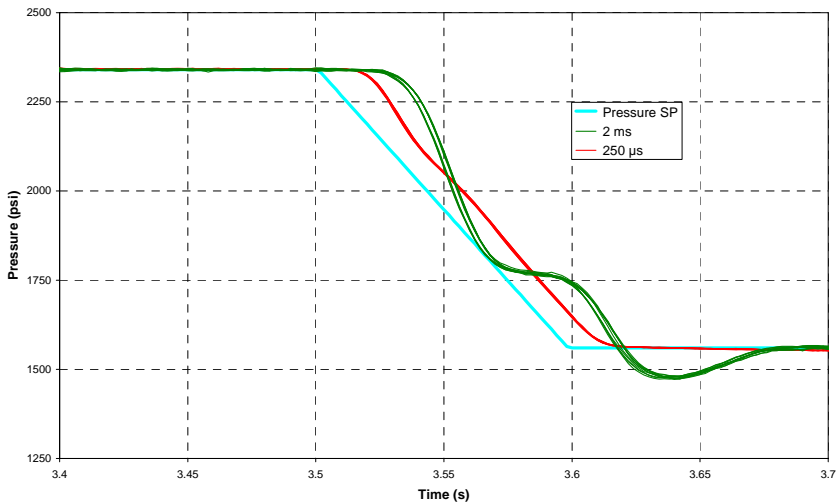
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Injection Hold Pressure Control

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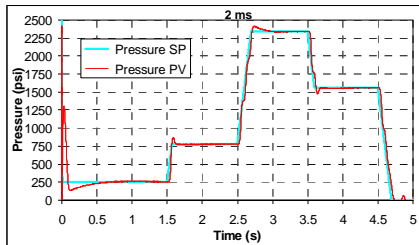
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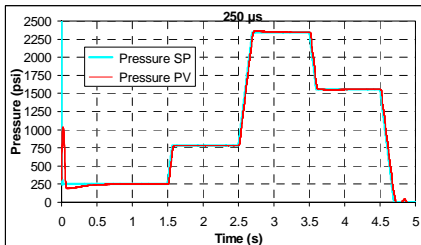
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Performances

2 ms control cycle



250 μ s control cycle



Better performances with faster control cycle time?

What are the constraints?

Hints:

- Time constant of the process; rise time; bandwidth



Summary of Performance Improvements

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Performances

- Better injection repeatability
- Improved injection profile control
- Less melt degradation
- Better melt homogeneity
- Higher packing pressure
- Less energy consumption
- Lower maintenance
- Reduced noise level

Part's Weight Variations
 $\leq 0.3\%$

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Thank You!