

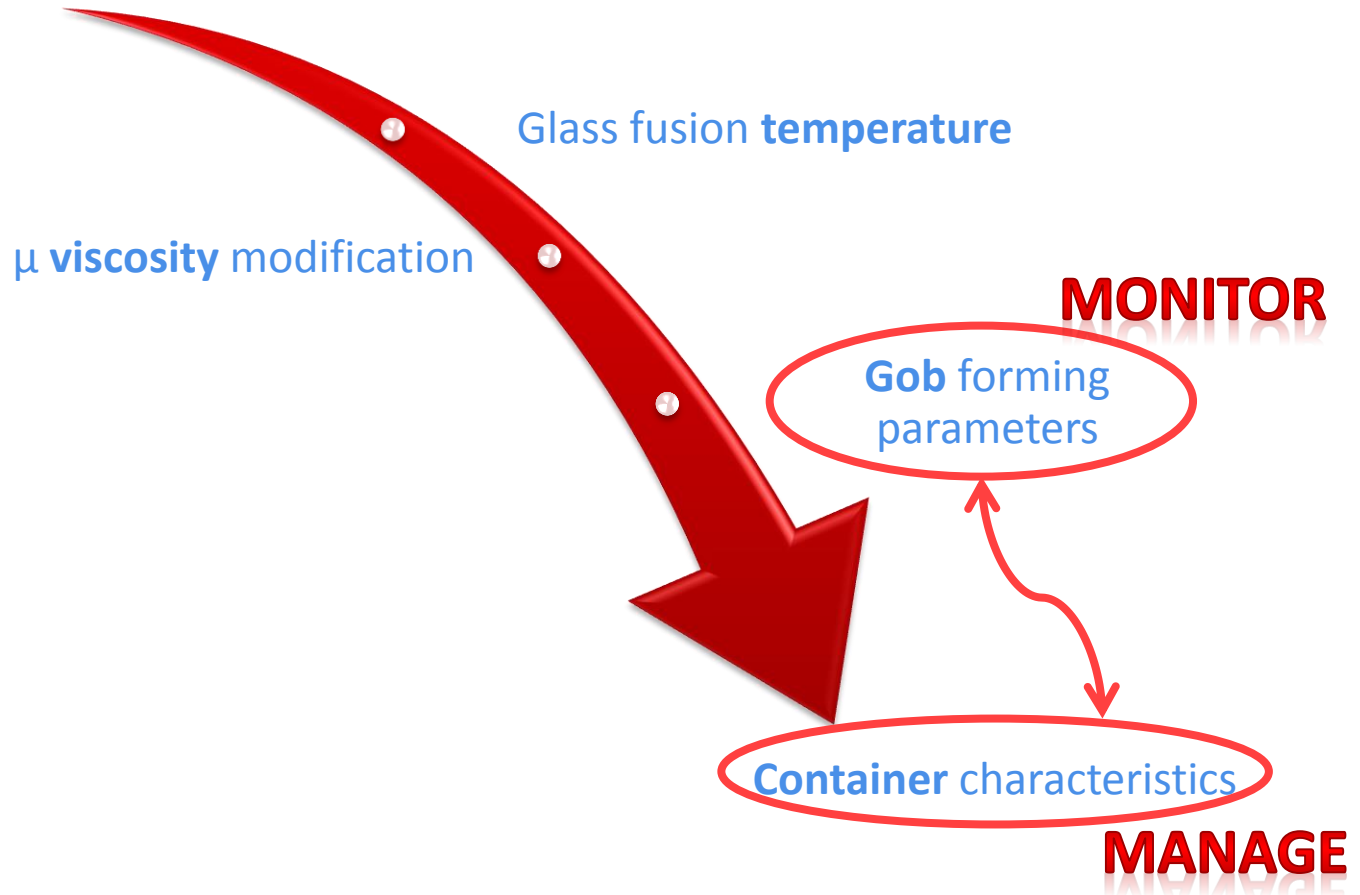
# **GLASSPEX 2015**

**Hot End process control:**

**Two bricks to characterize your  
production and pilot your process**

# INTRODUCTION

## Composition



# **GLASSPEX 2015**

- 1. Master your process with Gob Supervision.**
- 2. One new product : Tiamama Hot End Laboratory Tool.**

## 1. Gob Critical Parameters

Which parameters need to be monitored for critical gob and forming performance ?

## 2. Available Tools for Gob Monitoring

- Optical Pyrometric measurement tools
- Gob vision shape control state of the art
- Closed loop weight control objectives

## 3. Environment Benefits in Gob Control

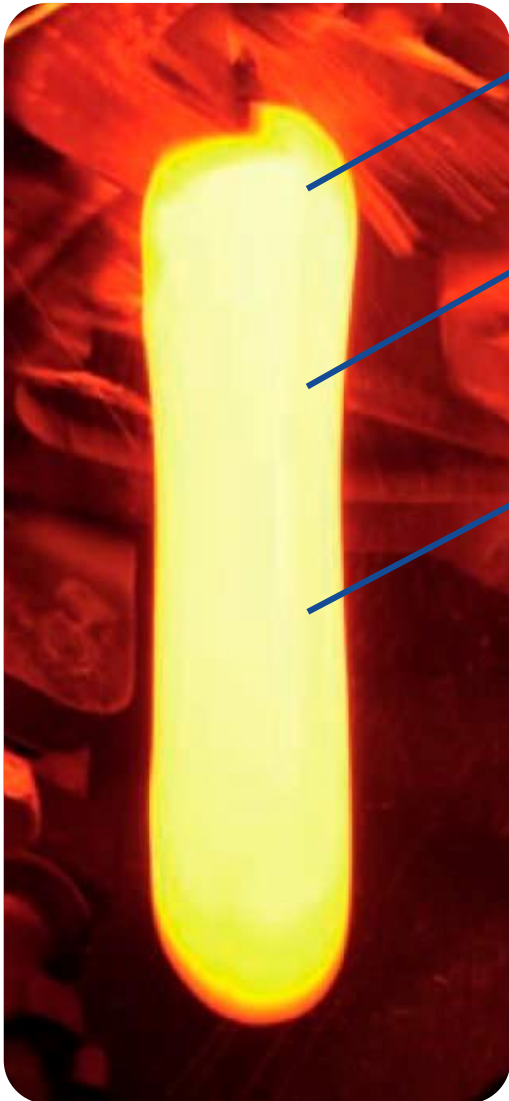
- Energy
- Raw materials
- Safety and Health

# Gob Critical Parameters



Credit: Lober, Müller-Simon, Bergmann and Simon, IVG, IGF-AIF-FV Nr. 16547N

# Available Tools for Gob Monitoring: Optical pyrometric measurement tools



**1- Gob weight control**

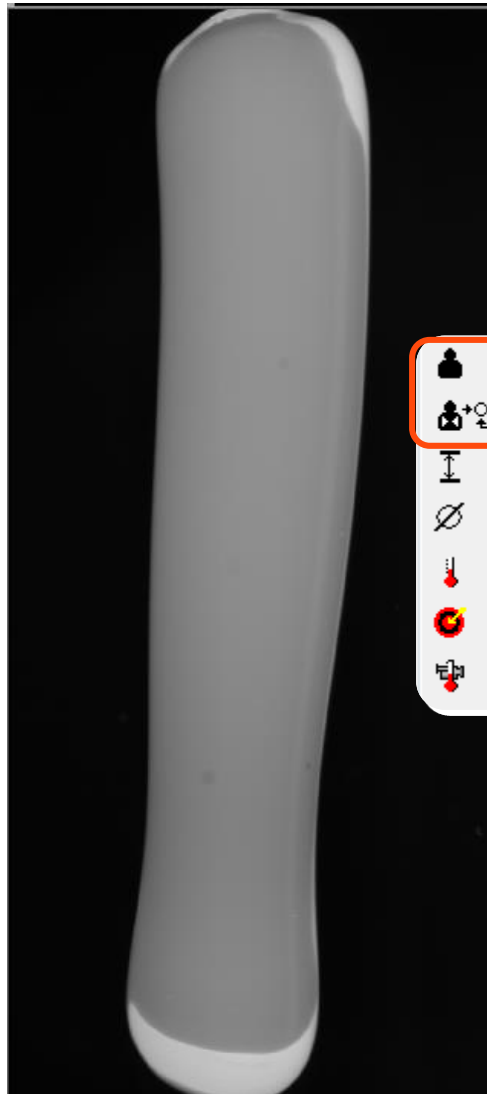
**2- Gob temperature monitoring**









**3- Gob shape monitoring and reference storage**



**Immediate feedback to improve gob properties and prevent production loss**

# Feature 1 - Gob Weight Control (1/2)



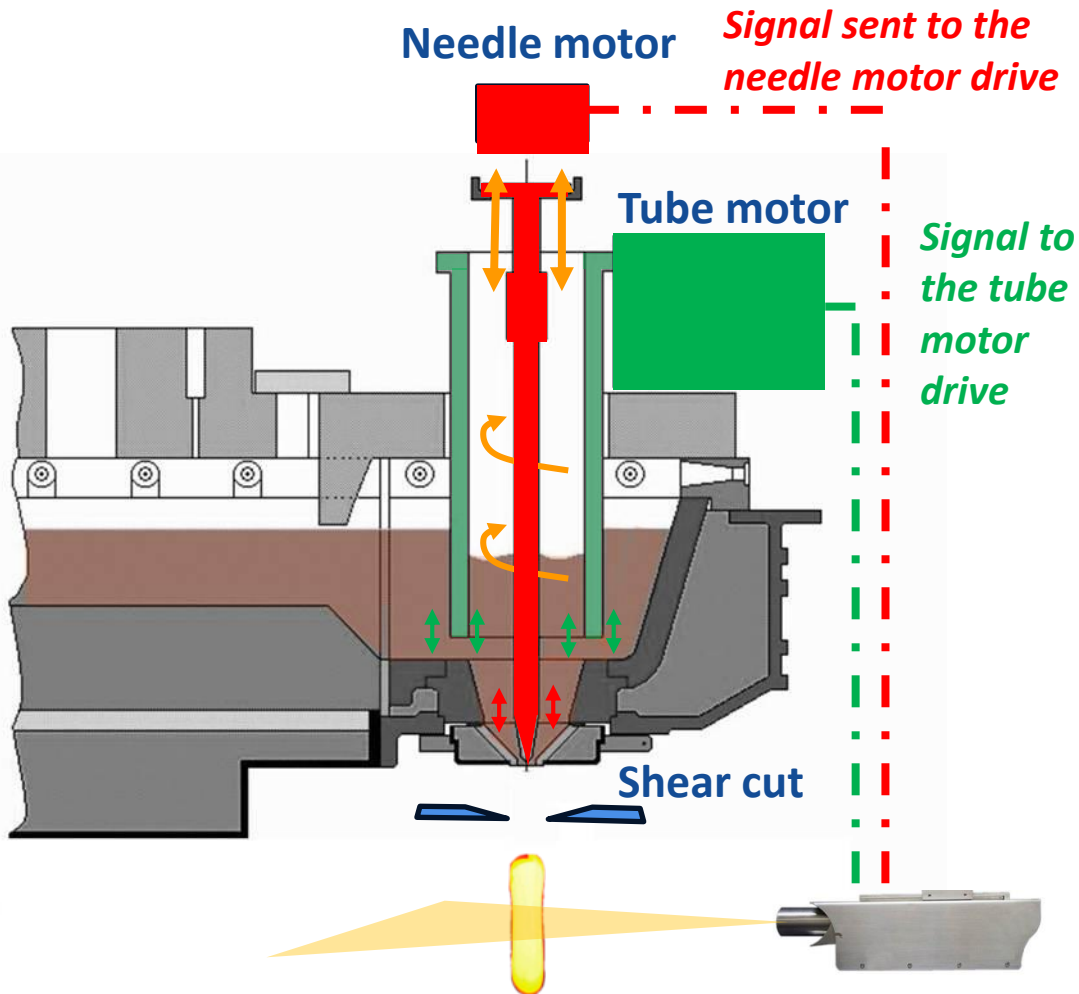
	504,3 g	
	504,0 g	
	200,2 mm	
	38,8 mm	
	1141 °C	
	100 %	
	0 °C	

## Your benefits :

- ✓ Reduction of container weight
- ✓ Reduction of job change time,
- ✓ More stable conditions in the forehearth

# Feature 1 - Gob Weight Control (2/2)

“CLOSED LOOP”

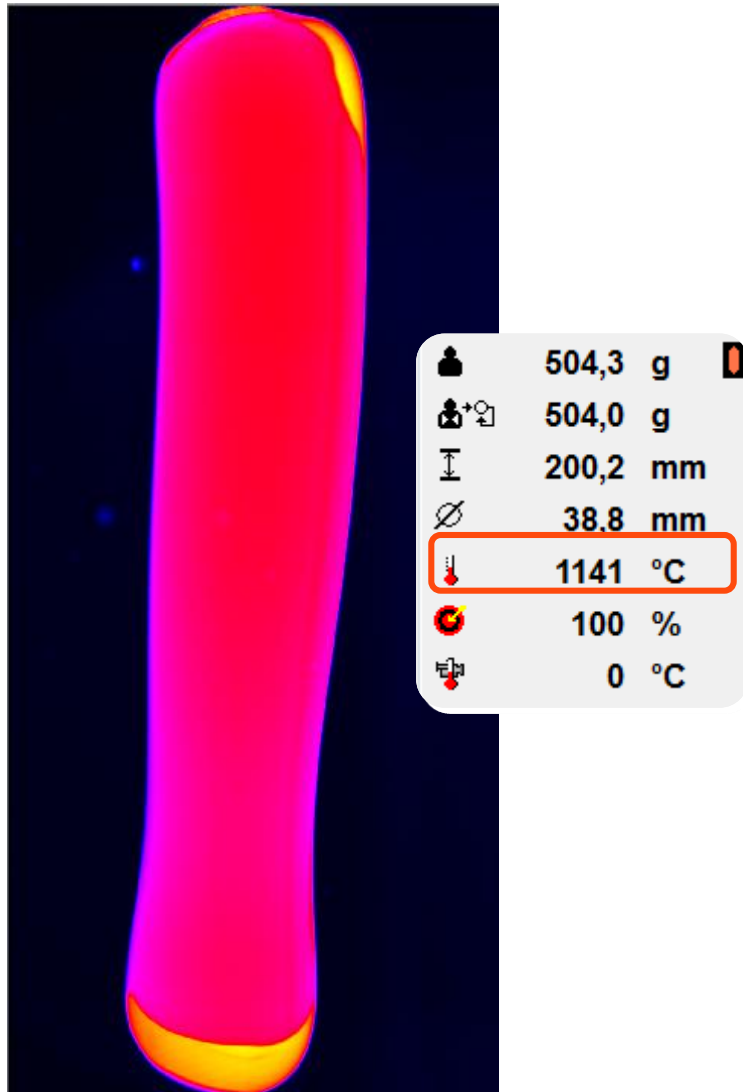


## CLOSED LOOP

- **AUTOMATIC** gob weight control by adjusting the tube height or the needle position
- Keeps the gob weight stable within  $\pm 0,25\%$



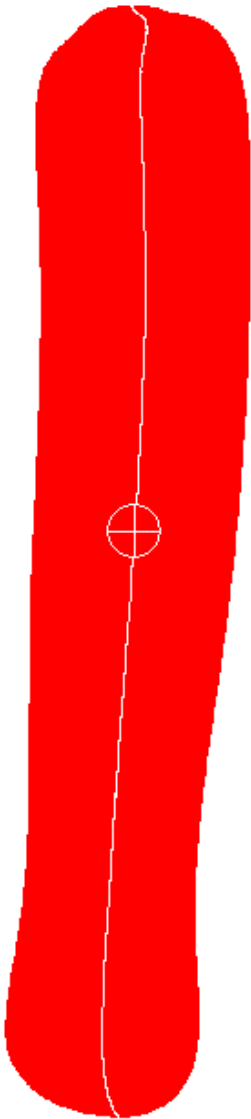
## Feature 2 - Gob temperature (1/1)



- Temperature measurement along the gob,
- Accuracy :  $\pm 3^{\circ}\text{C}$
- Multi zone and average temperature display,

### Your benefits :

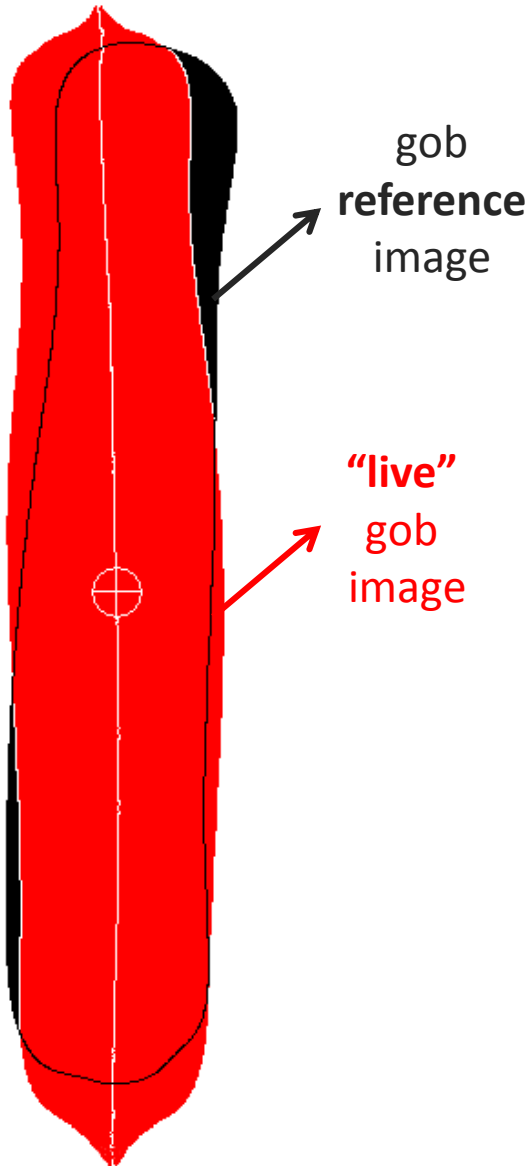
- ✓ Temperature reading
- ✓ Temperature mapping of the gob surface



### GOB SHAPE MONITORING

Your benefits :

- ✓ Gob tilt and length **alerts**.
- ✓ **Immediately** identify bad shear cuts



## GOB REFERENCE STORAGE

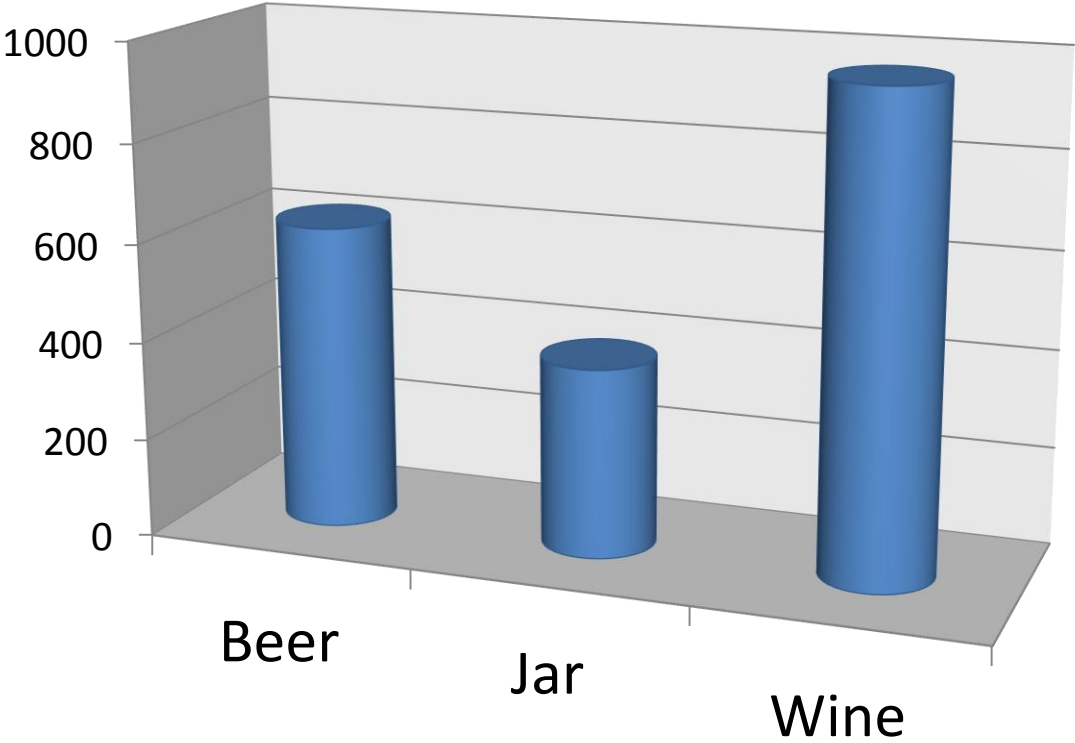
Your benefits :

- ✓ True **job change assistance**
- ✓ **Reference gobs** significantly reduces the job change time
- ✓ Eliminate trial & error during **job change**

# Benefits

- **Raw Material**

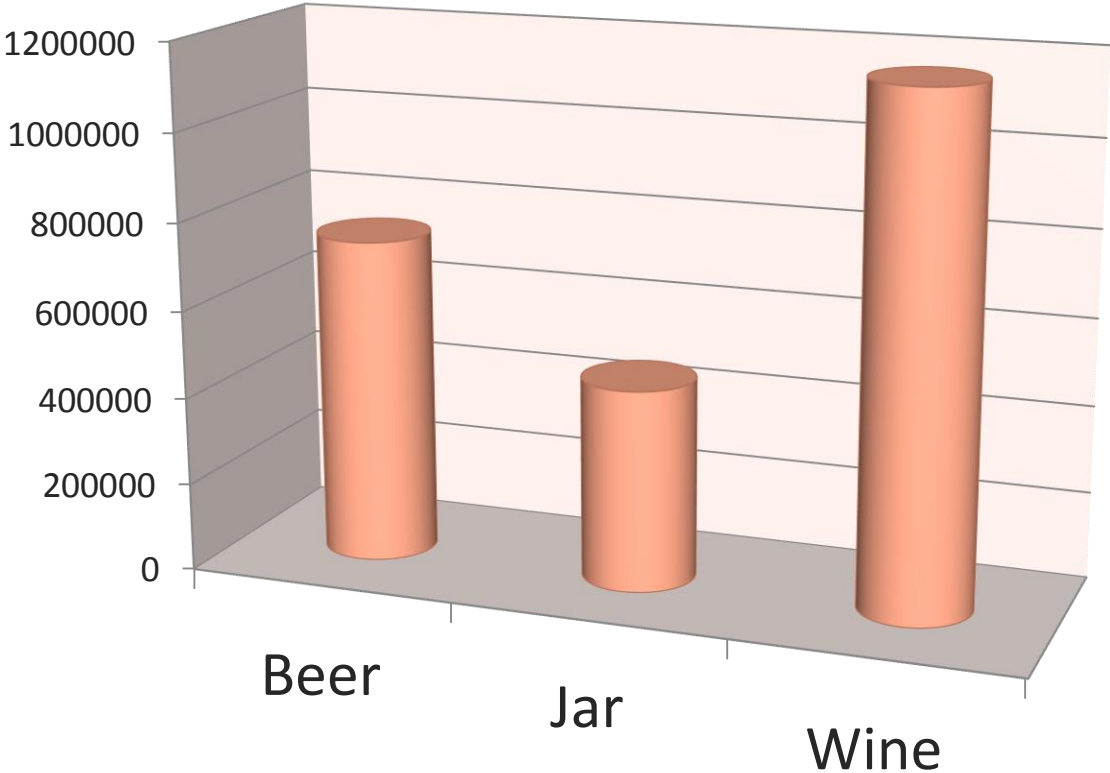
Weight: Tons per year



# Benefits

- **Energy**

Energy: kWh per year



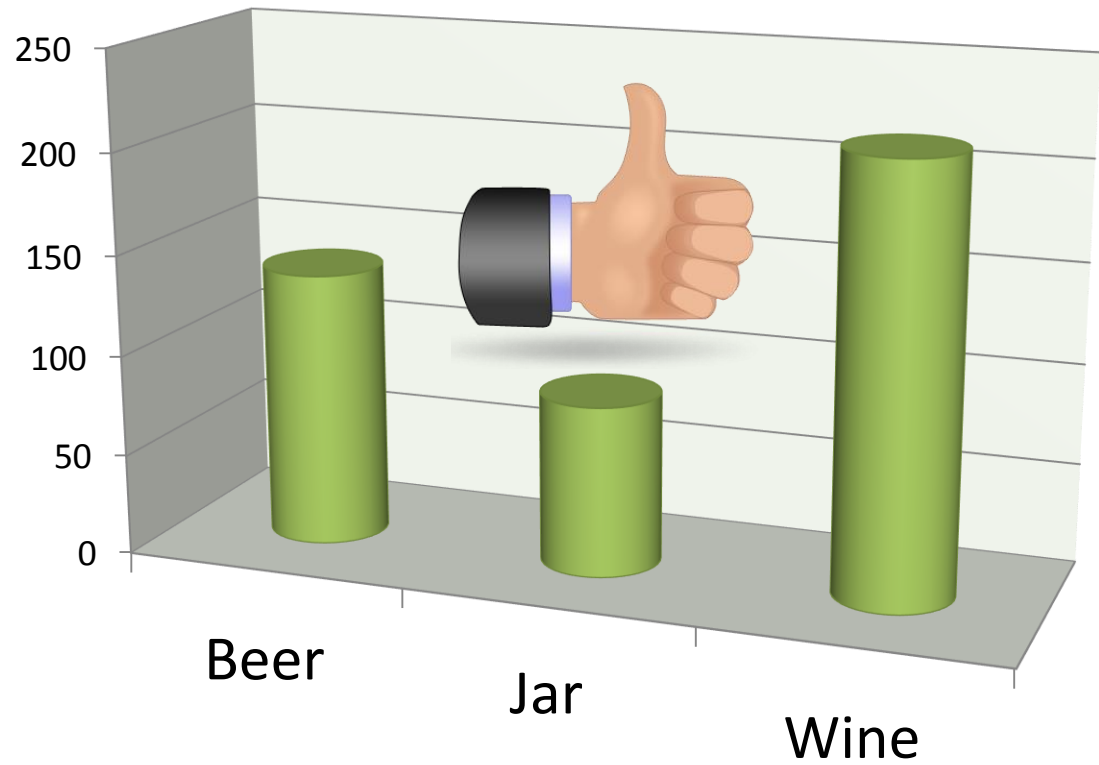
# Benefits

- **Raw Material**

- **Energy**

- **Safety**

CO2 saved: Tons per year





# GLASSPEX 2015

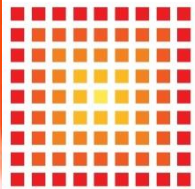
**One new product : Tiama Hot End  
Laboratory Tool.**

# Tiama HOT systems product range



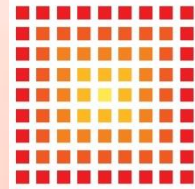
TO FOLLOW

tiama

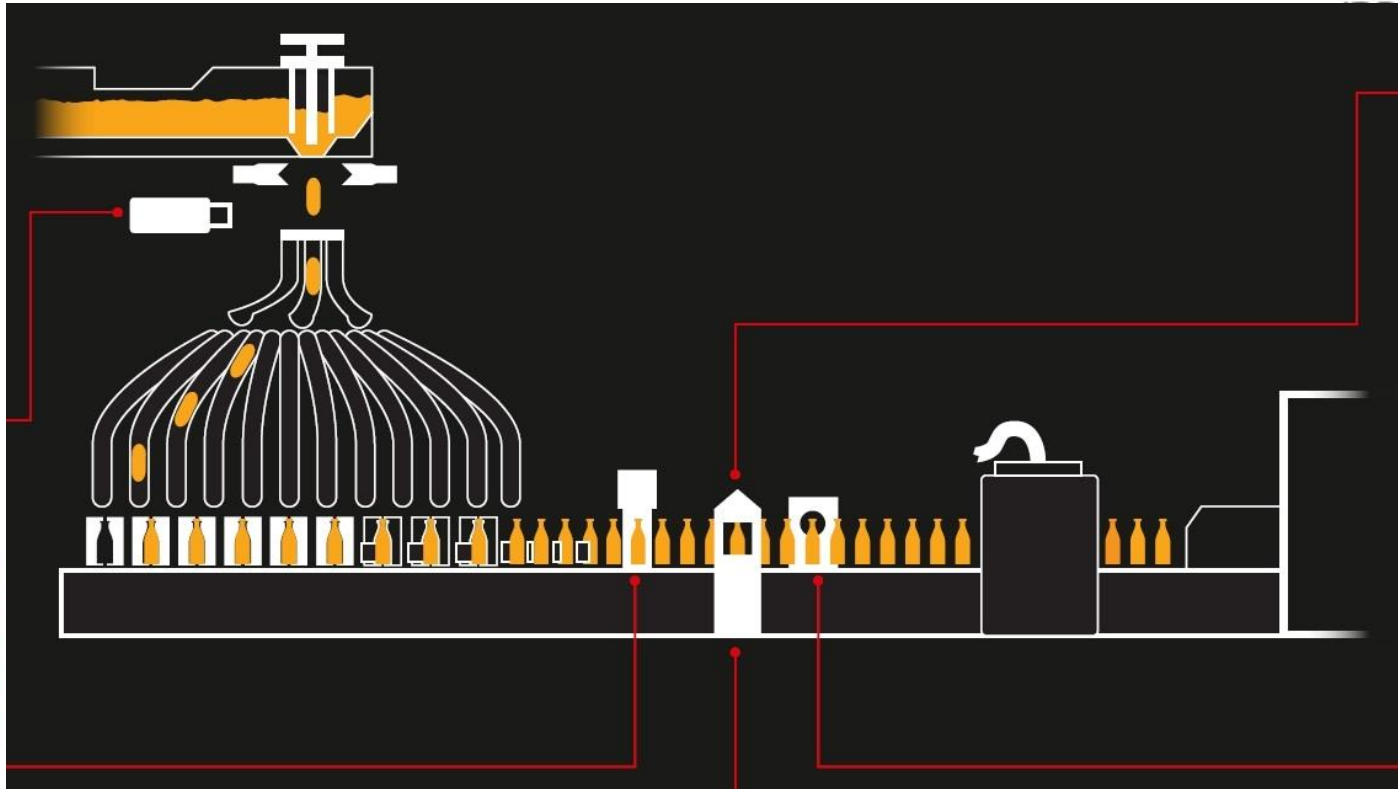


hot mass  
hot-end  
article weight  
management

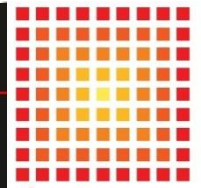
tiama



hot move  
hot-end  
article  
positioning  
management



tiama



hot eye

*One or more  
visible light-range  
cameras combined  
with infrared  
cameras*

tiama



hot wall

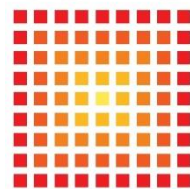
*A thickness  
measurement  
sensor adapted to  
hot-end conditions*

tiama

hotlab

hot-end  
laboratory  
tool

tiama



hot form

hot-end IR  
radiation  
monitoring



# Tiama HOT lab

Hot-end laboratory tool



# Current hot-end gauging

*With the exception of weight, bottles at the HE are currently measured with go /no-go gauges.*

*Characteristics such as :*

*\_lean,*

*\_ovality*

*\_and glass wall-thickness*

*are currently measured at the CE and only then is the information transferred back to the HE.*

***This equates to a time duration of >1 lehr-length.***



# Overview

*Tiama HOT lab – Precise statistical dimensional measurement of hot bottles including glass thickness*



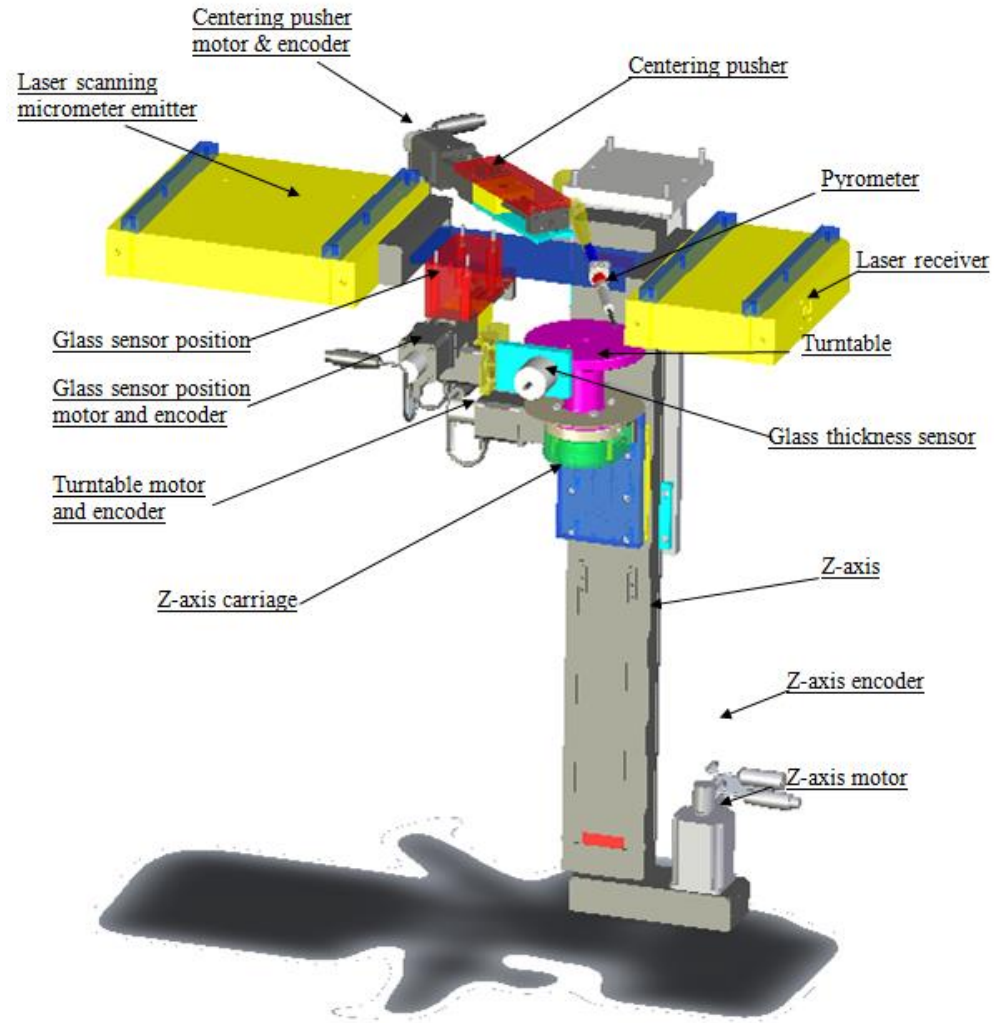
*Machine Electronics Cabinet*

*Measuring Chamber*














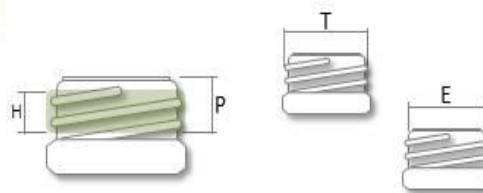
## Measurement Technology

- *Up-to-date Micrometer Laser*
- *CHRcodile Glass Thickness Control*
- *Measurement Time < 2 mins.*
- *Container Temperature up to 300° Celsius.*

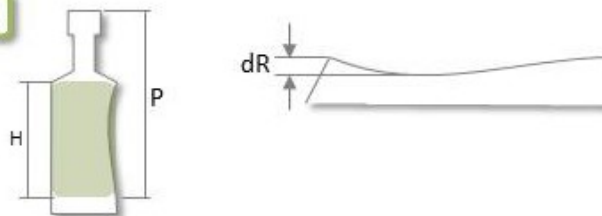


# Available measurements

-  Band Diameter
-  Diameter / Out of Round
-  Finish Height
-  Glass Thickness
-  Height
-  Height at Diameter
-  Inside Diameter
-  Lean (1)
-  Lean (2)
-  Square Bottles
-  Thread Area
-  Thread without Seam
-  Vertical Zone



Name	...
Aktiv	True
Position (P) [mm]	0,00
Höhe (H) [mm]	0,00
Winkeländerung [°]	30

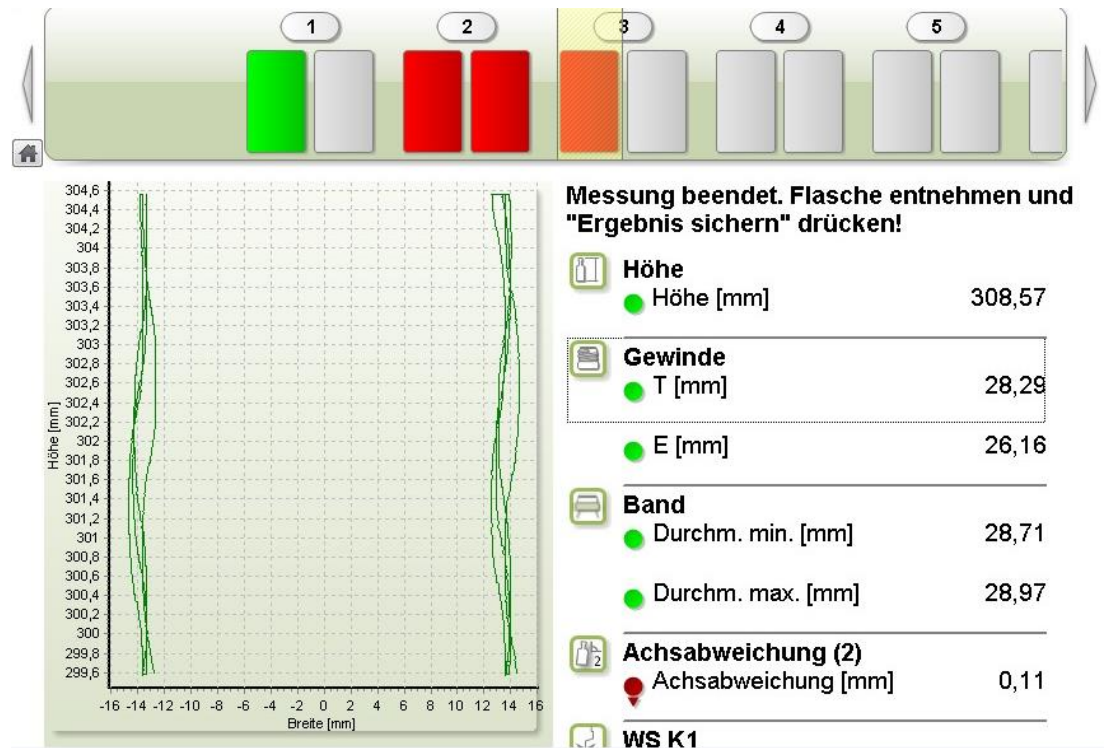


Name	...
Aktiv	True
Position (P) [mm]	0,00
Höhe (H) [mm]	0,00
Winkeländerung [°]	30

# Finish measurement

*Graphical display of thread measurement ( T & E )*

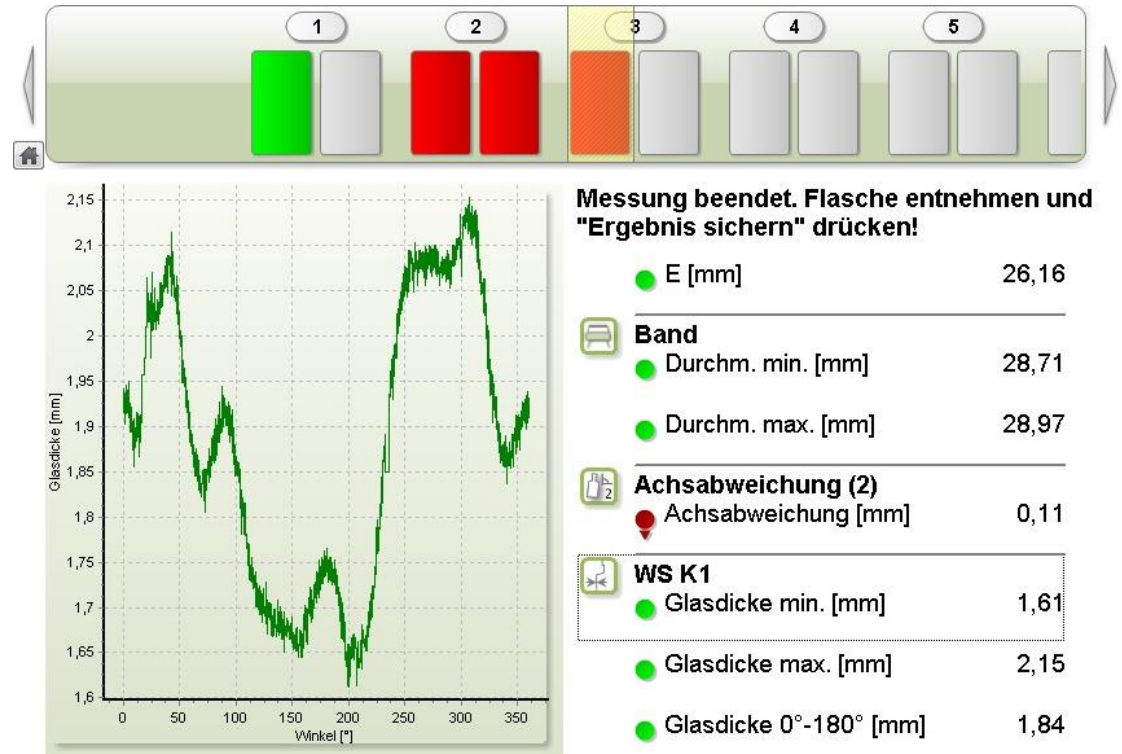
*The right side of the screen displays the numerical results.*



# Glass thickness 360°

*Graphical display of glass thickness (360 degrees)*

*The "x" axis in the graph corresponds to the table/bottle position. Thus the thin glass areas can be easily identified on the bottle.*

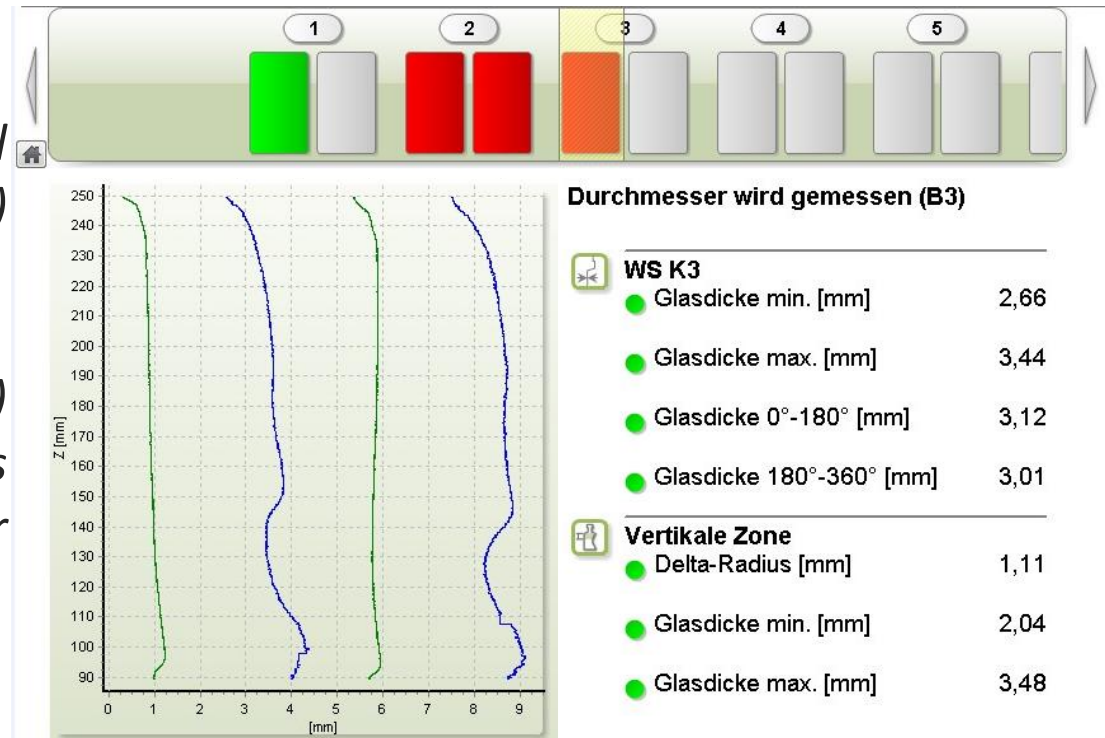




# Sunk/Bulge & Vertical Glass Thickness

Graphical display of vertical outer surface (green line) and inner surface (blue)

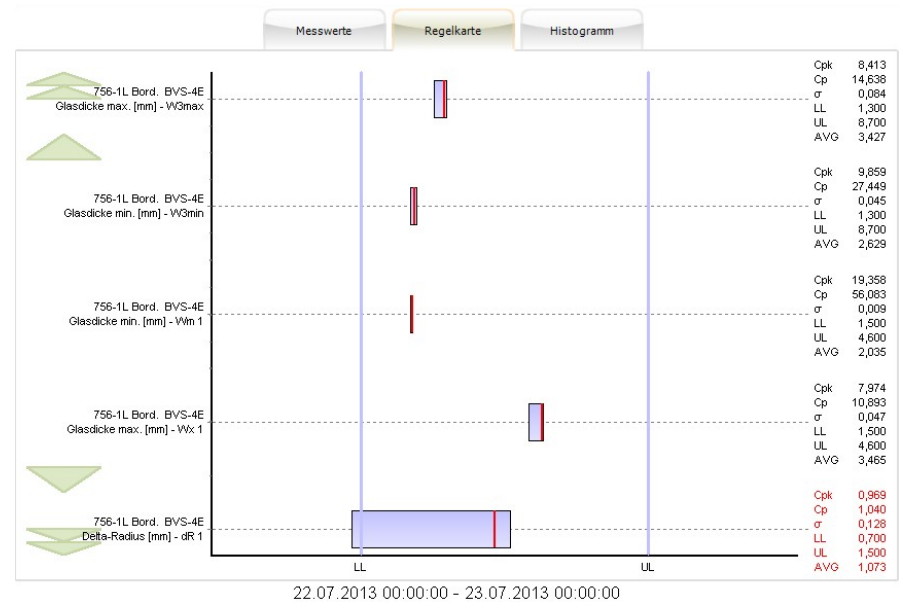
The flatness (sunk/bulge) together with the glass thickness is calculated over the defined area.



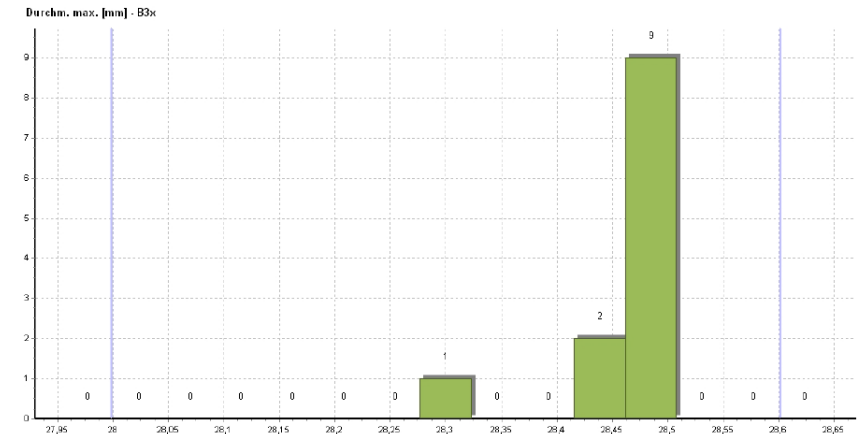
## Capability of the Process Overtime (CPK)

The Numerical and graphical analysis of an individual measurement location or a particular cavity can be analysed.

Distribution charts clearly shows where the process is within the set tolerances



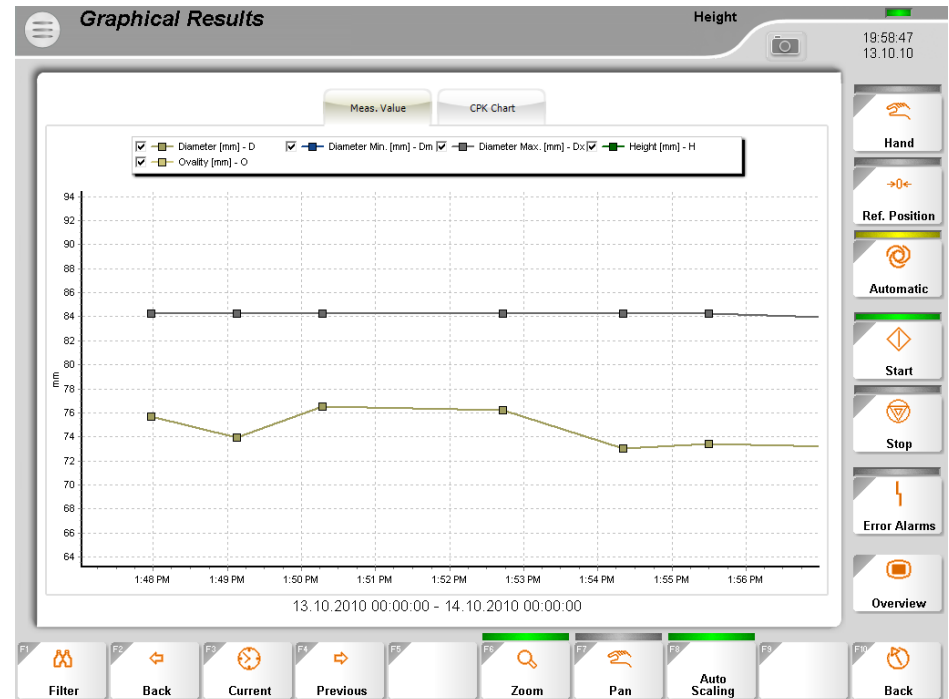
ProLab - Messwert-Grafik  
Histogramm - T [mm] - T  
22.07.2013 00:00:00 - 23.07.2013 00:00:00



# Statistics (2/2)

*The “History” is a graphical display of the collected data over time*

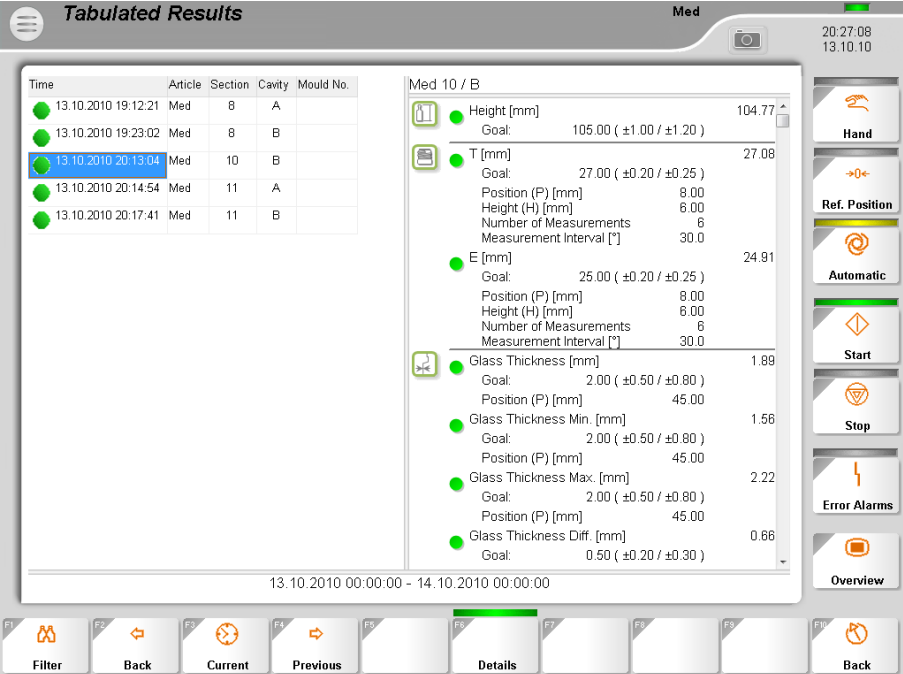
*Possible to display and compare against other moulds or simply view trend over time.*



# Tabulated results

*The “Tabulated” results allows the user to see all numerical value measurements in a table format*

*Possible to display results based on a filtered criterion*



The screenshot displays the 'Tabulated Results' interface. On the left, a table lists measurement data for 'Med' across different times, articles, sections, cavities, and mould numbers. The row for '13.10.2010 20:13:04' is highlighted. On the right, a detailed view for 'Med 10 / B' shows various parameters such as Height, T, E, and Glass Thickness, each with a goal and a measured value. The interface includes a top navigation bar, a right-side control panel with buttons like 'Hand', 'Ref. Position', 'Automatic', 'Start', 'Stop', 'Error Alarms', and 'Overview', and a bottom toolbar with function keys F1-F10.

Time	Article	Section	Cavity	Mould No.
13.10.2010 19:12:21	Med	8	A	
13.10.2010 19:23:02	Med	8	B	
13.10.2010 20:13:04	Med	10	B	
13.10.2010 20:14:54	Med	11	A	
13.10.2010 20:17:41	Med	11	B	

Med 10 / B

- Height [mm]: 104.77  
Goal: 105.00 (±1.00 / ±1.20)
- T [mm]: 27.08  
Goal: 27.00 (±0.20 / ±0.25)  
Position (P) [mm]: 8.00  
Height (H) [mm]: 6.00  
Number of Measurements: 6  
Measurement Interval [°]: 30.0
- E [mm]: 24.91  
Goal: 25.00 (±0.20 / ±0.25)  
Position (P) [mm]: 8.00  
Height (H) [mm]: 6.00  
Number of Measurements: 6  
Measurement Interval [°]: 30.0
- Glass Thickness [mm]: 1.89  
Goal: 2.00 (±0.50 / ±0.80)  
Position (P) [mm]: 45.00
- Glass Thickness Min. [mm]: 1.56  
Goal: 2.00 (±0.50 / ±0.80)  
Position (P) [mm]: 45.00
- Glass Thickness Max. [mm]: 2.22  
Goal: 2.00 (±0.50 / ±0.80)  
Position (P) [mm]: 45.00
- Glass Thickness Diff. [mm]: 0.66  
Goal: 0.50 (±0.20 / ±0.30)

13.10.2010 00:00:00 - 14.10.2010 00:00:00

Filter Back Current Previous Details Back

# If you need to simplify your life

The chalkboard is filled with various mathematical expressions and diagrams. Key elements include:

- Equations:**
  - $E = \frac{1}{2} m L^2 \dot{\theta}^2 + \frac{1}{2} M g L \theta^2$
  - $\frac{d\theta}{dt} = \left( \frac{2E - M g L \theta^2}{M L^2} \right)^{1/2} = \left( \frac{2}{L} \right)^{1/2} \left( \frac{E}{M g} - \theta^2 \right)^{1/2}$
  - $\frac{dr}{dt} = \frac{dr}{d\phi} \frac{d\phi}{d} = \frac{dr}{d\phi} \omega = \frac{dr}{d\phi} \frac{d\phi}{dt} \frac{1}{\mu r^2}$
  - $E = \frac{1}{2} M g L \theta^2, \dot{\theta} = \frac{\omega E}{M g L}$
  - $\frac{d\theta}{dt} = \left( \frac{2}{L} \right)^{1/2} \left( \frac{E}{M g} - \theta^2 \right)^{1/2}$
  - $\frac{dr}{d\phi} = \frac{r}{\mu r^2} = \frac{1}{\mu r}$
  - $\frac{dw}{d\phi} = \frac{1}{r^2} \frac{dw}{d\phi} = \frac{1}{r^2} \frac{d^2 w}{d\phi^2} = -w \frac{J^2}{P^2} \frac{d^2 w}{d\phi^2}$
  - $\frac{d^2 r}{dt^2} = -\frac{1}{r^3} \left( \frac{S}{\mu} \right)^2 \frac{d^2 w}{d\phi^2}$
  - $E = M c^2 \left[ 1 + \left( \frac{p}{M c} \right)^2 \right]^{1/2}$
  - $\Delta t' = \Delta t \sqrt{1 - \frac{v^2}{c^2}}$
  - $\Delta p'_x = \frac{\Delta p_x}{\gamma} = \left( 1 - \frac{v^2}{c^2} \right)^{1/2} \Delta p_x$
  - $\Delta p'_y = \frac{\Delta p_y + v \Delta E / c^2}{\gamma} = \frac{\Delta p_y + v \Delta E / c^2}{\left( 1 - \frac{v^2}{c^2} \right)^{1/2}}$
  - $E_0 = E + \frac{1}{2} E + \frac{1}{2} E$
  - $\frac{V}{c} = \frac{E_f}{E_f + M_p c^2}$
- Diagrams:**
  - A diagram of a spherical cap with radius  $r$  and chord length  $2a$ .
  - A sine wave graph with amplitude  $A$ .
  - A graph of a function  $f(x) = \frac{1}{2} \ln \left| \frac{x+\hat{x}}{x-\hat{x}} \right|$ .
  - A diagram of a person with their arms raised in the center of the board.
- Other Text:**
  - Quantum mechanics terms:  $\langle \psi_1 | \psi_2 \rangle = \int \psi_1^* \psi_2 d\tau$
  - Wave functions:  $\psi(r, \theta, \phi) = Y_{lm}(\theta, \phi) R_{nl}(r)$
  - Legendre polynomials:  $P_0 = 1, P_1 = \cos \theta, P_2 = \frac{1}{2}(3\cos^2 \theta - 1), \dots$

...it's time for

**tiamas**  
  
**hot**systems