DTC – Die Thermal Control

A modern Thermography System for increasing the HPDC quality process and control

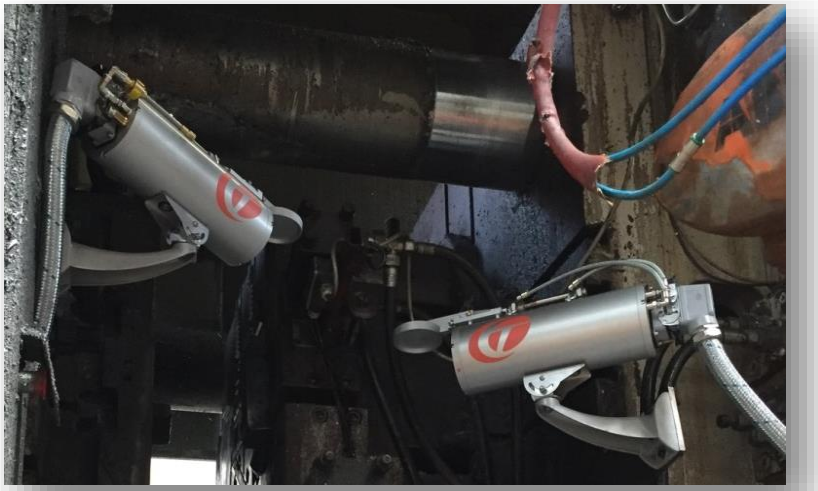
Case Study

Case Study #1

Interaction DTC – Robot Spray

European Customer

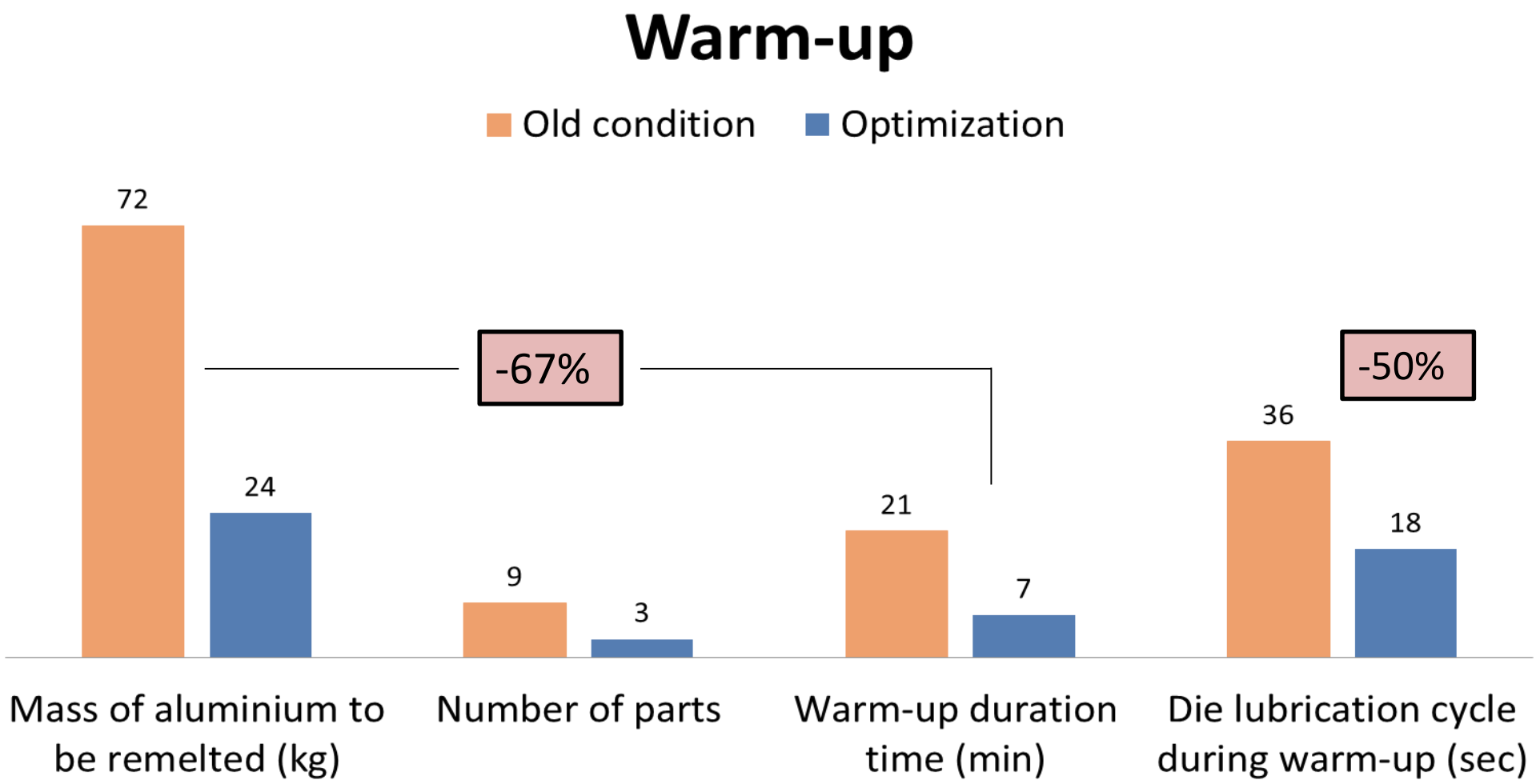
- Customer – ChemTrend – Inprotec IRT
- Trial with interactive DTC – Robot spray
- Complex and heavy parts – 8kg GH



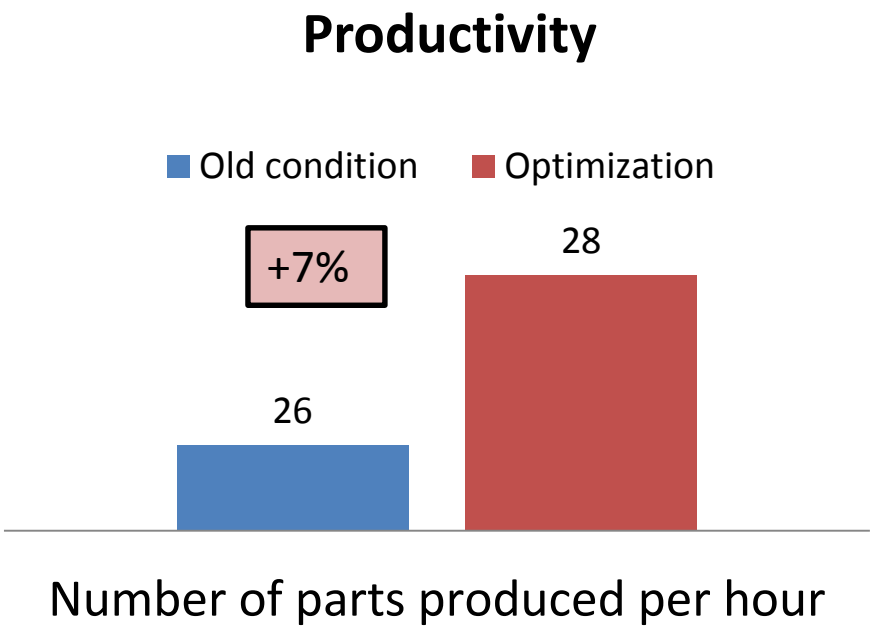
Main targets

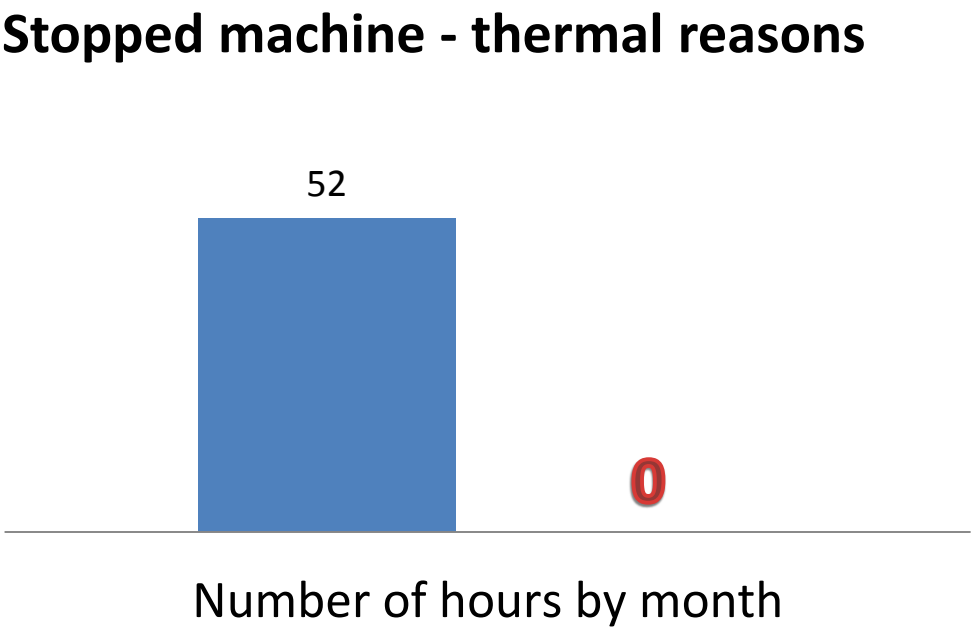
- Interactive control DTC – ABB Robot
  - Avoid soldering and stopped machine occurrences
- Understand and define the best warm-up curve
  - Increase productivity and reduce scrap
- Improve OEE
  - Overall equipment effectiveness of the HPDC cell

Results


Warm-up
Old condition
Optimization
72
24
-67%
9
3
21
7
-50%
36
18
Mass of aluminium to be remelted (kg)
Number of parts
Warm-up duration time (min)
Die lubrication cycle during warm-up (sec)

Results





- Estimated monthly cost for a 2,700 tons DCM stopped:
  - In 22 working days: 52 hours stopped
  - 150 €/hour (estimation from a DCM producer)
    - TOTAL of approximately 7,800 €/month

Results

- Good interaction between DTC-ABB Lubrication Robot
  - Variation of the lubrication cycle according to DTC alarm limits
- Reduction in the defect occurrences
- Optimization of the die lubrication cycle
  - Wastewater reduction
- Improvement of 3.5% in OEE
  - Overall equipment effectiveness of the HPDC cell

Conclusions

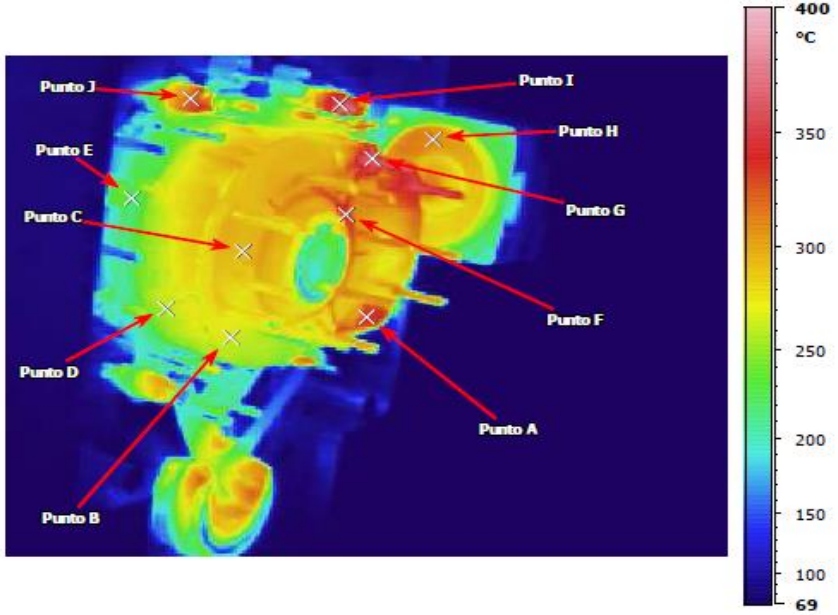
- The DTC is an «open» device:
  - Interface with peripheral devices is real
- The DTC is a monitoring device for the series production:
  - Productivity improvement
- Tailor-made on Customer's needs

Case Study #2

Casting defects – Surface temperature

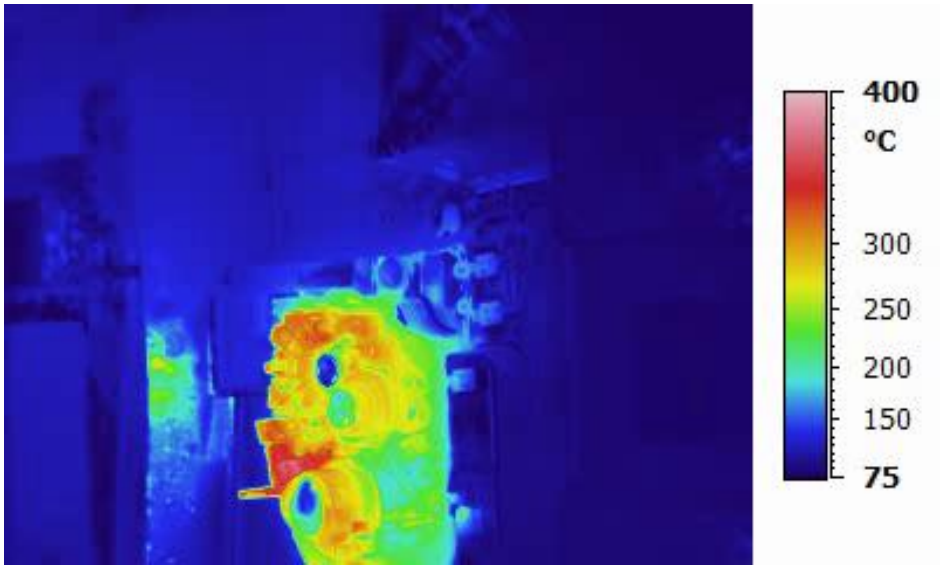
European Customer

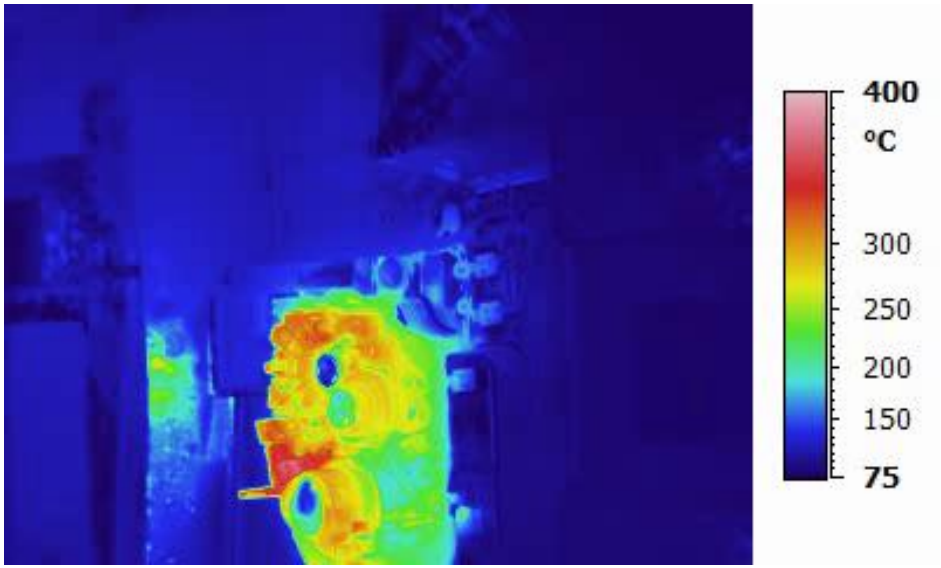
- Customer – ChemTrend – Inprotec IRT
- Casting defects – Surface temperature
- Complex and heavy parts – xxx GH

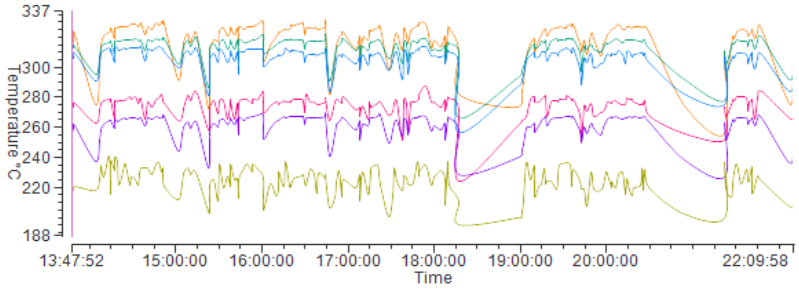


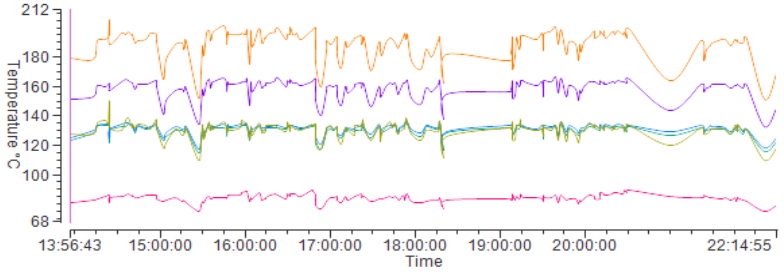
Monitoring and understanding

- Complete diagnostic



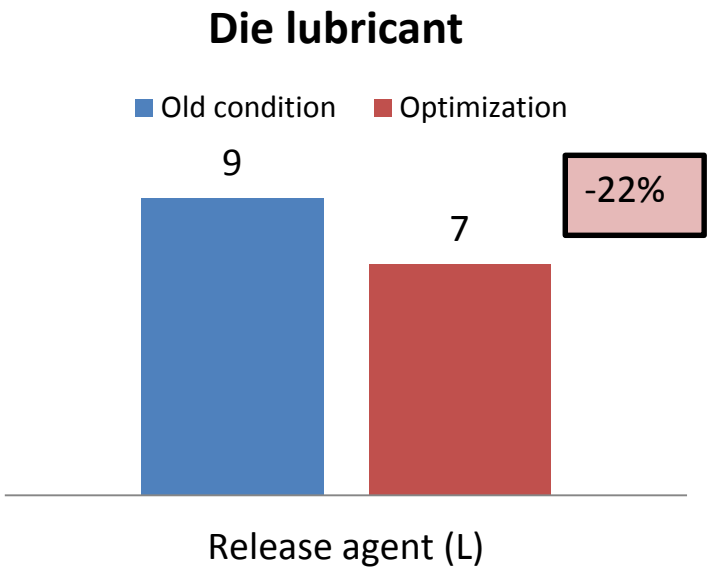


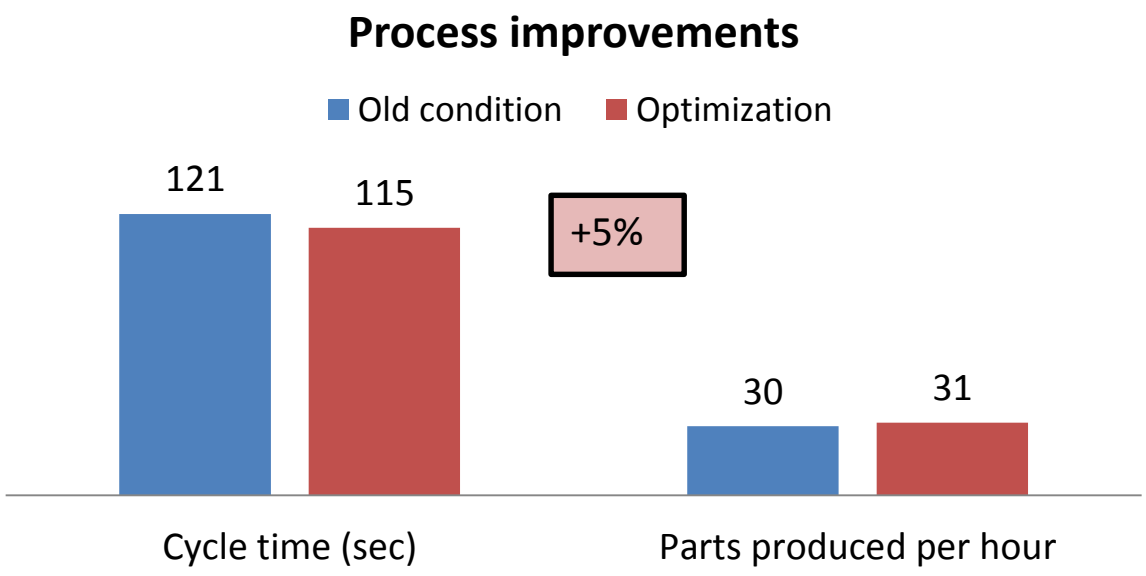




Results

Parameters	Old condition	Optimization	Variation
Average temp before spraying (ºC)	305	307	2
Average temp after spraying (ºC)	98	150	**52**
Temp variation Pre-Post (ºC)	**207**	**157**	**-50**





Results

- Die surface temperature optimized
- Die lubricant reduced in 22%
  - Wastewater reduction
- Enhanced casting quality
  - The X-ray test showed markedly reduced pores
  - Cold flows, shrinkages and die-solderings, were eliminated
- Increased productivity in + 5%
- Design of the spraying programs on other machines

Customer comments and conclusions

- *Monitoring and controlling the die surface temperature can result on fundamental process improvement*
- *The DTC device clearly showed the high benefit as a valuable tool to analyze production processes and to identify any potential optimization*
- *The results of the first project showed that the high benefit of the DTC will also pay off the investment in a short time*

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DTC – Die Thermal Control

Thermography in HPDC

- Useful technology to:
  - Understand the thermal balance of a die surface
  - Select the correct Release Agent
  - Adjust its application

Main advantages:

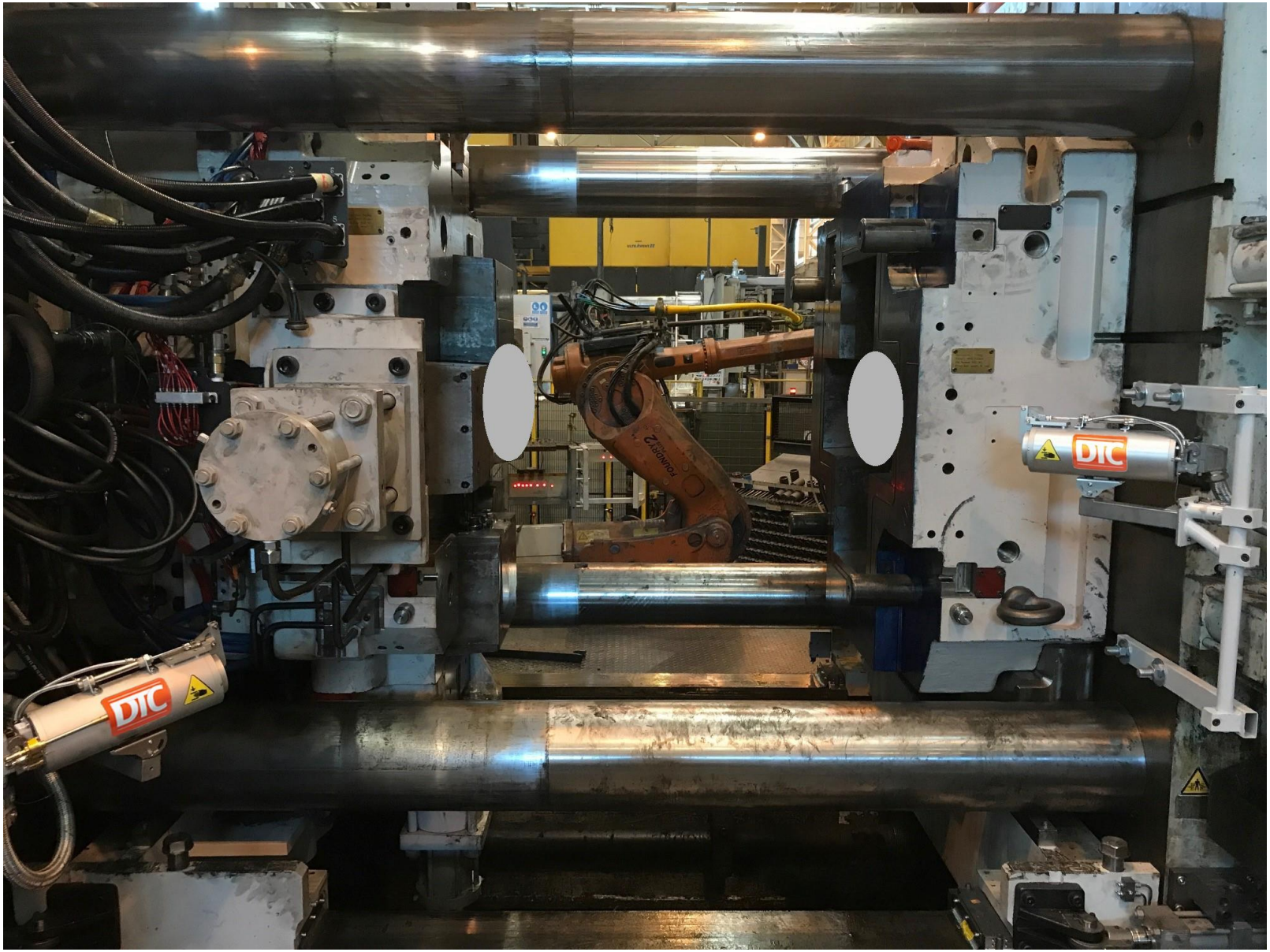
- Fast (moving objects)
- Non-contact (no hazard)
- Overview of temperature
- Digital data
- In-line analysis
- Off-line analysis

The value-added

- The DTC is a monitoring device for the series production:
  - Start-up > reduction of scrap rate
  - Die Sampling > reduction of sampling times
  - Improved productivity > shorter lubrication times
  - Criticist «finder» > quality check

- The DTC is an «open» device:
  - I/O for interfacing and integration with others devices
  - Analog Input for future applications
    - Interfacing with peripheral possible > Spray-head, Thermoregulator, HPDC machine, etc.
    - Customer tailoring

DTC – Installation on DCM



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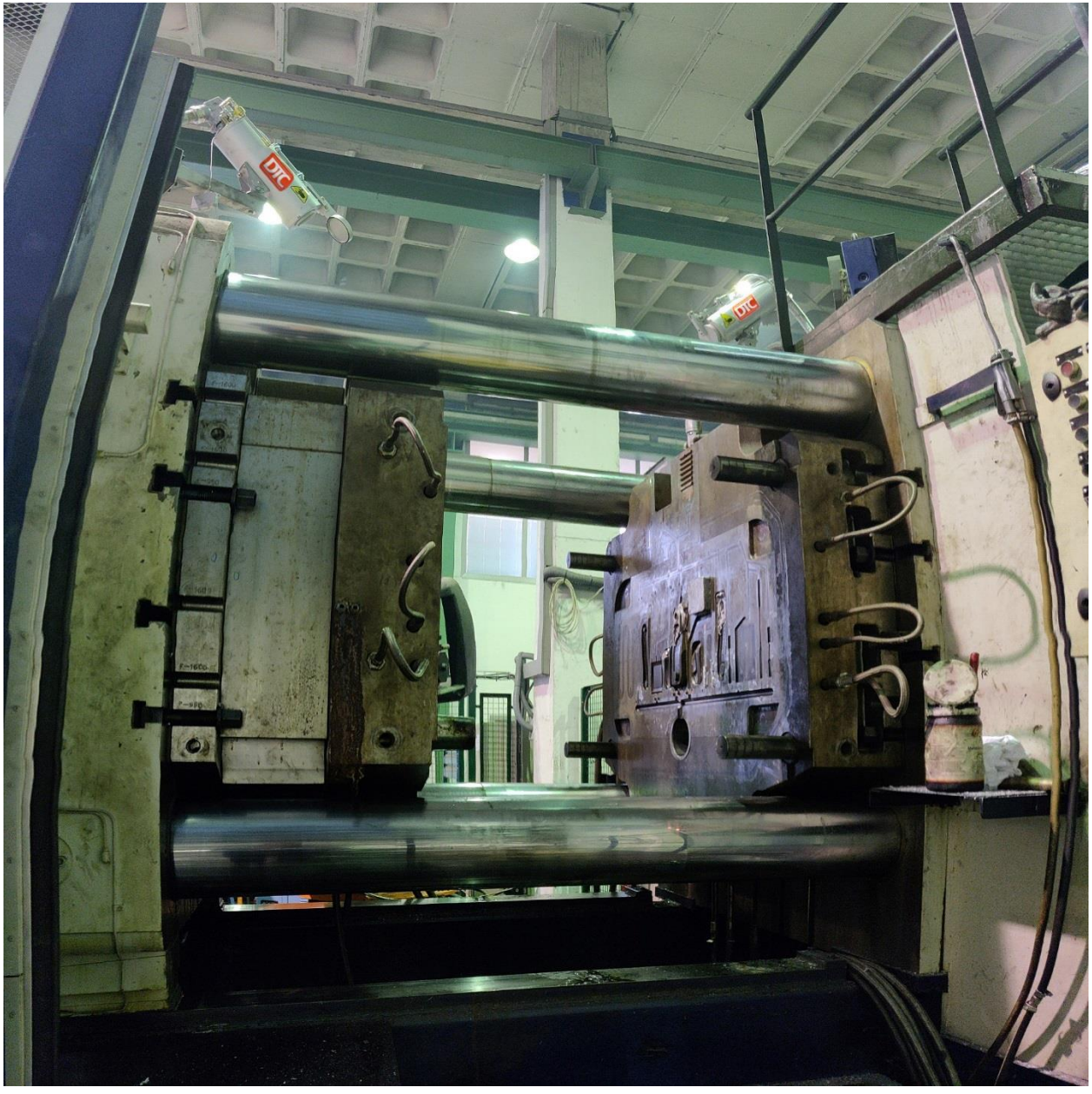
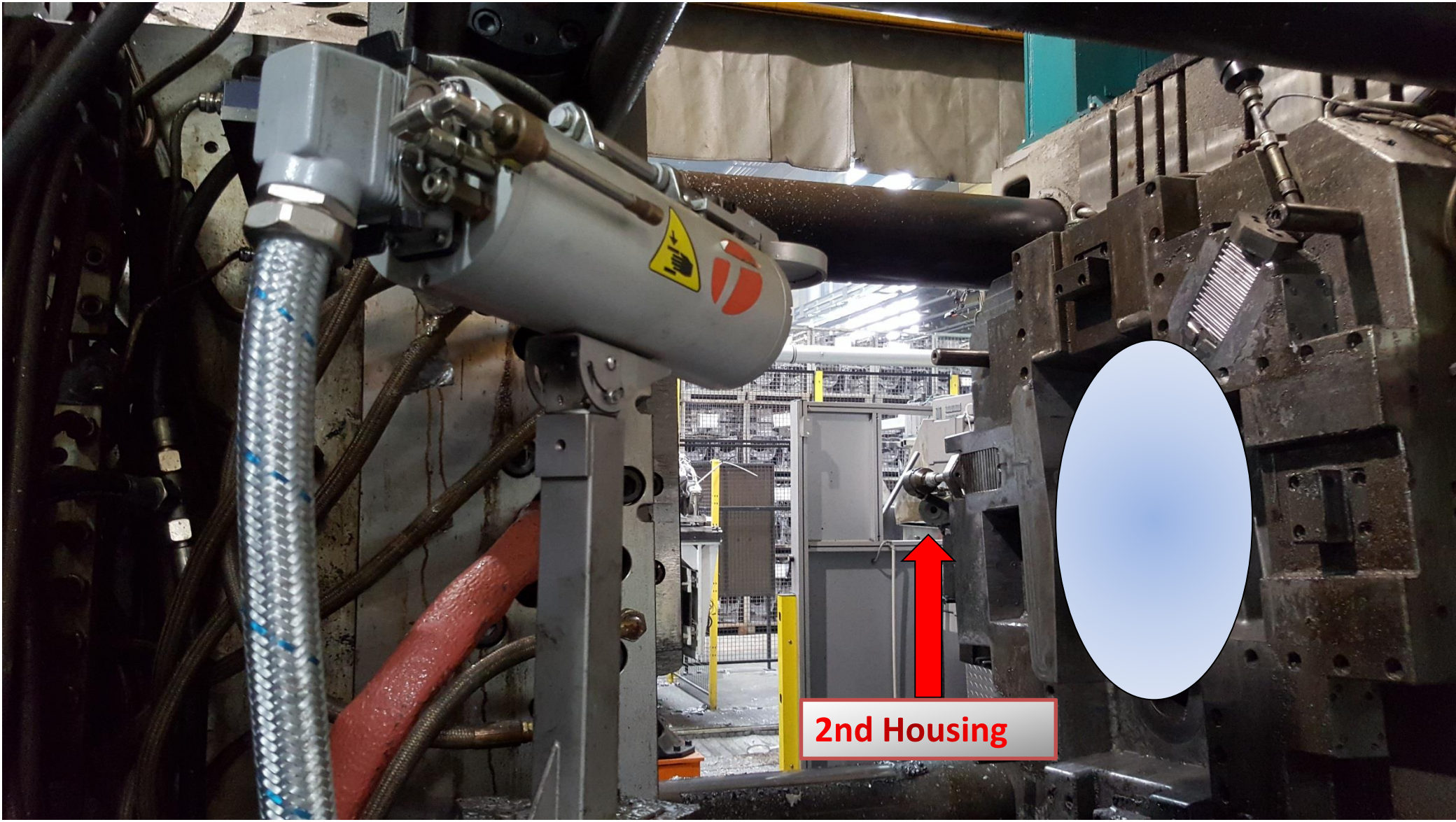
DTC – Installation on DCM



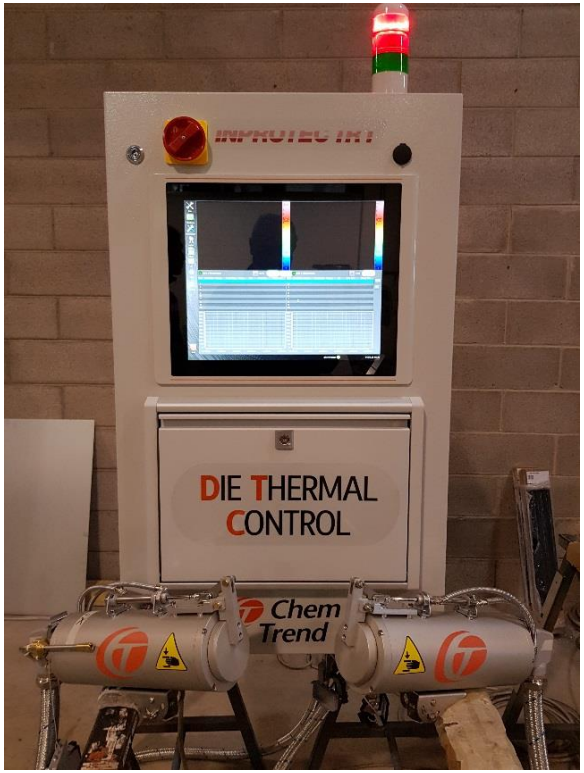
DTC – Installation on DCM



DTC – Trolley version

DTC – Fix version

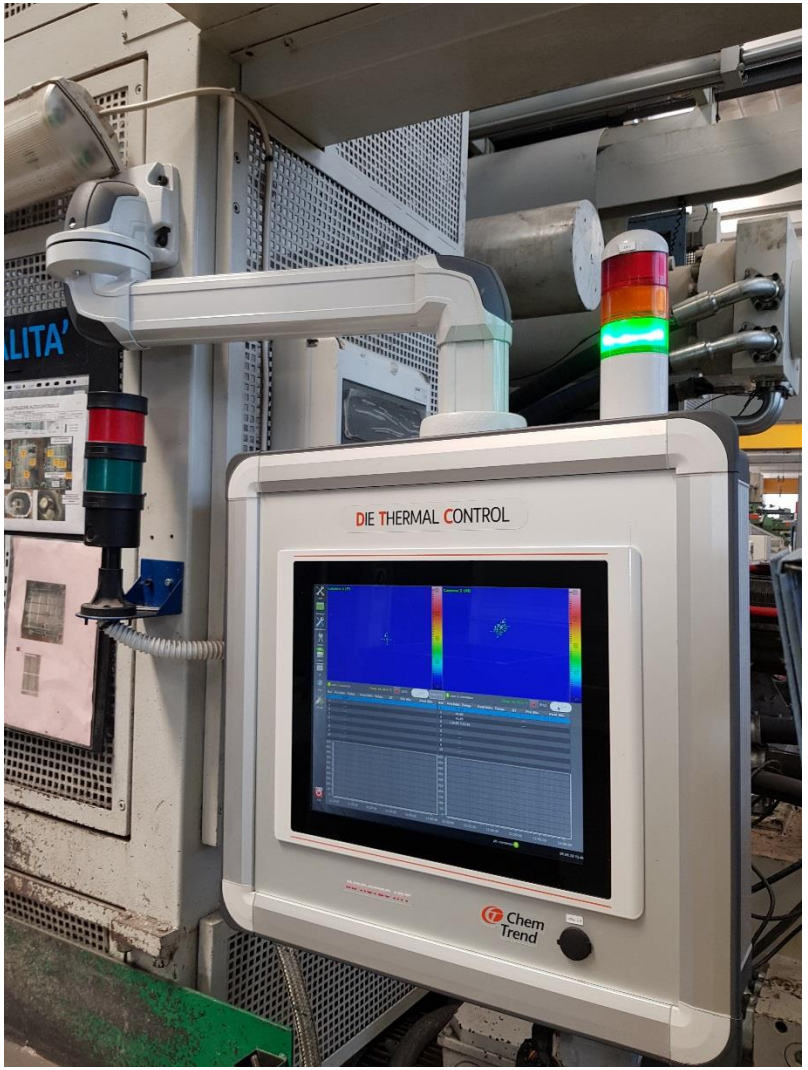
- Developed for OEM to install on HPDC machine
  - All the version of DTC (Trolley, Fix, Remote) have the predisposition for the connection in the Network Ethernet of the customer, and is conforming to the requisite for “Industry 4.0”
  - Each DTC is also however autonomous and accessible in the place where is installed, with access through password.



DTC – Remote version

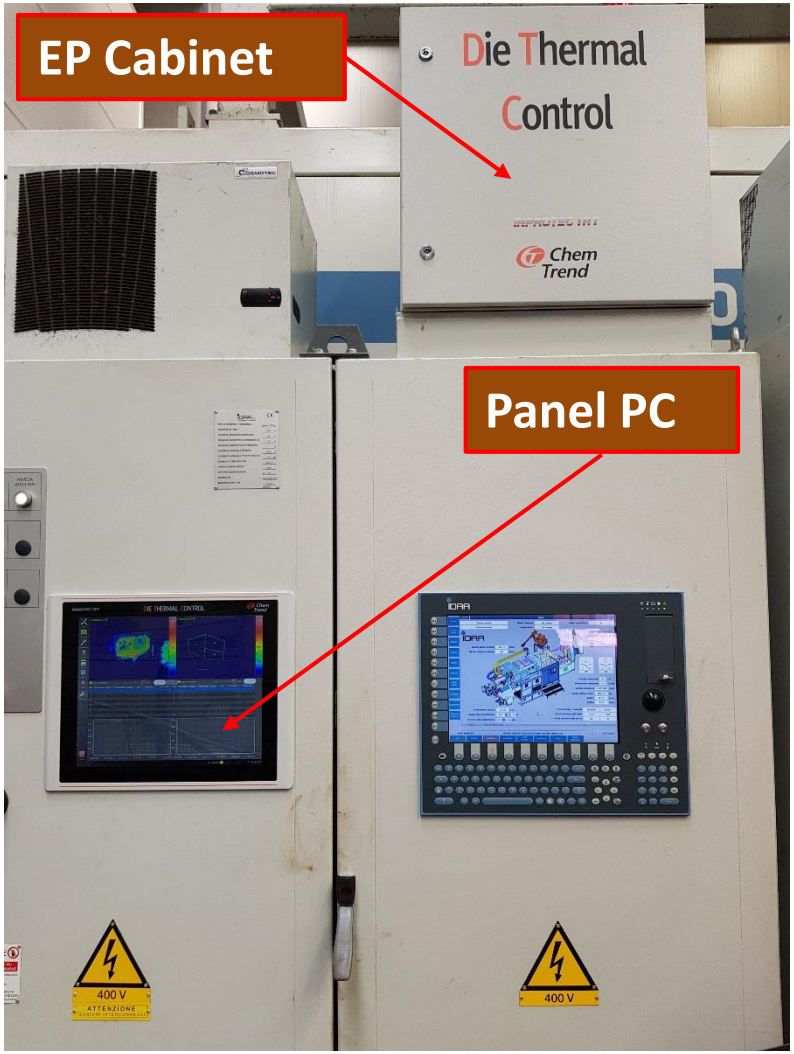
- Developed for Custom installation on HPDC machine

Panel PC positioned to operator side on mobile arm and electro-pneumatic cabinet installed on wall or on raised support



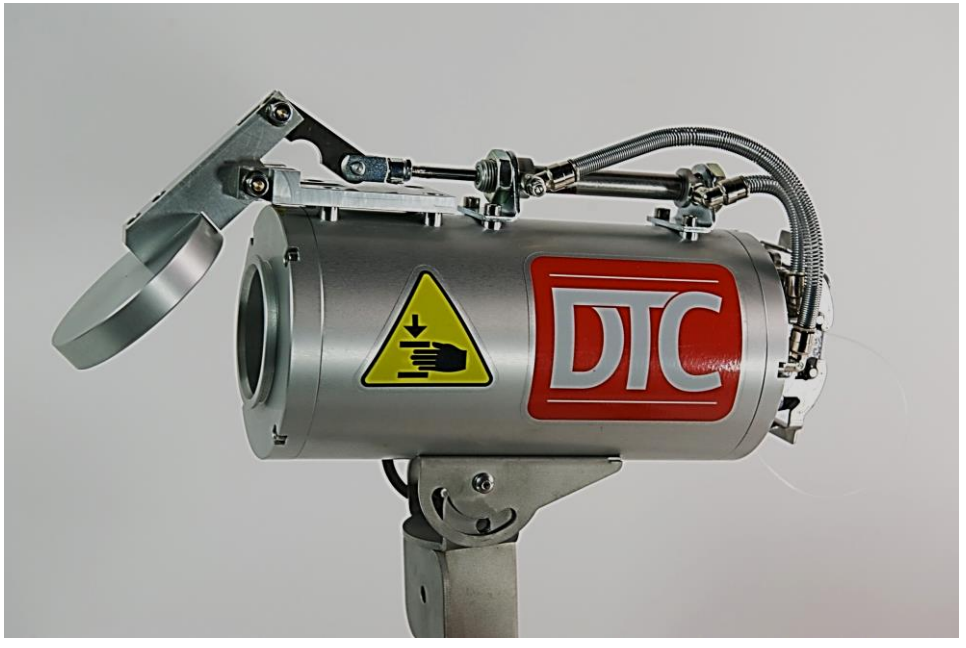
DTC – Remote version

- Developed for Custom installation on HPDC machine



Panel PC integrated on DCM cabinet and electro-pneumatic cabinet installed on wall or on raised support

Special Housings



Infrared cameras

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- 4 choices possible:
  - **FLIR A35** > 320 x 256 pixel (81.920 temperature points), more lenses available with different FOV (Field Of View)
  - **FLIR A315** > Autofocus/Motorized focus, 320 x 240 pixel (76.800 temperature points), additional lenses available, HT calibration, etc.
  - **FLIR A65** > High Definition version, 640 x 512 pixel (327.680 temperature points), more lenses available with different FOV (Field Of View)
  - **FLIR A615** > Autofocus/Motorized focus, 640 x 480 pixel (307.200 temperature points), more lenses available with different FOV (Field Of View)

DTC Software – Main page #1

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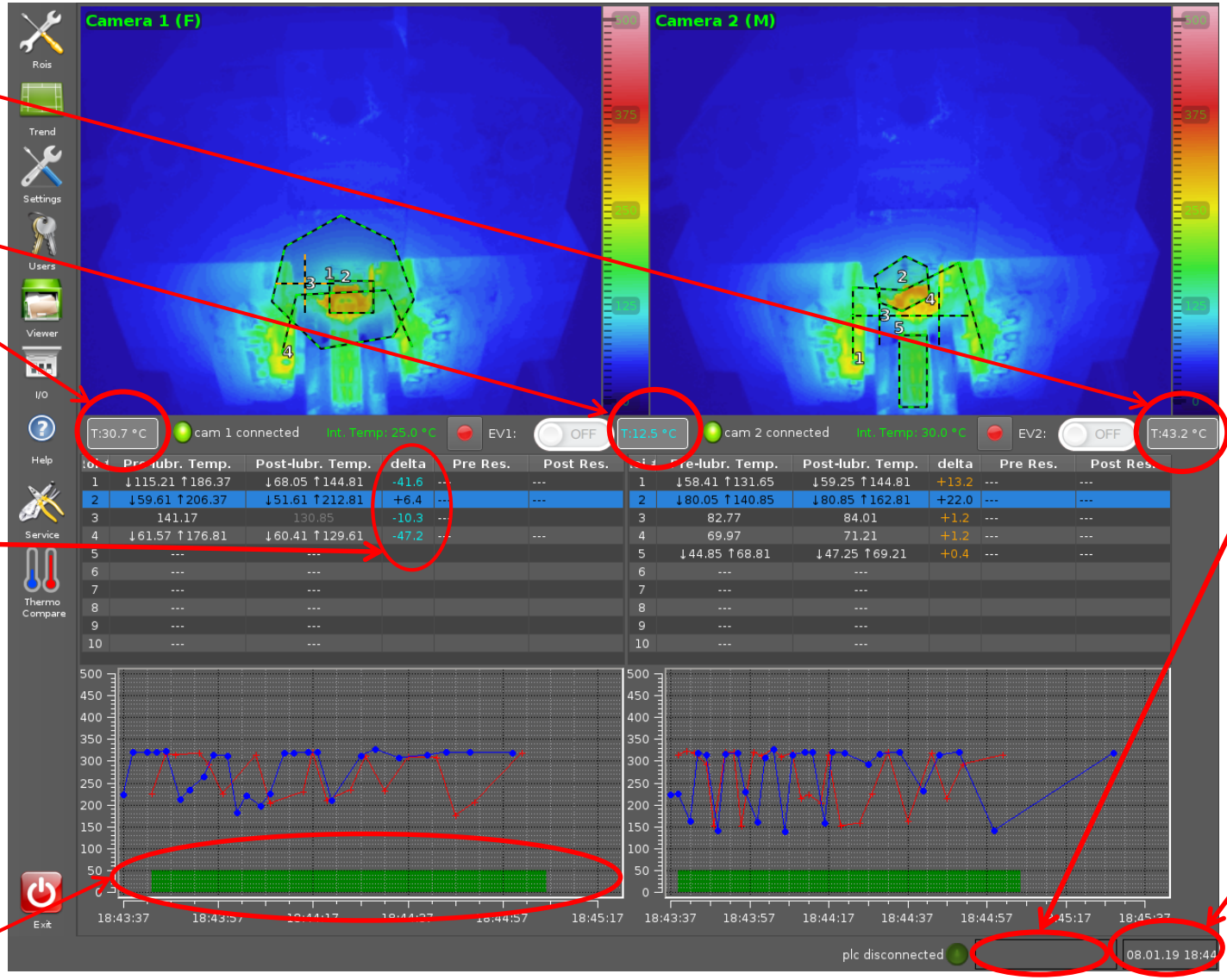
Movable marker on each image and ΔT between marker 1 and marker 2

Temperature difference POST vs PRE lubrication

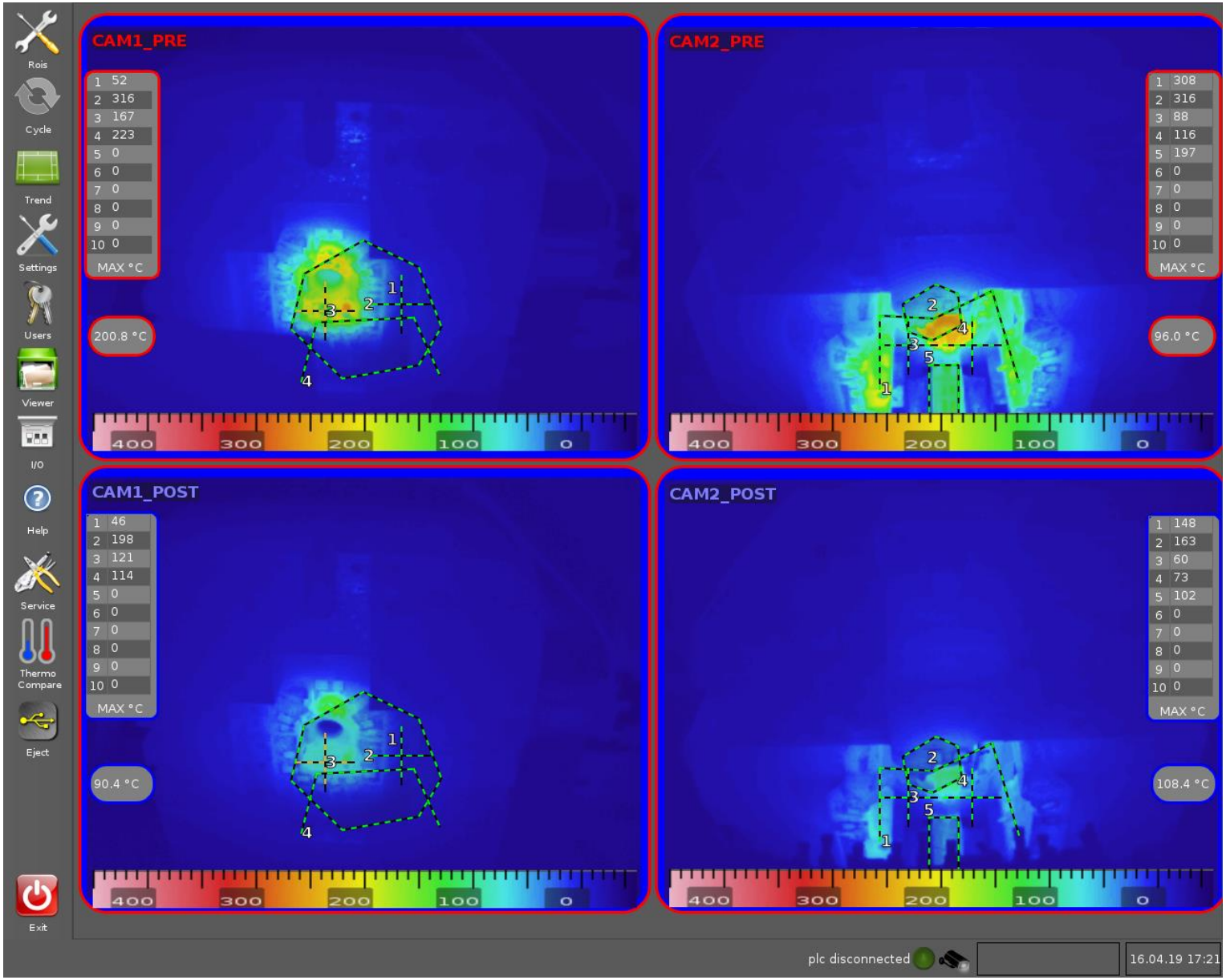
Warm-up bar

Name of Mould

Date & Time



DTC Software – Main page #2



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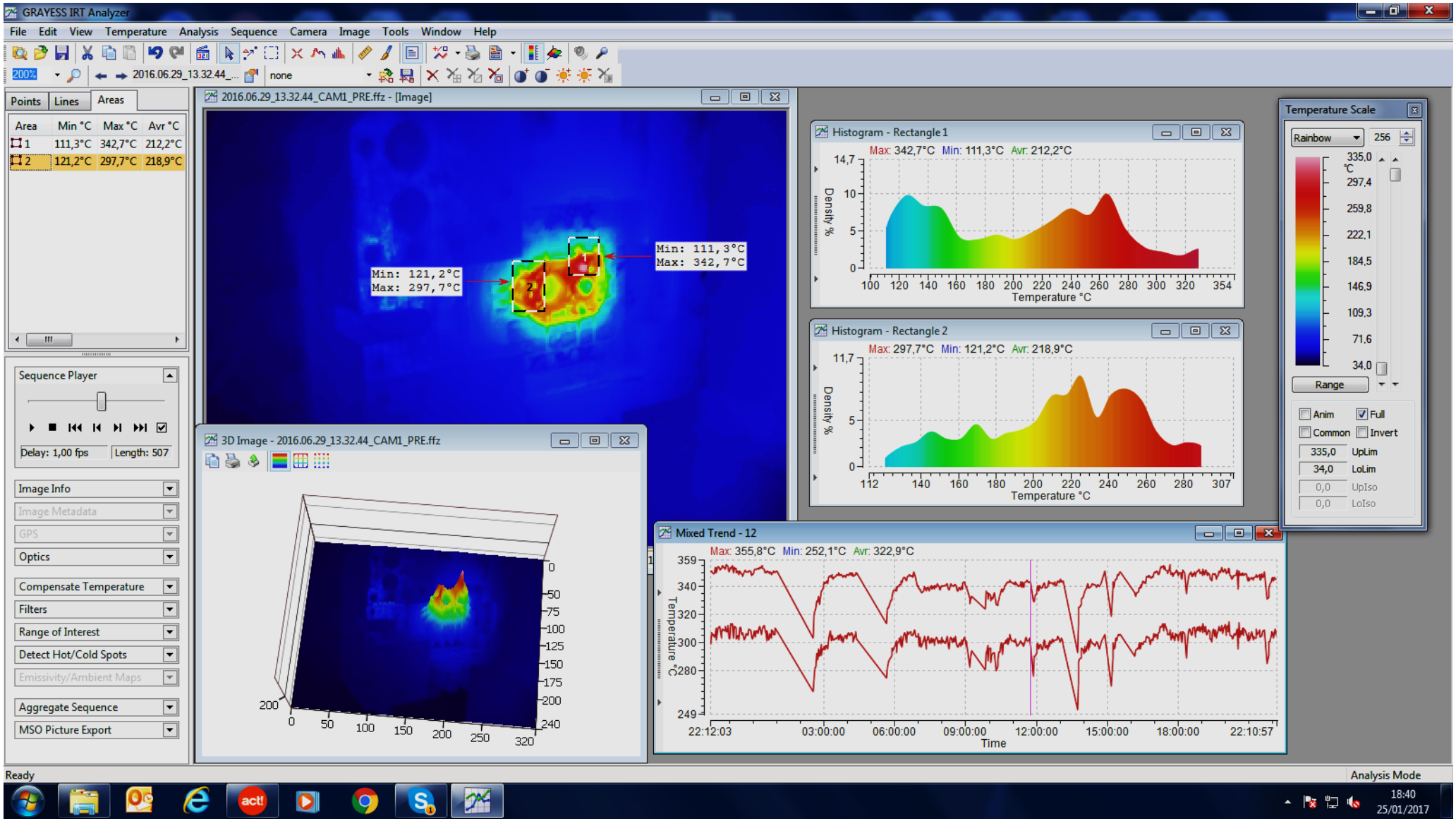
IRT – Analyzer software for PC



Interfacing

- Possible interaction with peripheral's :
  - Robot
  - Spray head
  - Thermoregulators
  - HPDC machine
- Active process!
  - Target: closed-ring process
- Open modular system
- «Slave»
- Tailor-made on Customer's needs

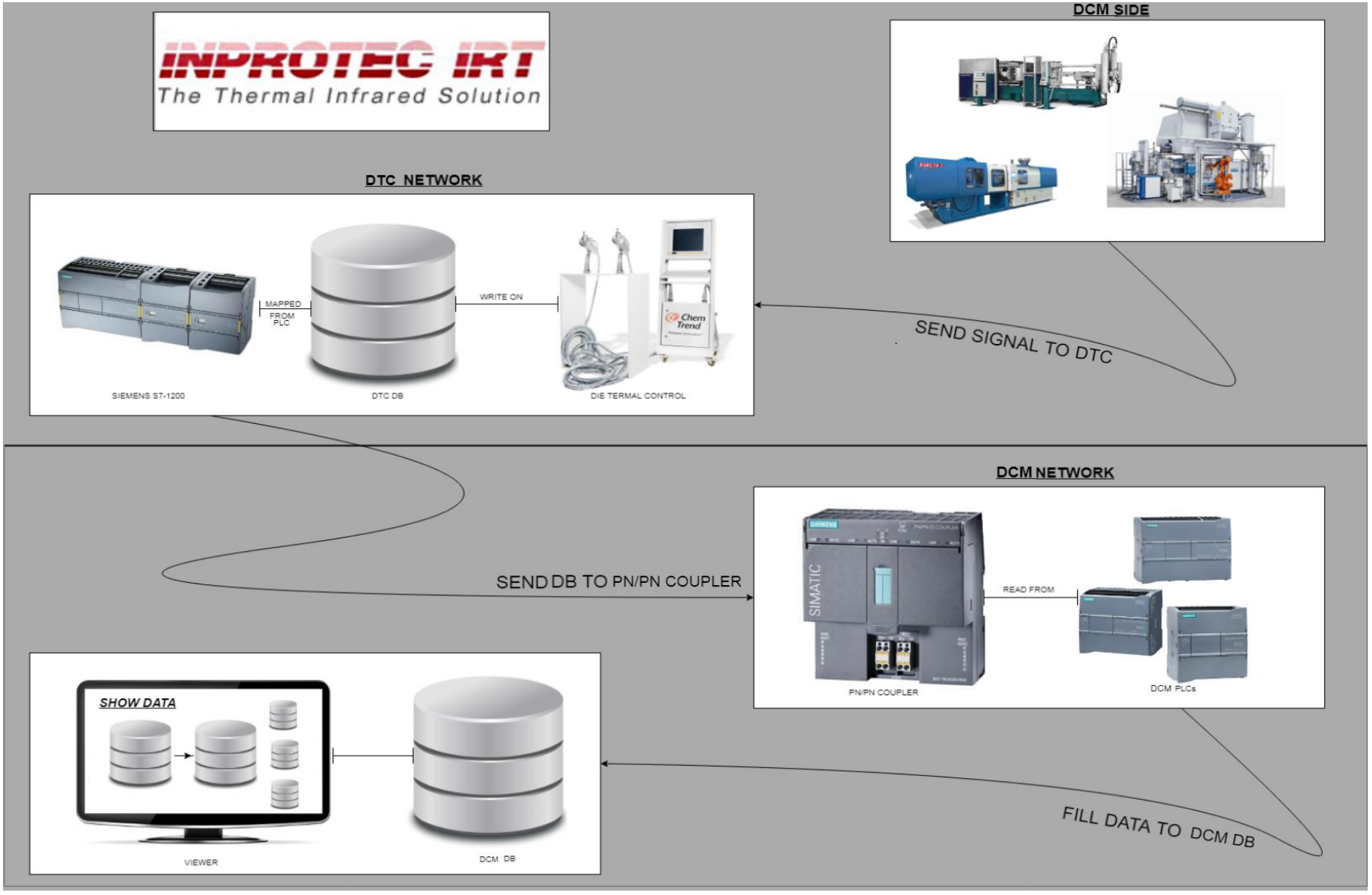
DIE CASTING INDUSTRY 4.0

Global approach

- Many devices affect temperature:
  - TCUs, sprayers, pin coolers, spot coolers, air blowers…
- In most cases, all these devices are coordinated by process technicians, but there is a lack of integration.
- Tools must be prepared to control temperature. Tool makers bear the responsibility in making temperature control possible.
- Temperature control is the result of a synergy of systems.

Need of a global approach !

PROFINET Integration

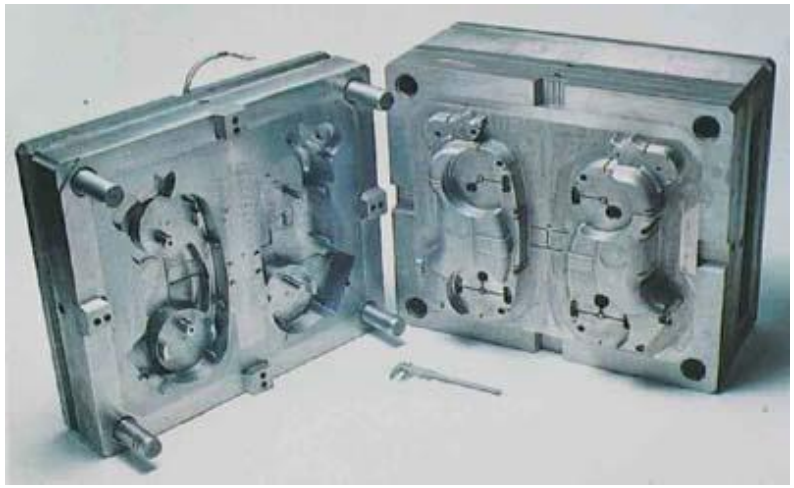


DTC Plugin system – intro

- Plugins allow full DTC customizations
- DTC „Plugin“ concept is similar to „app“ for Smartphones device: adapts the device to users specific requirements, without losing the ability to update the system core (new features, optimizazions,..)
- Plugins are an user interface to……
  - ✓ HW systems connected to DTC (thermoregulators, DCMs, Lubrication robots,……)
  - ✓ SW systems (MES, Network servers, Network databases,..)
  - ✓ DTC‘s optional devices
  - ✓ Customer‘s special requirements

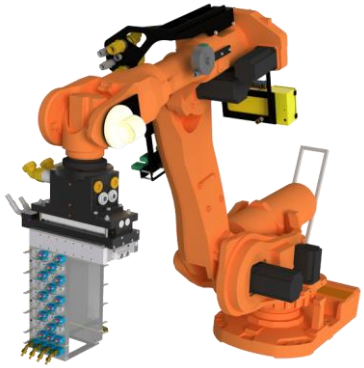
Reaction

Long-term



Short-term

Release Agents
&
Die Lubricants



Die Casting Industry 4.0

- The DTC has been tested from IMQ (Institute for the Quality Mark), Institute recognized by Italian Goverment for the asseveration of systems and plants for the Industry 4.0 regulation

IMQ

Relazione Tecnica

Rif. No. A779

Data: 2017-06-30

Relazione Tecnica – Sistema Die Thermal Control

RICHIEDENTE : **INPROTEC IRT SRL**

Via Beethoven, 24 – 20092 Cinisello Balsamo (MI)

ALTRE INFORMAZIONI: Data del sopralluogo

15/09/2017

Luogo del sopralluogo

Cinsello Balsamo

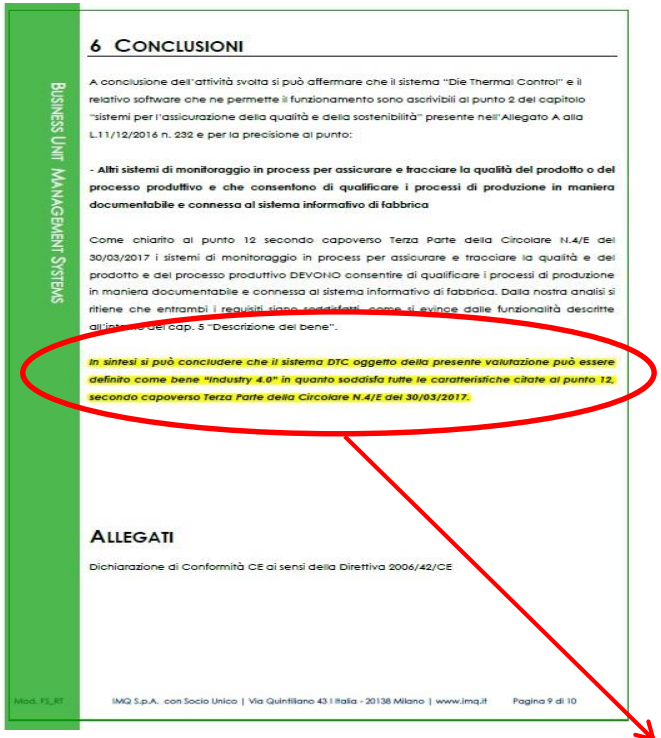
Nr. Pagine documento 10

Nr. Allegati 1

Responsabile della Valutazione — Bringhenti Lorenzo

Approvato da — Dego Ferrari

Business Unit Management Systems



6 CONCLUSIONI

A conclusione dell'attività svolta si può affermare che il sistema "Die Thermal Control" e il relativo software che ne permette il funzionamento sono ascrivibili al punto 2 del capitolo "sistemi per l'assicurazione della qualità e della sostenibilità" presente nell'Allegato A alla L.11/12/2016 n. 232 e per la precisione al punto:

- Altri sistemi di monitoraggio in process per assicurare e tracciare la qualità del prodotto o del processo produttivo e che consentono di qualificare i processi di produzione in maniera documentabile e connessa al sistema informativo di fabbrica

Come chiarito al punto 12 secondo capoverso Terza Parte della Circolare N.4/E del 30/03/2017 i sistemi di monitoraggio in process per assicurare e tracciare la qualità e del prodotto e del processo produttivo DEVONO consentire di qualificare i processi di produzione in maniera documentabile e connessa al sistema informativo di fabbrica. Dalla nostra analisi si ritiene che entrambi i requisiti siano soddisfatti, come si evince dalle funzionalità descritte all'interno del cap. 5 "Descrizione del bene".

In sintesi si può concludere che il sistema DTC oggetto della presente valutazione può essere definito come bene "Industry 4.0" in quanto soddisfa tutte le caratteristiche citate al punto 12, secondo capoverso Terza Parte della Circolare N.4/E del 30/03/2017.

ALLEGATI

Dichiarazione di Conformità CE ai sensi della Direttiva 2006/42/CE

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Business Unit Management Systems

….the DTC system can be defined "Industry 4.0" because it satisfies all the characteristics indicated at point 12, ….of the circular N.4/E dated 30/03/2017