EXERGEN Global
Industrial Sales

SPEEDBOOSTING THE DIGITAL PRINTING INDUSTRY!

December 1, 2016, Amsterdam

IMI Amsterdam

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Speed Increase through thermal management via infrared sensing

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Exergen designs and produces the world's only self powered non-contact Infrared temperature sensors (IRt/c) with a high level of accuracy and repeatability to regulate and control various industrial OEM machine applications

Based in Boston/Watertown USA and Veghel/Eindhoven the Netherlands

180 employees

>70 patents

January 2016: F&S Global Entrepreneurial Company of the Year Award

Customers: HP-Indigo, Heidelberg, Xerox, Kodak, M&R, Xeikon, Fuji

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Increasing Speed and Quality in many OEM applications

Digital Printing

Textile Printing

3D Printing

Various:

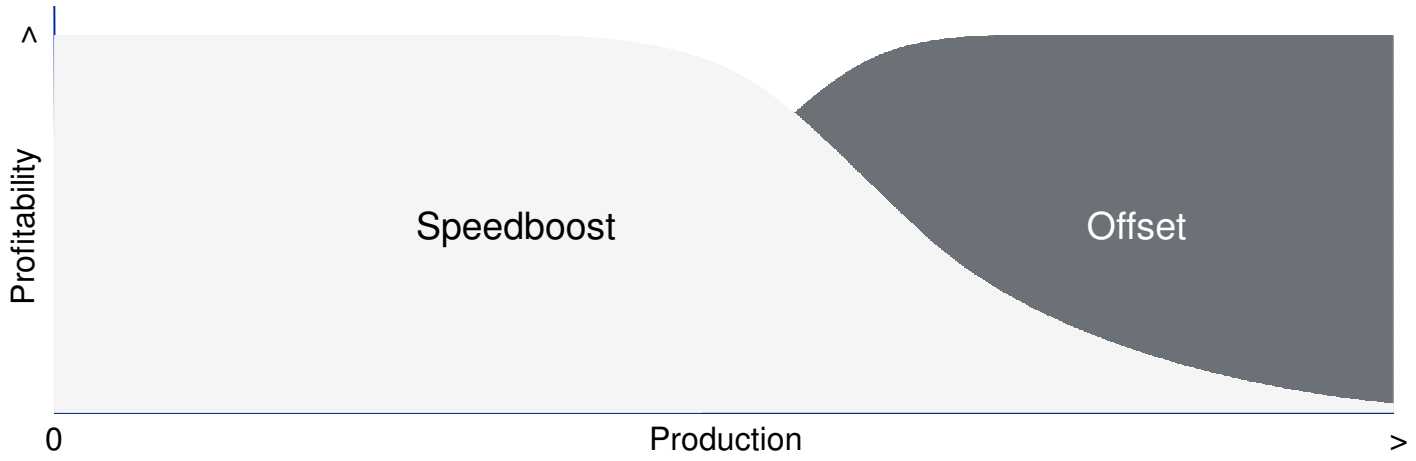
- ***Medical / Aesthetical / Diagnostics***
- ***Semiconductor Industry***
- ***Automotive - Racing***
- ***Food***
- ***Plastics***
- ***Agriculture Industry***

WORKING MECHANISM

AND

PERFORMANCE

Speedboost Equation in Digital Printing



Our best secret weapon:
Dr. Francesco Pompei & his team

Exergen's founder and president, Dr. Pompei, holds 70 patents in non-invasive thermometry for medical and industrial applications, is the inventor of the IRt/c and the Temporal Artery Thermometer.

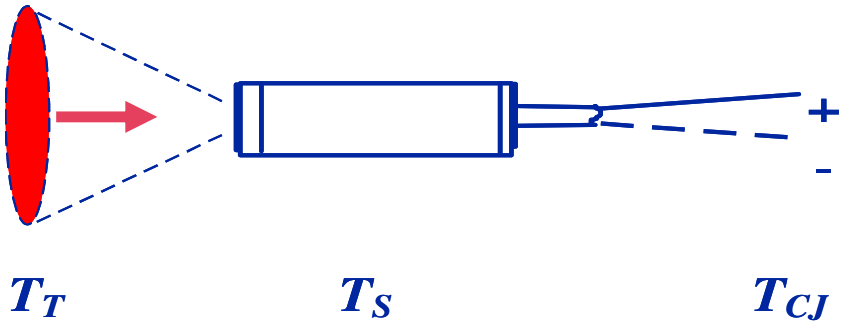
He is a world expert in thermometry and thermodynamics.

New method: Speedboost

Leads to a General Equation for Non-Contact Temperature Monitoring of Internal Temperatures of Moving Materials

$$T_c = \frac{h\sqrt{\tau\kappa}}{k}\sinh\left(\frac{a}{\sqrt{\tau\kappa}}\right)\left(T_s - T_\infty\right) + T_s + \left[\cosh\left(\frac{a}{\sqrt{\tau\kappa}}\right) - 1\right]\left(T_s - T_0\right)$$

Principles of the Self-Powered IRt/c



$$mV_{out} = c\,(T_T - T_S) + \alpha\,(T_S - T_{CJ})$$
$$= \alpha\,(T_T - T_{CJ}) \quad when\ c = \alpha$$
$$\alpha = Seebeck\ coefficient$$

Uniqueness of our IRt/c

- No Power Required
- T/C Compatible
- 0.0001°C Resolution
- 0.01°C Repeatability
- Intrinsically Safe
- Simple, Rugged, Cost effective

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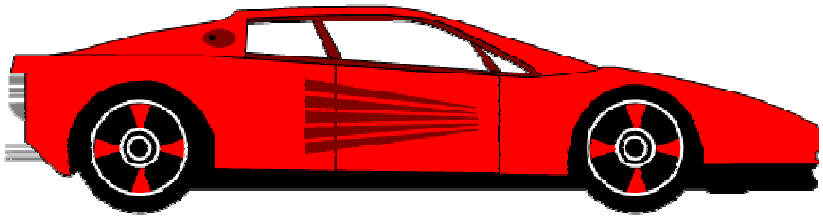
Thermal Management:

SPEEDBOOST



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Jean Baptiste Joseph Fourier
1768-1830

- **Fourier's Equation of Heat Conduction**

$$\left(\frac{q}{A}\right)_x = -k\frac{\partial T}{\partial x}$$

- **Unsteady State Heat Conduction for Moving Materials**

$$\frac{\partial^2 T}{\partial x^2} = \frac{1}{\kappa}\frac{\partial T}{\partial t}$$

Pierre Simon Marquis de LaPlace
1749 -1827

- **Laplace Transform Method of Solution**

$$\overline{T}(x,s) = \int_0^\infty e^{-st} T(x,t)dt$$

- **Converts Partial Differential Equation to Ordinary Differential Equation**

$$\frac{d^2\overline{T}}{dx^2} - \frac{s}{\kappa}\overline{T} = \frac{T_o}{\kappa}$$

Francesco Pompei
1948 -

- **Patented New Method of Solution Leads to a General Equation for Non-Contact Temperature Monitoring of Internal Temperatures of Moving Materials**

$$T_c = \frac{h\sqrt{\tau\kappa}}{k}\sinh\left(\frac{a}{\sqrt{\tau\kappa}}\right)\left(T_s - T_\infty\right) + T_s + \left[\cosh\left(\frac{a}{\sqrt{\tau\kappa}}\right) - 1\right]\left(T_s - T_0\right)$$

Deriving The SPEEDBOOST Equation

$$T_c = K_1(T_s - T_\infty) + T_s + K_2(T_s - T_o)$$

- Set the surface temperature equal to the center temperature, then the equation reduces to

$$T_c = T_s$$

$$\frac{(T_\infty - T_s)}{(T_s - T_o)} = \frac{K_2}{K_1}$$

- Since K_2/K_1 is a function only of material properties and speed:

The ratio can be formed, which then becomes:

The SPEEDBOOST Equation

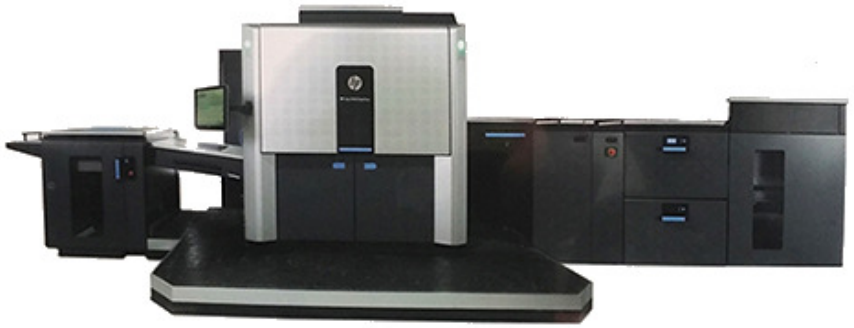
$$\frac{V_{new}}{V_{old}} = \frac{\left(\overline{\Delta T}\right)_{new}}{\left(\overline{\Delta T}\right)_{old}}, \quad where\ \overline{\Delta T} = \frac{T_\infty - T_s}{T_s - T_o}$$

- General Equation for Non-Contact IR Temperature Monitoring of Internal Temperatures of Moving Materials is Combined with Surface Temperature
- Leads to Uniform Material Temperature When Controlled via the SPEEDBOOST Equation
- Which Forces the Control System to Apply Heat at an Optimally Balanced Rate

Example SPEEDBOOST: HP Indigo

HP Indigo 12000 Digital Press

A 29 inch digital offset press with extensive capabilities



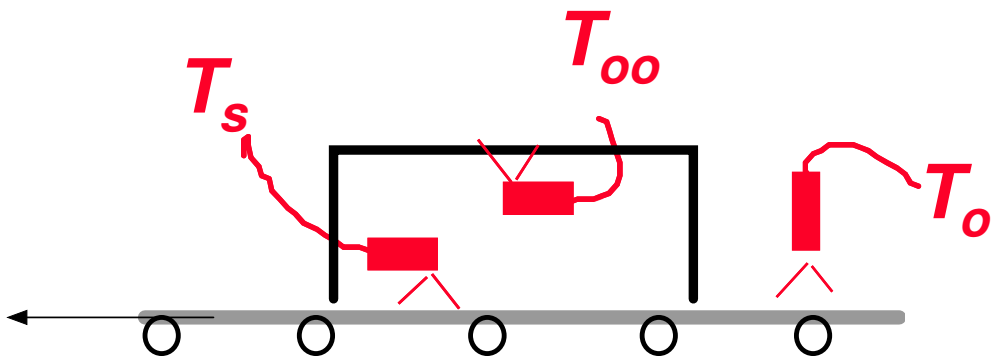
Printing speed

- 3450 sheets per hour 4/0
- 4600 sheets per hour in EPM 3/0
- 1725 sheets per hour 4/4
- 4600 sheets per hour 1/1 (monochrome)

Example SPEEDBOOST: Drying

- **Existing Set-up:**
  - T_{oo} = 260 C
  - T_s = 85 C
  - T_o = 25 C
- **New Set-up:**
  - T_{oo} = 260 C
  - T_s = 85 C
  - T_o = 40 C (with preheat)
- **Potential Speed Increase*:**

  $\Rightarrow$ **33%**



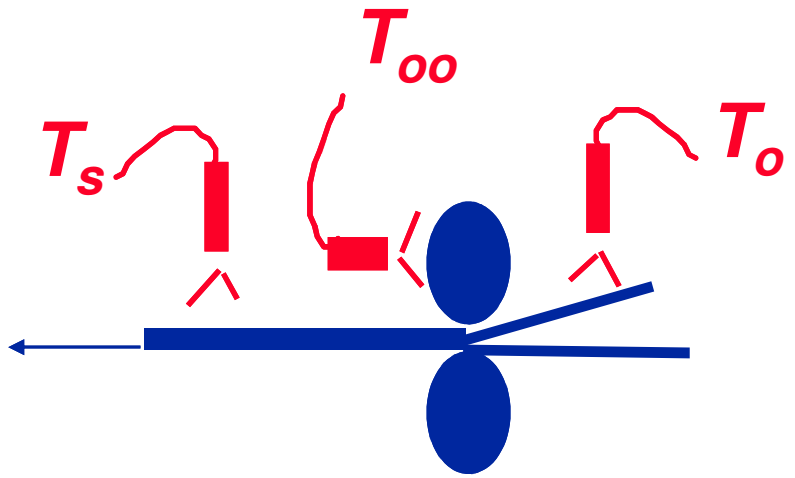
$$\overline{\Delta T} = \frac{T_\infty - T_s}{T_s - T_o}$$

*Assuming all other factors are permitting

Example SPEEDBOOST: Laminating

- **Existing Set-up:**
  - T_{oo} = 105 C
  - T_s = 85 C
  - T_o = 25C
- **New Set-up:**
  - T_{oo} = 110 C
  - T_s = 85 C
  - T_o = 25C
- **Potential Speed Increase*:**

  $\Rightarrow$ **25%**



$$\overline{\Delta T}_{Old} = \frac{T_\infty - T_s}{T_s - T_o} = \frac{105-85}{85-25} = \frac{20}{60}$$

$$\overline{\Delta T}_{New} = \frac{110-85}{85-25} = \frac{25}{60}$$

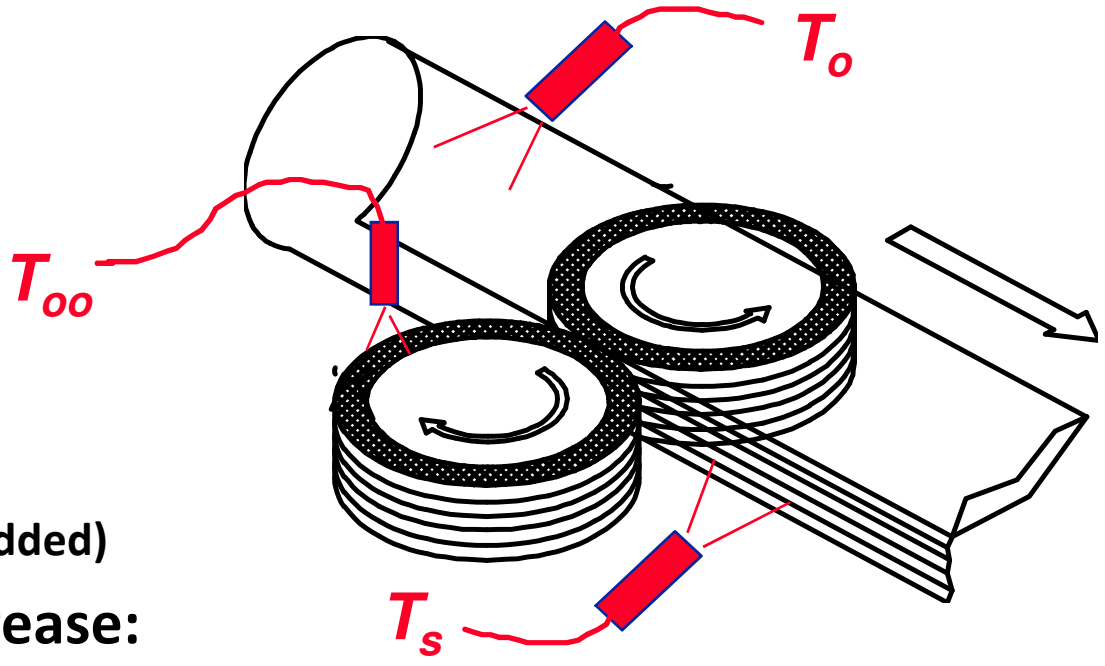
$$\frac{V_{New}}{V_{Old}} = \frac{\overline{\Delta T}_{New}}{\overline{\Delta T}_{Old}} = \frac{25/60}{20/60} = \frac{25}{20} = 1.25$$

*Assuming all other factors are permitting

Example SPEEDBOOST: Heat Sealing

- **Existing Set-up:**
  - T_{oo} = 150 C
  - T_s = 120 C
  - T_o = 25 C
- **New Set-up:**
  - T_{oo} = 150 C
  - T_s = 120 C
  - T_o = 45 C (with preheat added)
- **Potential Speed Increase:**

$\Rightarrow$ **27%**



$$\overline{\Delta T} = \frac{T_\infty - T_s}{T_s - T_o}$$

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SPEEDBOOST quote: M&R Printing

We're always looking for ways to increase flash curing speed and quality in the most cost efficient way possible. That meant working with an innovative and industry-leading sensor vendor to find the sensor that met our requirements. Exergen Global was that vendor. A complex problem was tackled by our combined teams and solved in a very neat way:

"A customized Exergen IRt'c sensor"

- Bo Magda, VP of Engineering of M&R, Chicago IL, USA

Our role

We don’t ‘just’ supply sensors, we provide:

Sensoranics: Custom Specific Solutions and developments

Technical support in the R&D phase and beyond

Huge knowledge and experience in thermodynamic processes.

Assistance in sensor read-out electronics: the most accurate, fast and cheap solution

Wireless sensor readout solutions

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How does a non contact infrared sensor solution fit into YOUR application or system?

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THANK YOU

AND REMEMBER…

YOU WILL BE OUR CUSTOMER…

BUT

YOU DON'T KNOW THAT YET!!!!!