South African Institute of Foundrymen

HOW DEVELOPMENTS IN DIE CASTING TECHNOLOGY IMPROVE COMPETITIVENESS

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What will be covered

- Where were we before?
- What stopped new markets/ what were the threats?
- What has changed?
- The new scene…

Where were we before?

1970's 1980's

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Die Casting- Parts

- Castings were getting complex and higher quality

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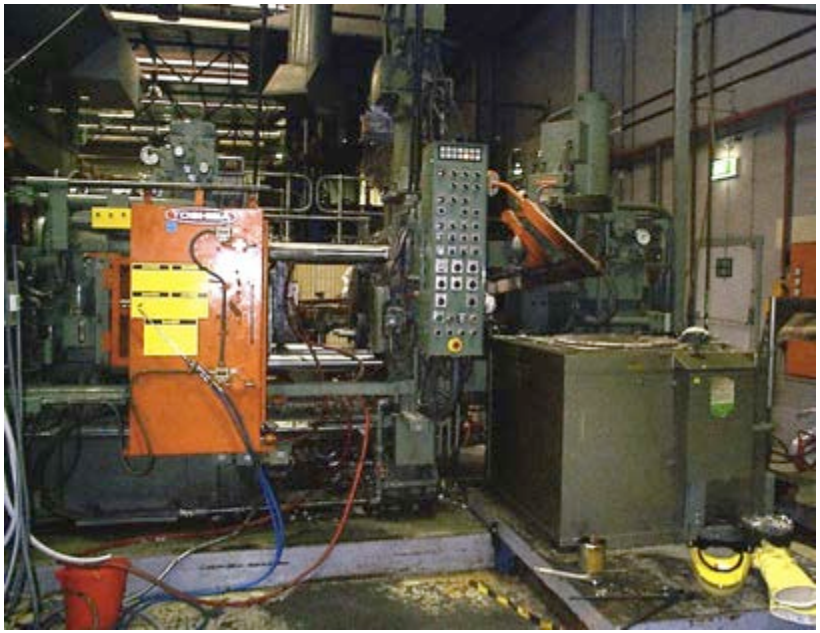
The Foundry



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Constraints/Threats

HPDC

- Porosity on machined surfaces
- Thermal design?
- Machines not controllable
- Limited envelope of parts- can't HT
- New technologies offering improved properties

Gravity/ LP

- Thin sections still hard
- Strength limited
- Tilt casting, but how?
- "HPDC can't touch us- we HT"
- Cooling die via air only for select few
- Die coats and cut-and-grind normal methods of solving

What has changed?

Tilt Casting

Consistent die filling

Controllable and fewer defects

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Low Pressure Machines

curacy

emperature

erature or

g rate

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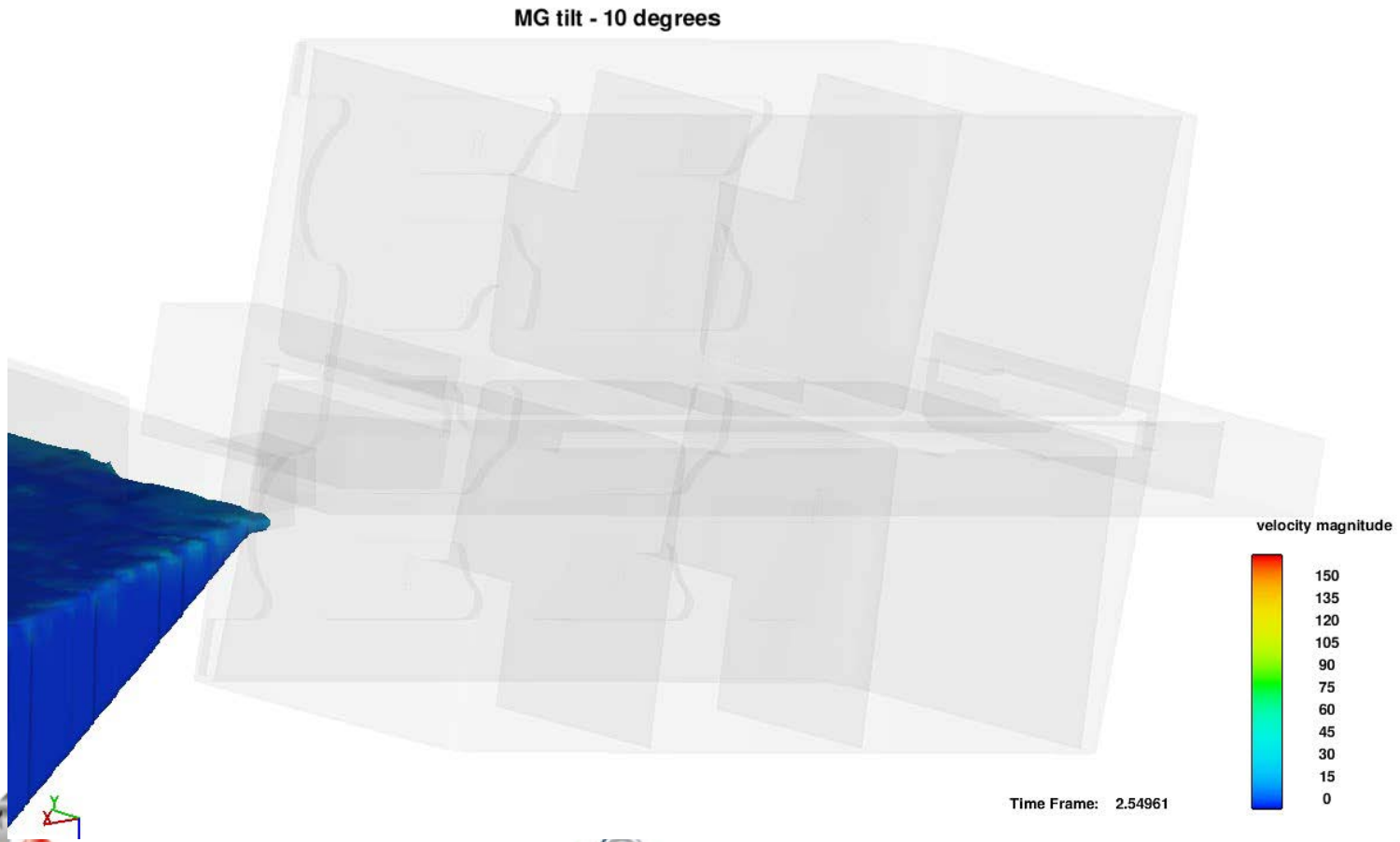
Molten Metal Quality

- "Borrowed" information from can-stock work
- Hydrogen poros ntrolled
- Strength can be ess oxides)
- Fatigue life impr
- Plate-ability imp

Simulation



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The outcome

We can work out runners and gating before cutting any dies

K-Frame (engine cross bracket)

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LP and Gravity

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High Pressure

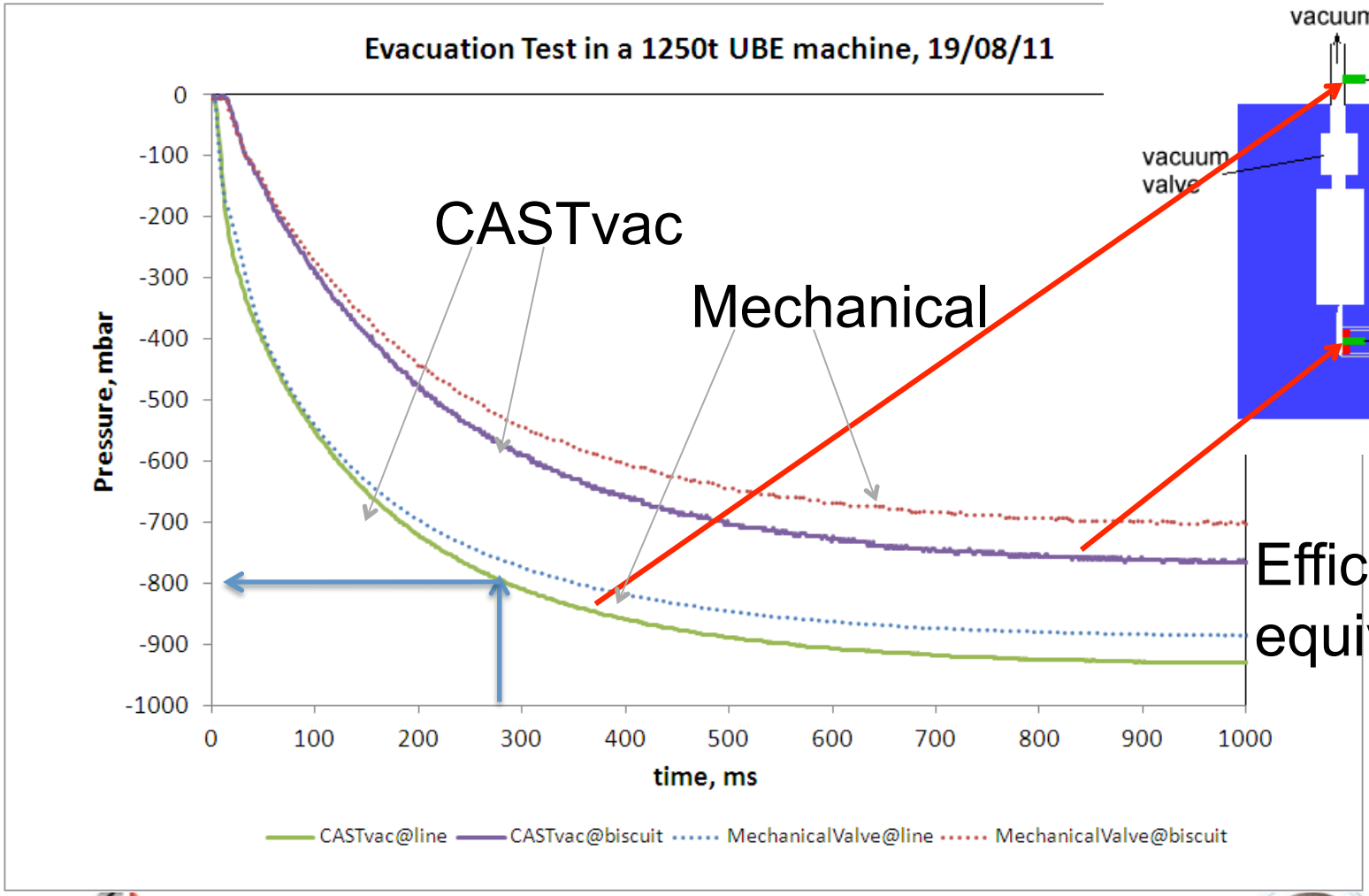
Enabling Technologies

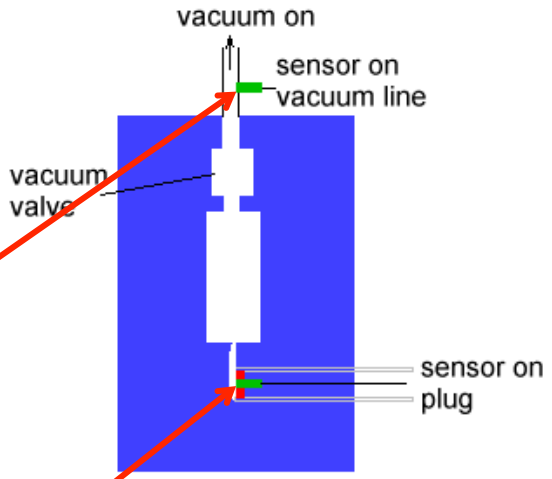
- Much better vacuum systems
- Better die spray units/ better understanding
- Much better simulation- more real
- Better process tracking and sensors
- Better understanding of what is needed
- Die cooling
- New pin designs

Vacuum

- Need 80% of the air removed in less than 0.3 second
- Need to overcome normal leaky dies
- Need it to be low maintenance
- Need to KNOW when it stops “working”

Efficiency comparison in the machine





Efficiency is equivalent

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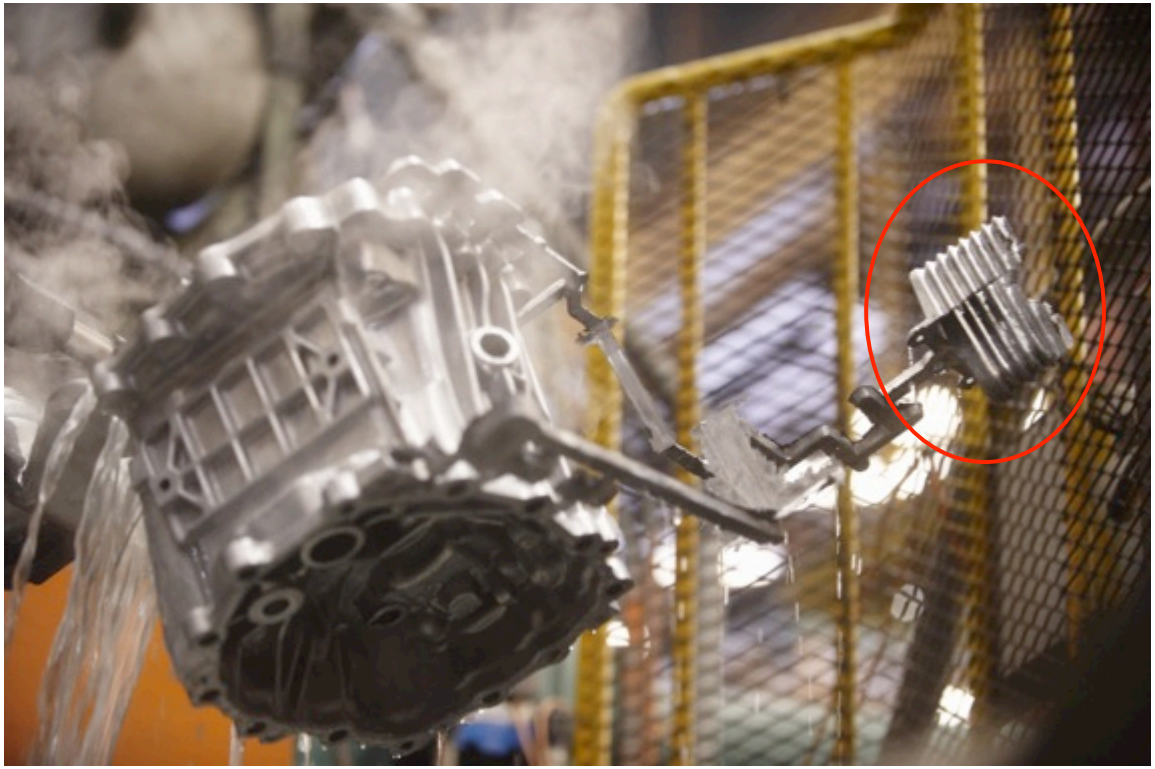
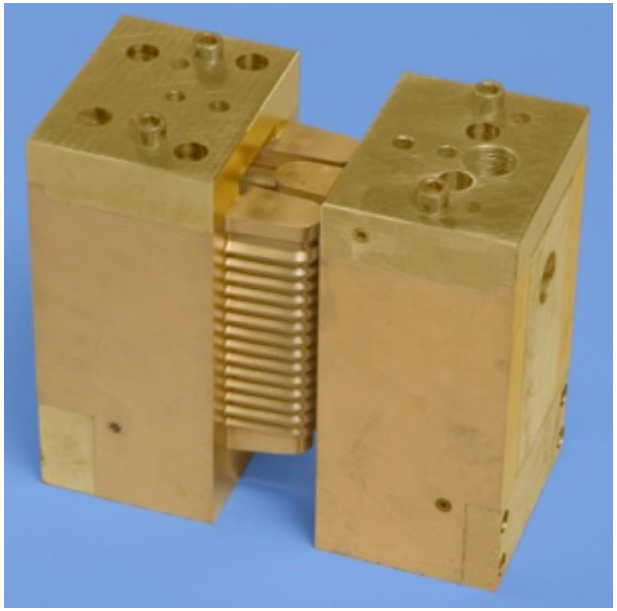
Wanda Technology

Production in Nissan Australia for 7+ years





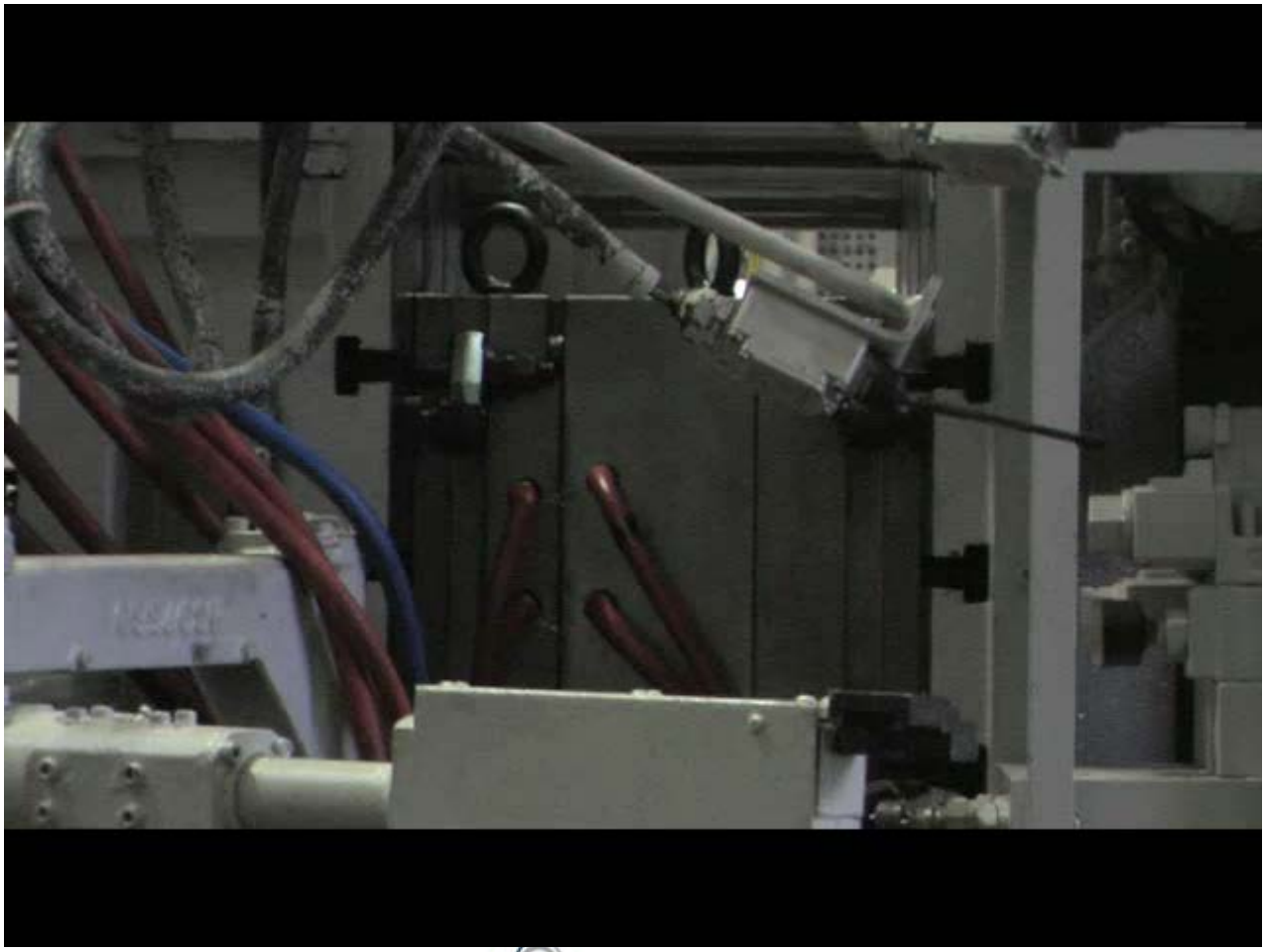
Very good vacuum in dies

Reduced or eliminated local porosity

Die Spray

- Die spray causes porosity
- Need only 3um thickness but evenly spread
- Must reach all corners evenly
- Must be able to check the die spray deposition

Electrostatic die spray



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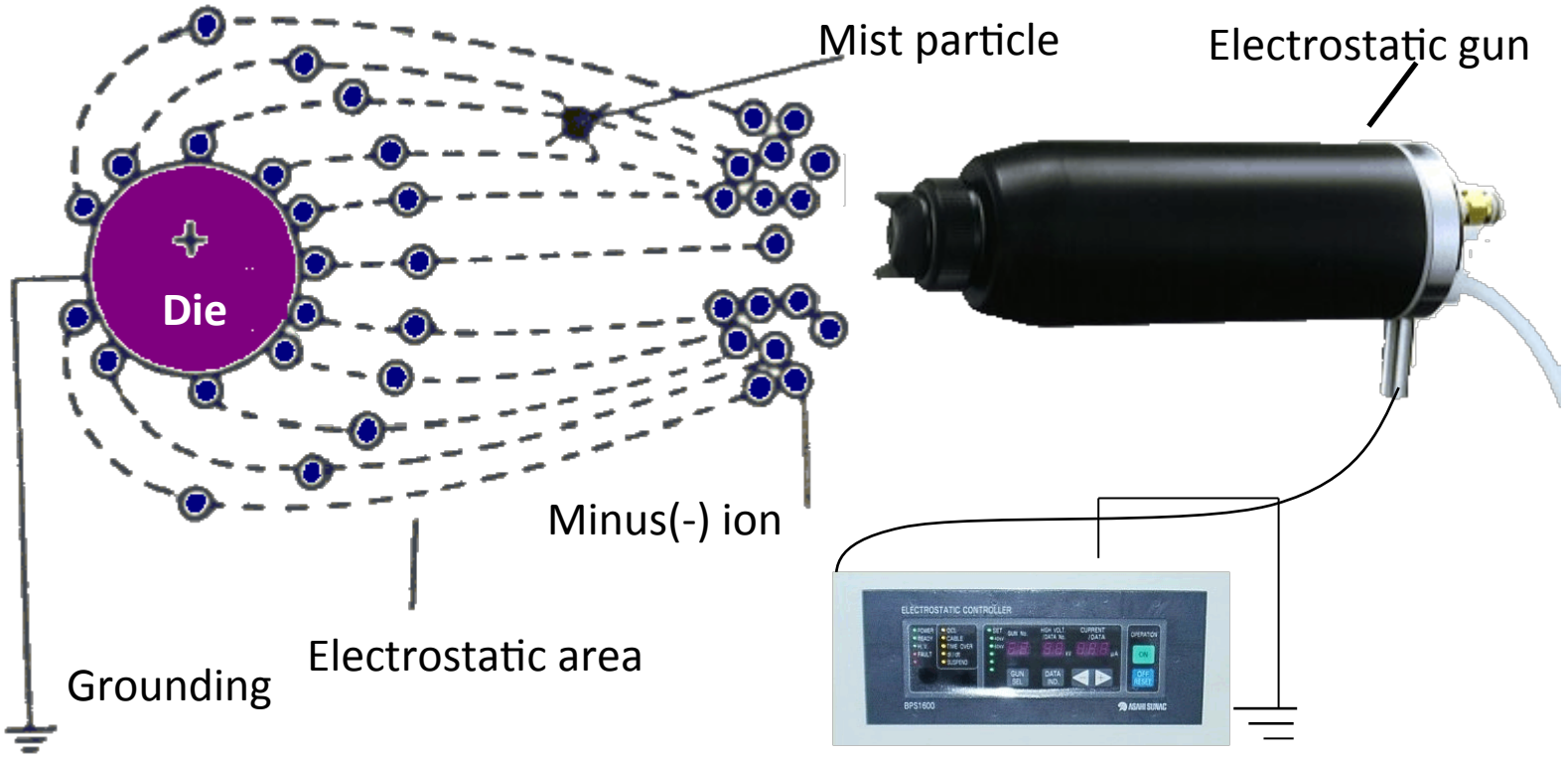
WFR's Evolutional Modification

What is "ELECTROSTATIC SPRAY"?

Die Spray Fluoresces under UV light



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Lubrolene

Minimal Die Spray evenly distributed

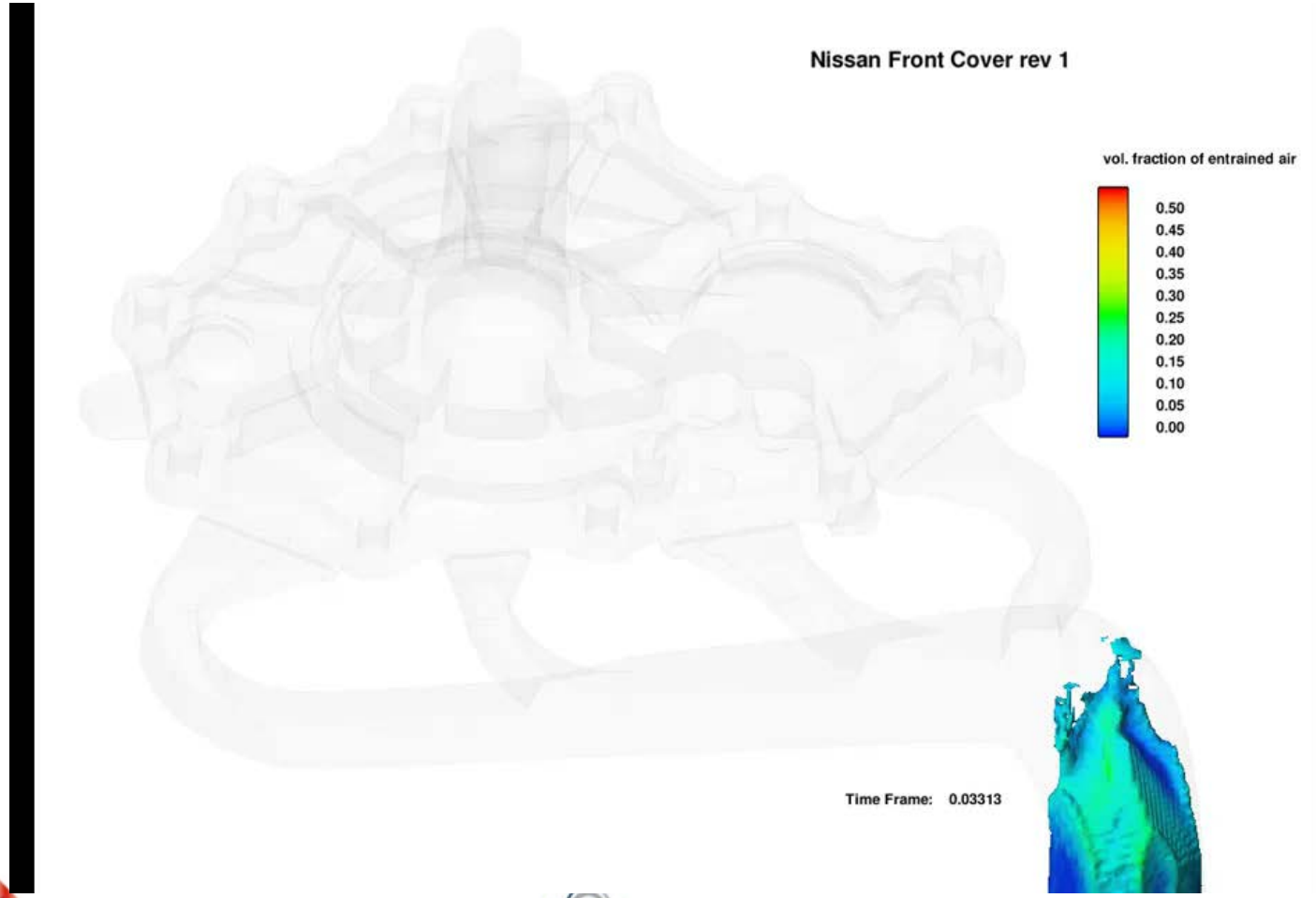
Reduced or eliminated local porosity

Ejection of part much easier

Simulation

- Quicker due to processing speed and algorithms
- The flow is now very accurate
- Simulation output can be “pretty” or show the real flow
- Can optimise the flow etc automatically

Pick what is wrong



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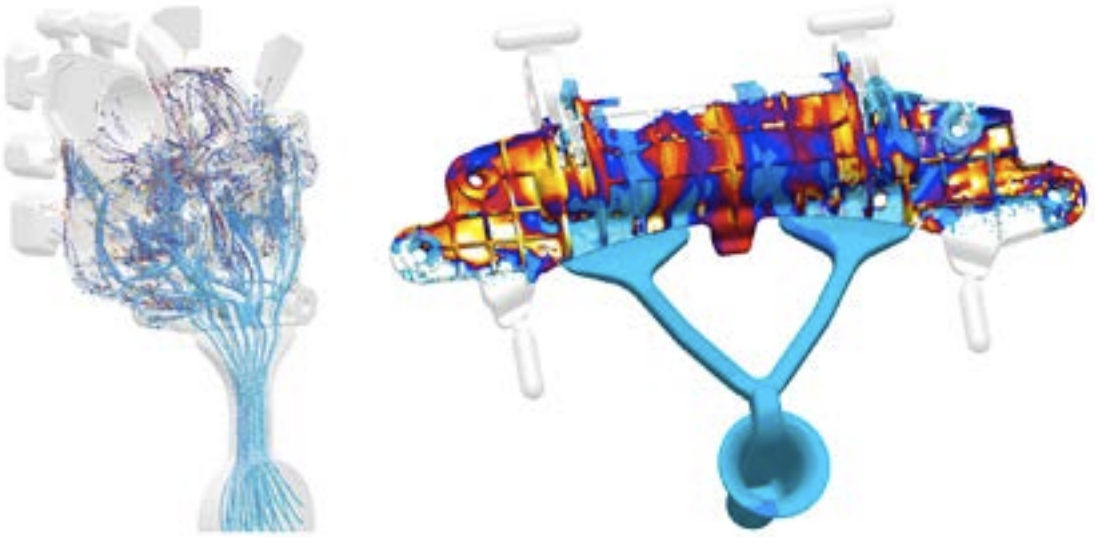
Different ways of visualising



Simulation of turbulence formation and resulting gas inclusions with the MAGMAhpdc module

MAGMA
Committed to Casting Excellence

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Optimum die filling and solidification

Reduced or eliminated local porosity

Reduce “time-to-market”

Improve surface finish

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Monitoring and Sensing

- Simple-to-use shot monitoring
- Talks to the main computer
- Talks to laser or impact marker
- Does all

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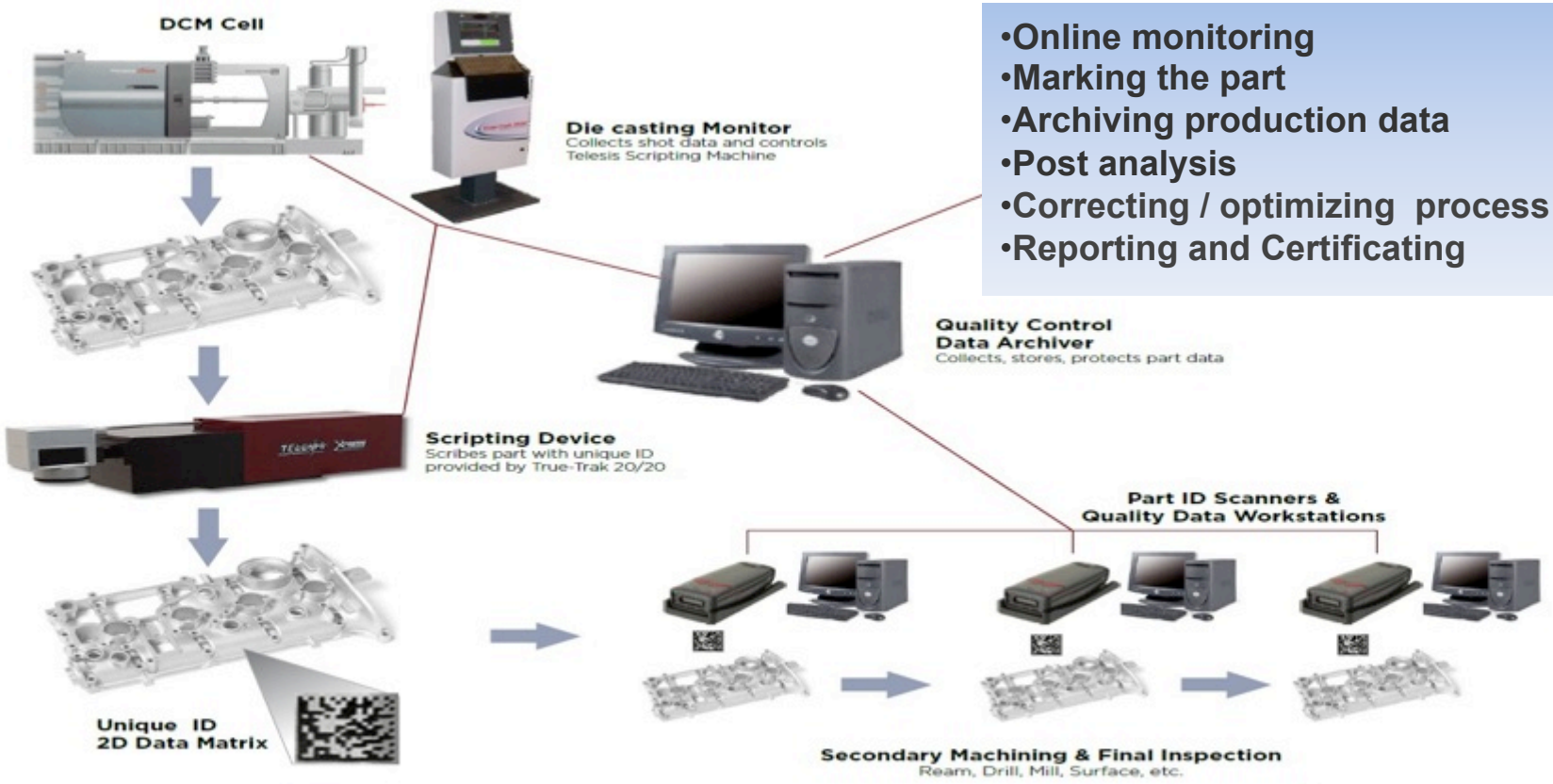
Traceability and Marking

Traceability & Part Marking system in a DieCasting working cell



- Online monitoring
- Marking the part
- Archiving production data
- Post analysis
- Correcting / optimizing process
- Reporting and Certificating

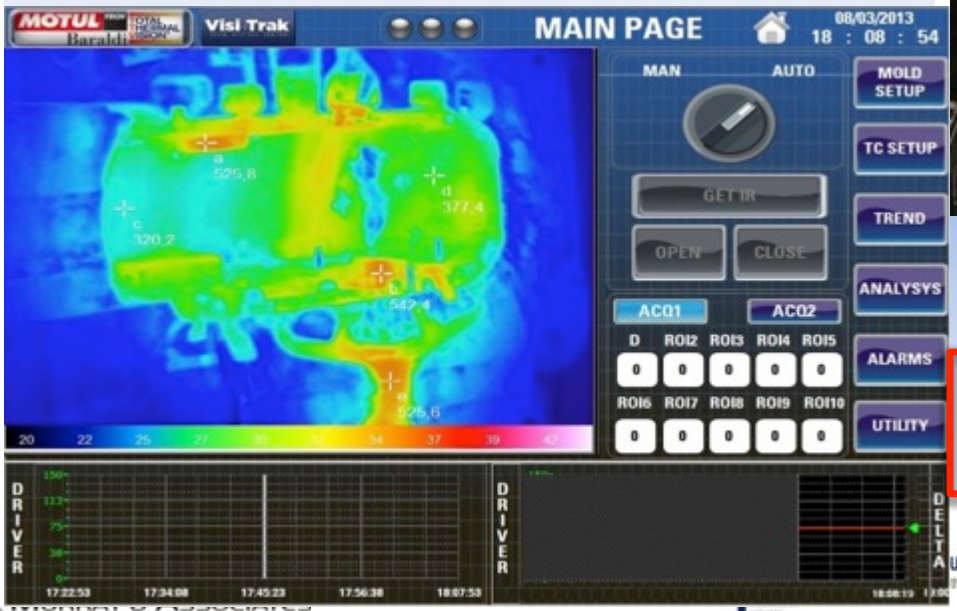
Model	Drawing Rev	Company	Year	Month	Day	Die	Shot#	Checksum
T36	2	AW	9	A	29	C	0353	G

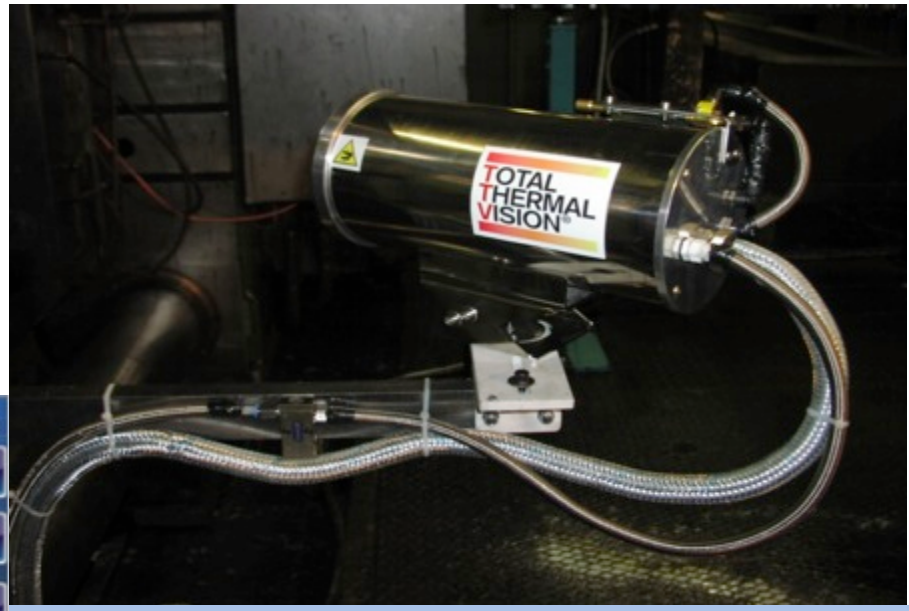
That includes the actual die temperature

TTV Total Thermal Vision

Simplicity & reliability of TTV sounds good for Diecasting

- System is designed to work near the die; **the protection of the camera is the key of the system.**
- Takes pictures (Infrared ThermoMap) of die surface at every cycle (before and after spraying)





- The software allows easy definition of surface regions to be monitored
- If temperature in the regions is out of range part rejection can be activated

More control of die and machine

Reduced or eliminated local porosity

Improve repeatability

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Die Cooling/Heating

- We know what we need
- We can simulate it first
- We have spot cooling, background cooling
- Water, pressurised water, air, oil, mist, die materials
- Jet cooling is used extensively
- Reduced shrinkage porosity etc

Evolution in Die-Casting Temperature Control

Torch & Hand Spray	▪ Beginning of Die-Casting
Internal Water Lines	▪ Cooling of hot spots
Automatic Sprayers	▪ Applying lube and cooling of die
Hot oil & Non-Pressure TCUs	▪ Temperature control of die
Hot oil & Pressure TCUs	▪ Optimized temperature control of die casting process

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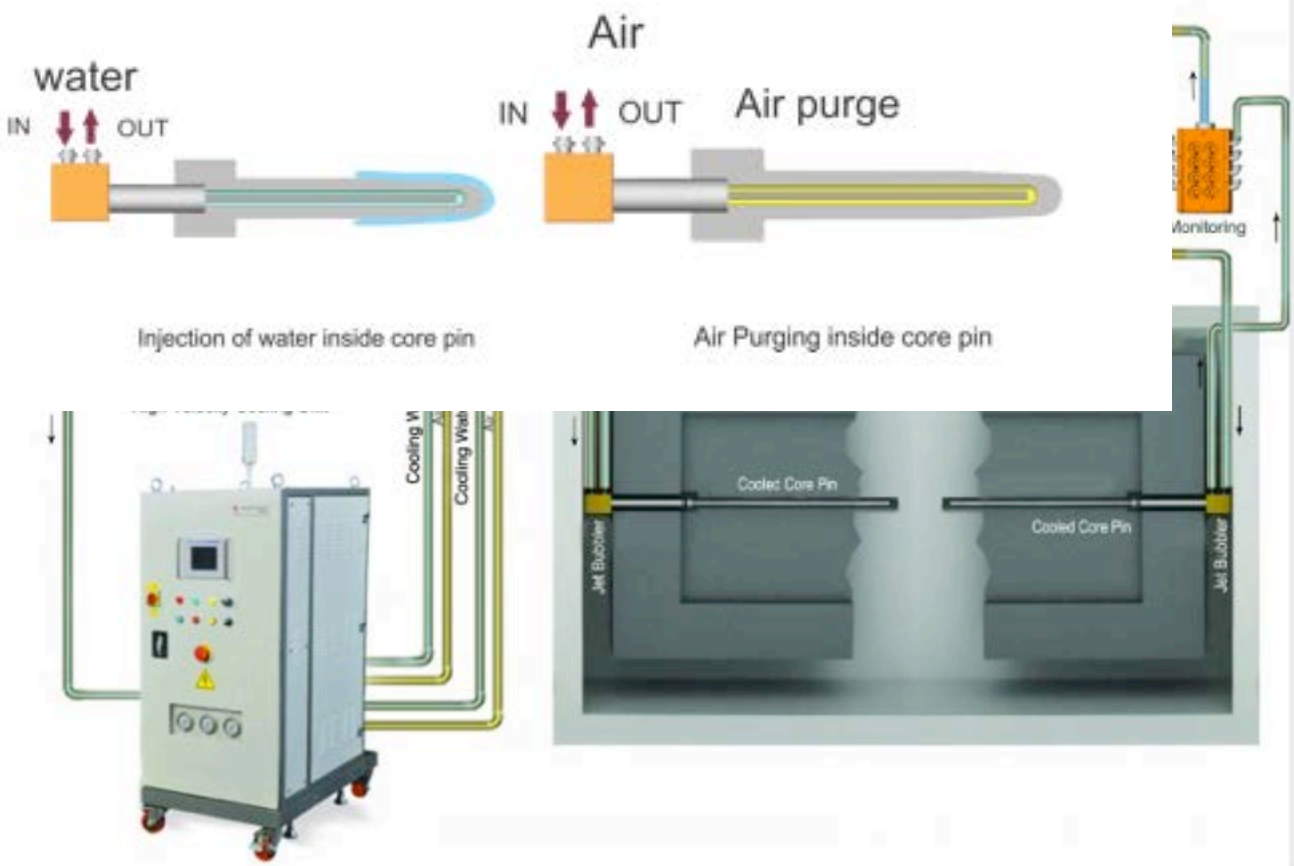
Jet Cooling



Case study gear box housing

Gear box housing

- 4,000 ton machine
- Die weight approx. 75 ton
- 6 hot oil TCU, 100 °C
- Poor cooling capacity

- 6 pressurized water TCU
- Preheat to 120 °C
- Production 100 °C lowering to 60°C
- Cost saving 20%

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More control solidification and casting distortion

Reduced or eliminated local shrinkage

Improve repeatability

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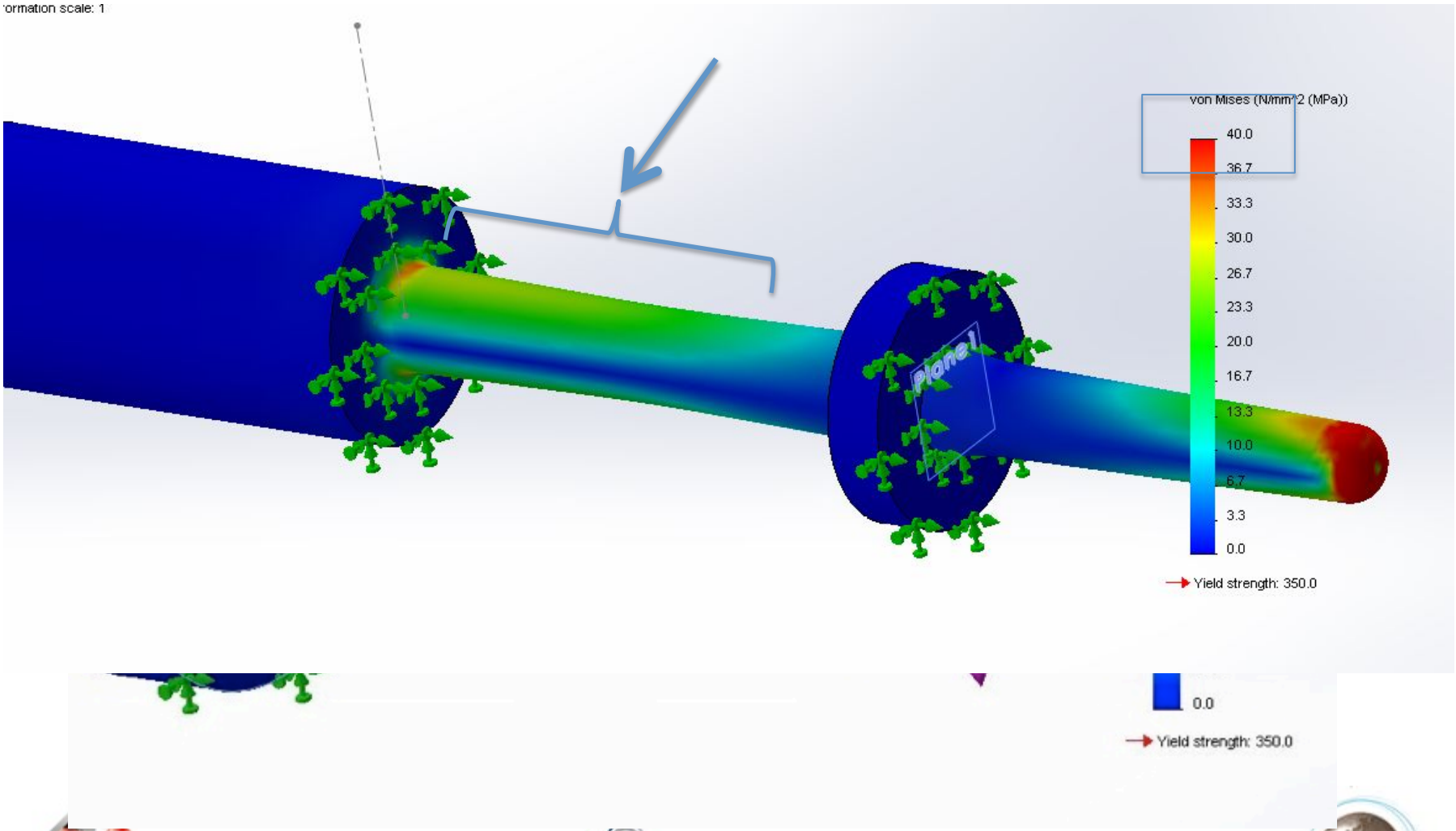
Redesigned core pins

- Castings are getting bigger
- As they cool, they shrink
- This puts huge stresses on any core pins around the outside
- Alpha-pins

The stress is at the root



0.0
Yield strength: 350.0

Longer core life, less core pick up

Improve repeatability

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So what does all this mean?

Heat Treated Parts

Structural die ca
The new die castin
based on the Buhl

BMW part is 40% weight of traditional steel part and comparably priced.

Full T6 Heat Treatment
540C for # hours
185C for % hours

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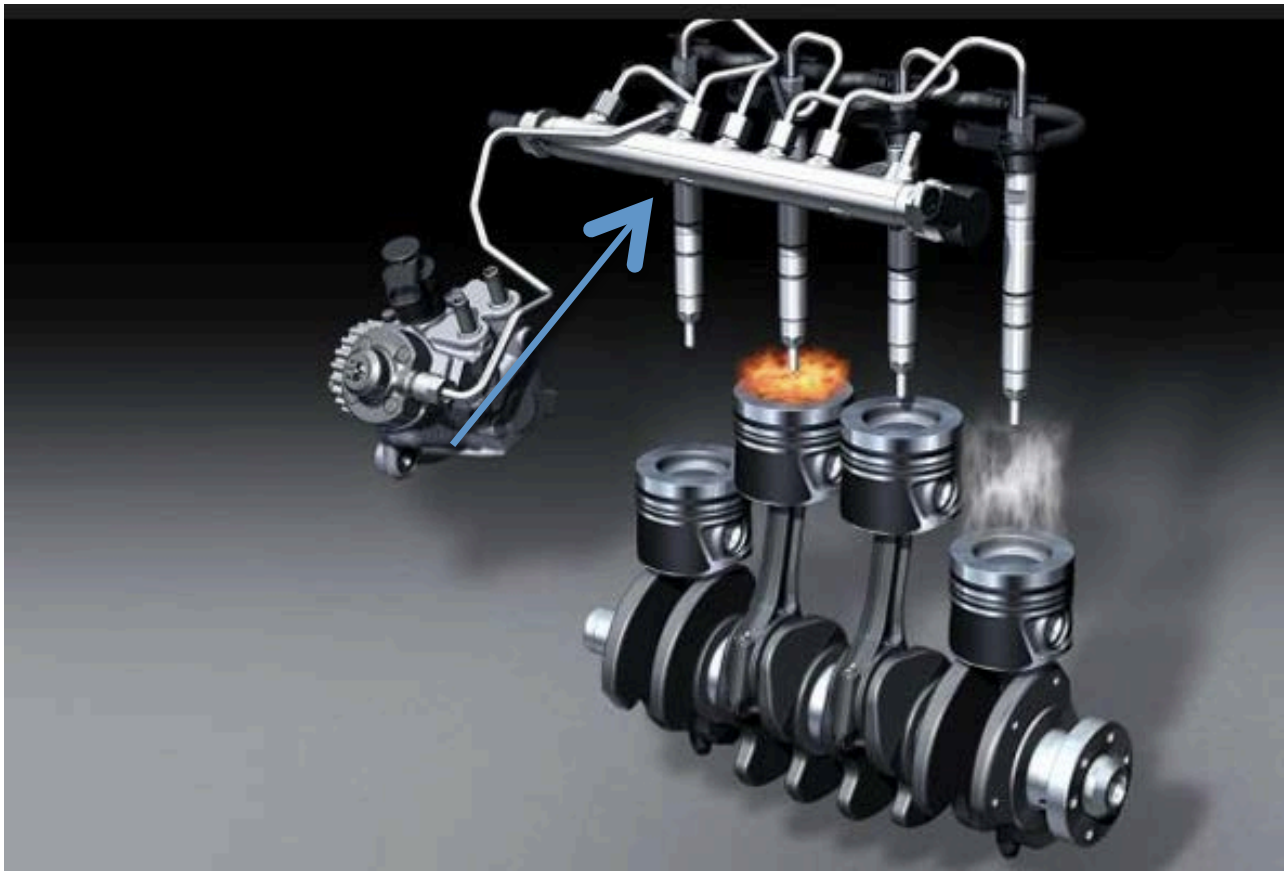
Squeeze cast now HPDC



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Highly decorative, high strength, weldable high pressure die castings

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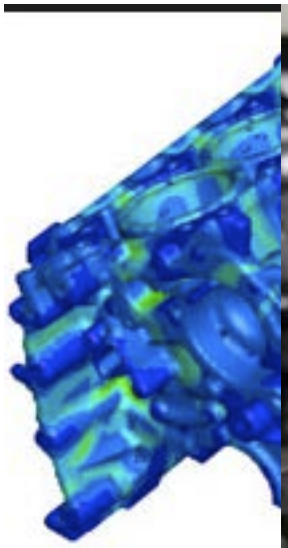
Engine blocks- Jet cooling



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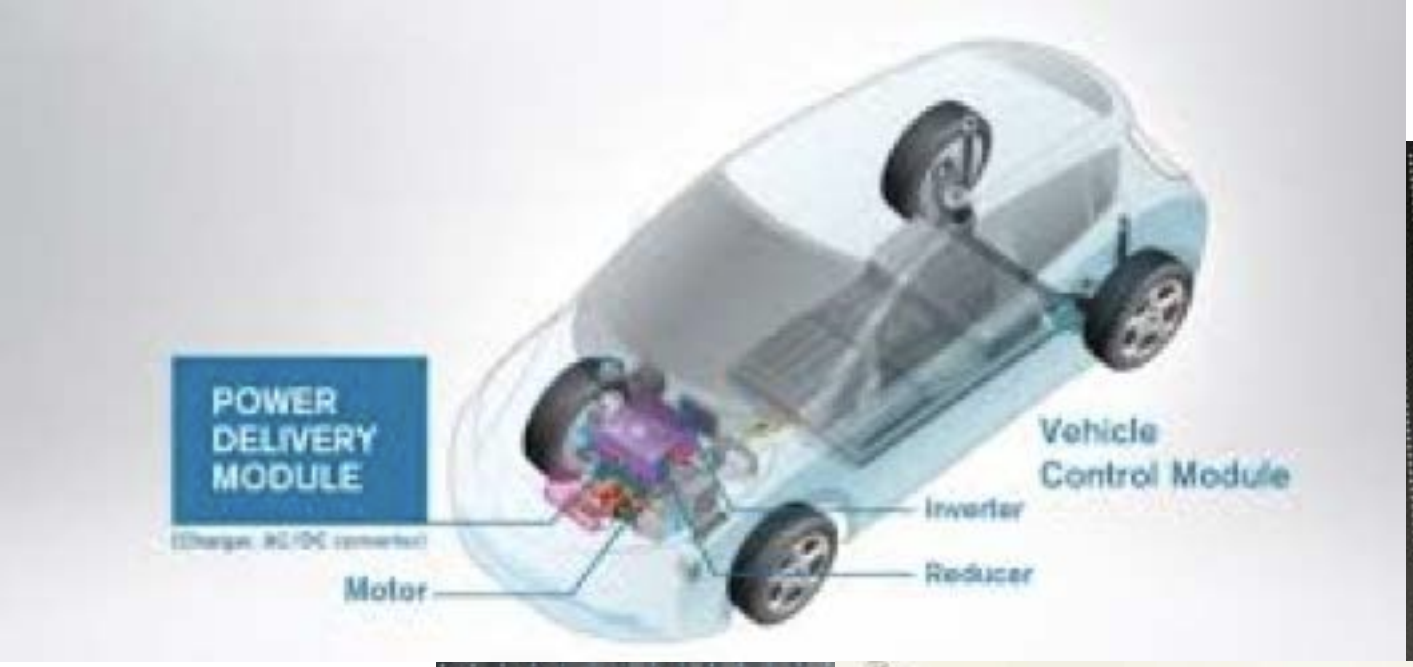

Hydrogen leak tested

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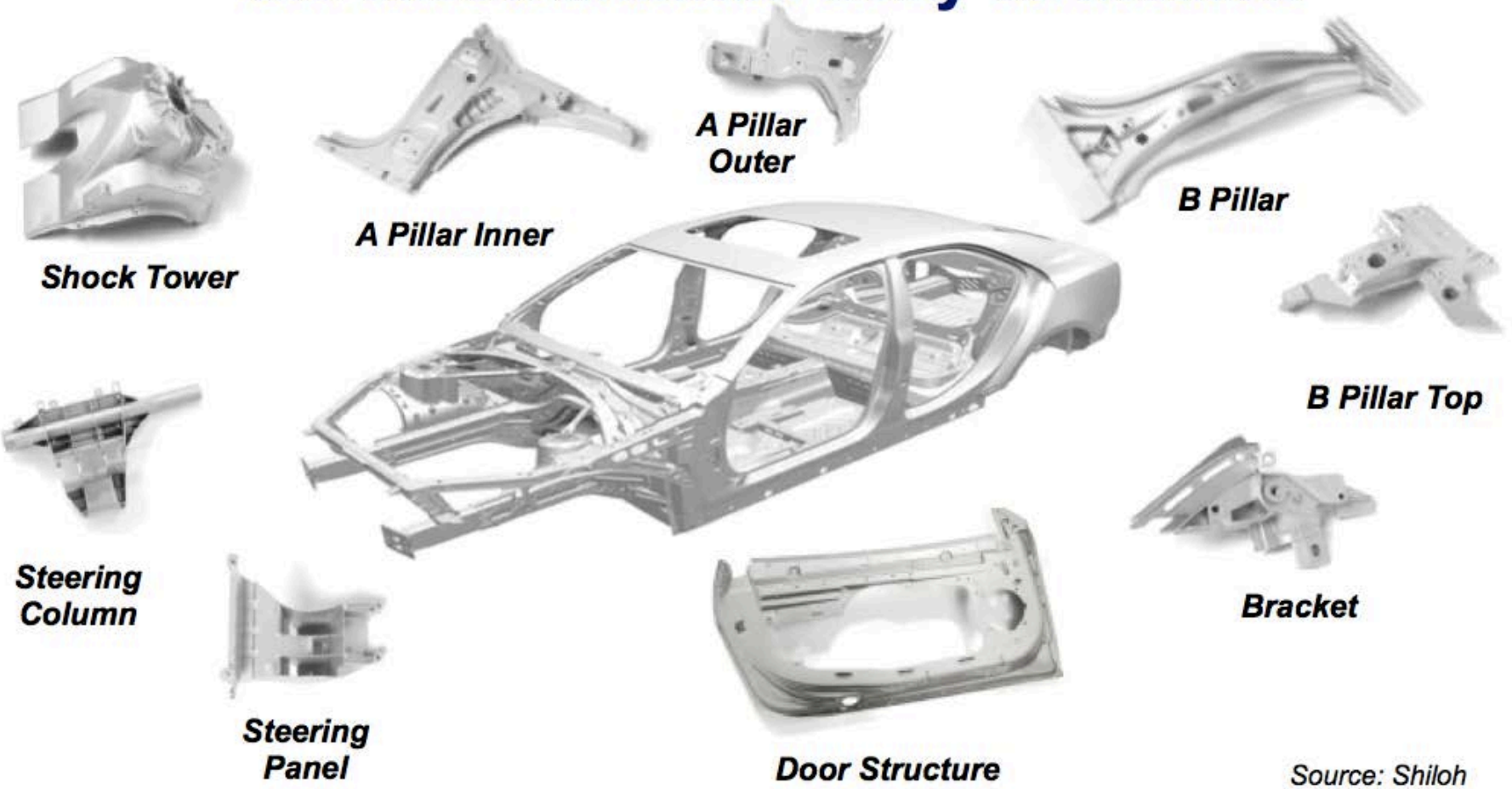
With HPDC Now

- Minimal porosity
- Heat Treatable to full T6
- HT castings are high integrity, no blistering
- Repeatable process at normal production levels
- This has opened up the market for
  - automotive wheels,
  - high ductility requirements (>18%)

Opportunities for high pressure, high vacuum die cast aluminum body structures



Source: Shiloh

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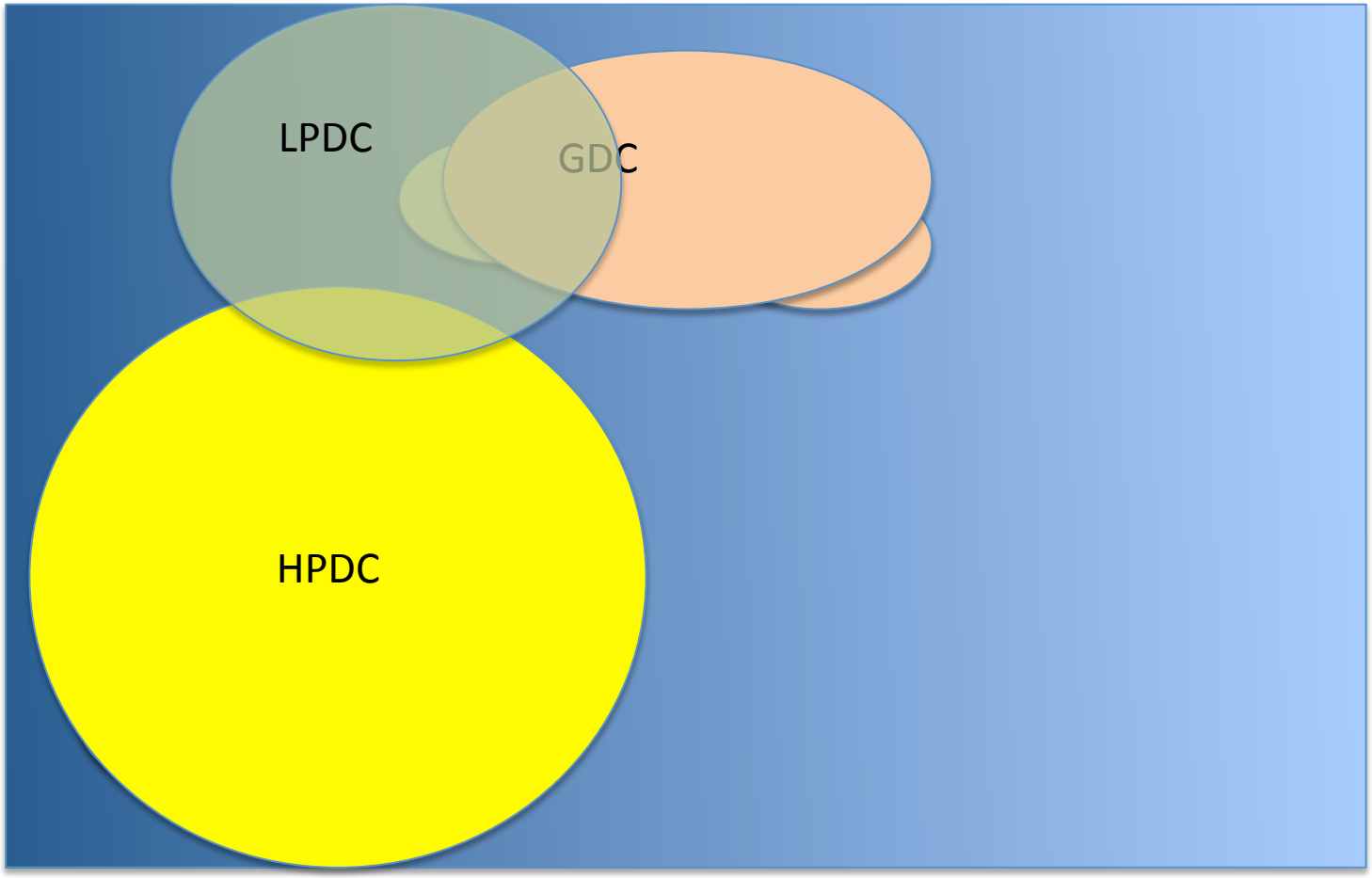
The new game



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