

# SILEX

## Wet Process Equipment for Photovoltaic Si-Cells

Economic processing of multi/mono crystalline solar-wafers



**STANGL**  
Semiconductor Equipment AG  
A MEMBER OF THE SINGULUS GROUP

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# STANGL & SINGULUS – Smart Solutions to Drive the Future

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### Wet process equipment for c-Si solarcell production lines

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The Semiconductor industry has enjoyed more than 40 years of success since its sophisticated technology was enthusiastically embraced. Today, the commercial use of the photoelectrical effect for photovoltaic power generation is poised for similar success as it prepares for conversion to fully automated mass production.

STANGL Semiconductor Equipment AG – a German manufacturer of qualified wet process equipment – entered the booming semiconductor industry in the late 1980's. Their expertise is based on

20 years of experience in the planning, design, assembly and implementation of wet process machines for semiconductor and solar cell manufacturing.

#### **SINGULUS TECHNOLOGIES Vacuum Coating and Systems Integration Experts**

While STANGL focuses on wet-chemical processes, SINGULUS' core competence is physical coating technology; it is also the integration of different processing steps into turnkey, predominantly automated production

systems, as demonstrated by the highly successful automation of its CD and DVD production lines. This know-how is an optimal base for the development of highly profitable, fully-automated production lines for the photovoltaic industry. Working in complementary fashion, STANGL and SINGULUS will consistently expand their solar activities. Each company will focus on its particular areas of expertise so that together they will be positioned to offer a broad range of products to the photovoltaics industry over the next few years.

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# Stangl Wet Process Machines in c-Si Solarcell Production Lines

Today's dominating solar cell concept bases on cells made from crystalline silicon. Stangl provides complete automated dry-in-dry-out solutions for wet treatment of Si-wafers in standard and high-efficiency cell lines.

Batch-type working Wet Benches (WB-series) are the "workhorses" for cleaning and etching processes in Si-cell technology.

Our machines are matched to the demands of solarcell mass production by

- \_ lowest cost of ownership
- \_ outstanding machine and process reliability
- \_ state-of-the-art design and technology

Si Cell Production Step-by-Step: ■ STANGL - SILEX ■ STANGL ■ SINGULUS



# Technical Features

## Technical Features of SILEX Batch Series

- \_ Proven, highly integrated design
- \_ High Throughput up to 3000 wph, 24 h/day, 7 days/week
- \_ High Availability (uptime > 95 %)
- \_ Low Breakage Rate (< 0,05 %) by gentle motion of substrates
- \_ High Flexibility in
  - \_ process sequence
  - \_ wafer type (mono, multi, EFG)
  - \_ wafer size (up to 210x210 mm)
  - \_ wafer thickness (down to 150  $\mu\text{m}$ ) by using optimized process cassettes
- \_ Reduced chemical consumption and stable process control by internal automatic chemical bath management (replenishment, mixing, bleed and feed)
- \_ Reproducible process results by complex process parameter control
- \_ Network communication support
- \_ Carrier tracking and data logging
- \_ Compliance with international safety regulations



## Main Components

### 1 Housing

- \_ Stable modular main frame, completely covered by PP-panels
- \_ Main systems for bath management, electrical cabinets and process control units are integrated into housing
- \_ safety gas sensor system for detection of harmful gas concentrations (NOX, H<sub>2</sub>, HF)

### 2 Load / Unload conveyor

- \_ manual or automated feed-in and take-out of wafer carriers
- \_ integrated carrier buffer with 6 positions
- \_ Safety interlock of human or automation interaction
- \_ RFID transponder identification

### 3 Central robot handling

- \_ Automated AC servo booster handling system guarantees quick, reliable and gentle carrier motion
- \_ Up to 3 parallel working x-z-robots
- \_ sensitive crash protection sensor system

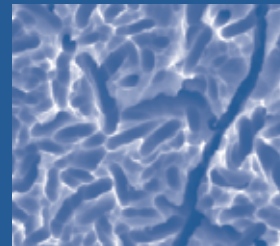


### 4 Pre-cleaning, Saw Damage Removal

- \_ Initial organic and particle cleaning of incoming wafer material in hot alkaline cleaning mixtures (up to 80° C)
- \_ Optional ultrasonic power integration for improvement of cleaning efficiency

### 5 Alkaline Texturing (ALTEX)

- \_ Preferably dedicated for texturing of monocrystalline Si wafers
- \_ Removal of crystalline surface defects, forming random pyramids
- \_ Uniform etching
- \_ Compliant to international safety standards for explosive atmospheres



### 6 Acidic Texturing (ISOTEX)

- \_ preferred process for state-of-the-art texturing of multicrystalline Si wafers
- \_ Removal of crystalline surface defects by using HF-HNO<sub>3</sub> mixtures
- \_ The high-flow bath recirculation in association with the effective chilling system guarantees excellent temperature control
- \_ NOX-emission control during ongoing process and carrier transfer

### 7 Porous Si-etch (PorSi)

- \_ Short dip-treatment in a cold alkaline solution etches off the thin layer of porous silicon, caused by previous isotexturing step

### 8 Cleaning

- \_ Acidic cleaning using HF and HCl for effective removal of metal contaminations and native oxides

### 9 Oxide etch (PSG removal)

- \_ Removal of P-doped SiO<sub>2</sub>-layer from wafers, formed during previous POCl<sub>3</sub>-diffusion
- \_ Self-limiting ambient DHF etch step

### 10 Rinsing

- \_ Optimized rinsing technology in terms of
  - \_ fresh water flow
  - \_ partial water reclaim
  - \_ mechanical support and temperature enhancements
- \_ Intelligent combination of highly effective dump-spray-rinse and water-saving multi-cascade overflow rinse

### 11 Drying

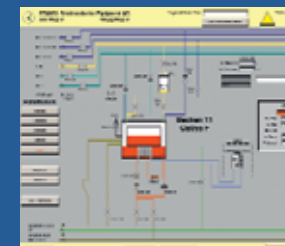
- \_ Stress-free 2-step drying process ensures perfect uniform, chemical and spot-free drying of wafers down to 150 µm with lowest risk of breakage
- \_ compatible with all common Low Surface Carrier types

### 12 Integrated process control

- \_ Weight determination of wafer carriers pre- and post process for internal etch rate control
- \_ Individual chemical bath management for filling and spiking of chemicals and DI water
- \_ Temperature control of all heated and cooled process steps
- \_ Control of recirculation and injection flow rates
- \_ Individual process time control
- \_ Optional online / offline analysis of chemical compositions by Titration, Conductivity measurement and / or IR Spectroscopy
- \_ Resistivity measurement
- \_ Process data storage and logging

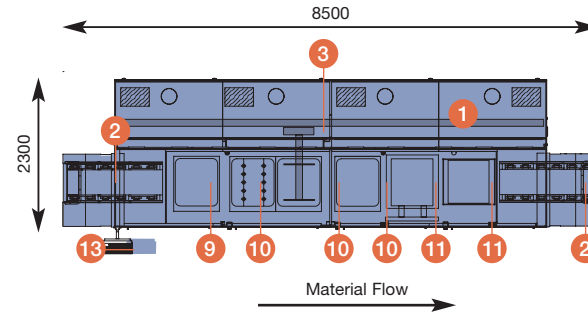
### 13 Central machine control system

- \_ Siemens SIMATIC S7 PLC system
- \_ PC-based Graphical User Interface (WINCC)
- \_ Bus systems for internal communication of sub-assembly systems
- \_ OPC interfaces for external data exchange



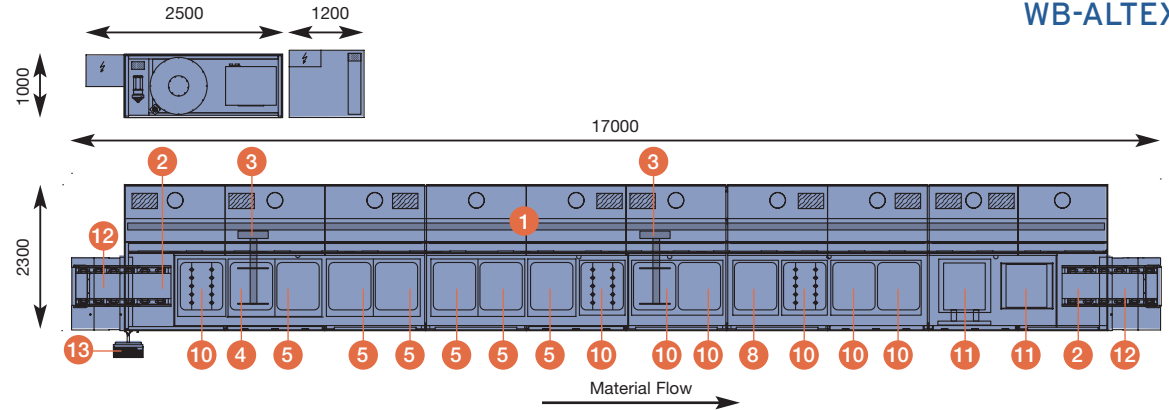
<b>Main Features</b>	<b>WB-PSG1500 RL/LR</b>	<b>WB-PSG3000 RL/LR</b>
<b>Dimension L/W/H mm:</b>		
Wet bench	6700/2300/3060	8500/2300/3060
Option Sump pump tank	within footprint	within footprint
<b>Capacity max.:</b>	1500 wph	3000 wph
<b>Wafer Material:</b>	Si, mono, multi, 156 x 156 mm, > 150 μm	
<b>Batch Size:</b>	100 wafer	200 wafer
<b>Utilities:</b>	N2, CDA, DI Water HF Waste Drains Electrical power 400 VAC 3/PE	
<b>Exhaust:</b>	2700 m³/h	3600 m³/h
<b>Typical Cycle Time:</b>	270 s	270 s

WB-PSG



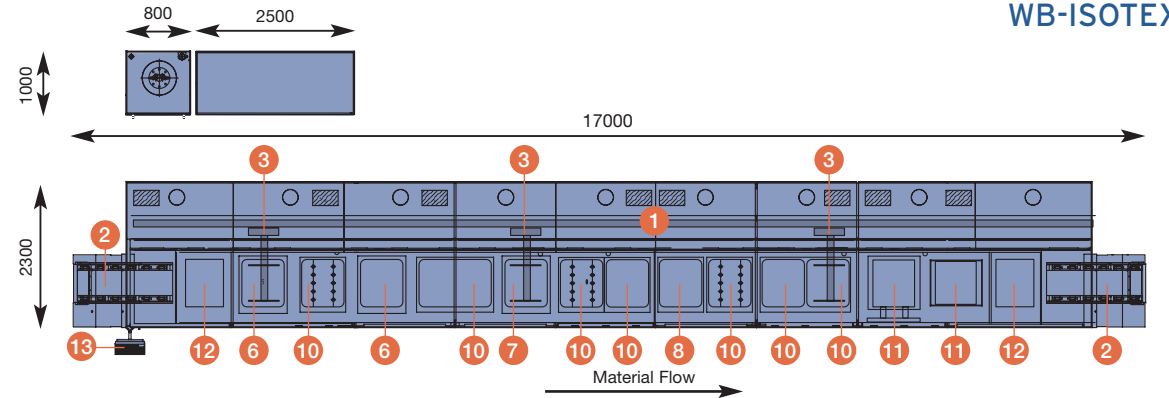
<b>Main Features</b>	<b>WB-ALTEX1500 RL/LR</b>	<b>WB-ALTEX3000 RL/LR</b>
<b>Dimension L/W/H mm:</b>		
Wet bench	13000/2300/3060	17000/2300/3060
Heater station	1200/1400/1200	1200/1060/2300
DI water heater	800/600/1600	2500/1000/2300
Option Sump pump tank	2500/500/600 per unit	2500/500/600 per unit
<b>Capacity max.:</b>	1500 wph	3000 wph
<b>Wafer Material:</b>	Si, mono, multi, 156 x 156 mm, > 150 μm	
<b>Batch Size:</b>	200 wafer	200 wafer
<b>Utilities:</b>	N2, CDA, DI Water, PCW, tap water HF, KOH, HCl, IPA Waste Drains Electrical power 400 VAC 3/PE	
<b>Exhaust:</b>	8000 m³/h	9500 m³/h
<b>Typical Cycle Time:</b>	270 s	270 s

WB-ALTEX



<b>Main Features</b>	<b>WB-ISOTEX1500 RL/LR</b>	<b>WB-ISOTEX3000 RL/LR</b>
<b>Dimension L/W/H mm:</b>		
Wet bench	15000/2300/3060	17000/2300/3060
Chiller station	800/1200/1500	2500/1400/1200
Day tank	Integrated	1000/1000/2500
Option Sump pump tank	2500/500/600 per unit	2500/500/600 per unit
<b>Capacity:</b>	1500 wph	3000 wph
<b>Wafer Material:</b>	Si, multi, 156 x 156 mm, > 150 μm	
<b>Batch Size:</b>	200 wafer	200 wafer
<b>Utilities:</b>	N2, CDA, DI Water, PCW, tap water HF, KOH, HCl, HF, HNO3, (HAc) Waste Drains Electrical power 400 VAC 3/PE	
<b>Exhaust:</b>	6500 m³/h	8500 m³/h
<b>Typical Cycle Time:</b>	120-270 s	120-270 s

WB-ISOTEX





STANGL Semiconductor Equipment AG

Fraunhoferstr. 9  
82256 Fürstentfeldbruck  
Tel. +49 8141 36 00-0  
Fax +49 8141 36 00-100  
stangl@stangl.de | www.stangl.de

**STANGL**  
Semiconductor Equipment AG  
A MEMBER OF THE SINGULUS GROUP

## Headquarters

SINGULUS TECHNOLOGIES AG  
Hanauer Landstrasse 103  
D - 63796 Kahl, Germany  
Tel. +49 6188 440-0  
Fax +49 6188 440-110  
sales@singulus.de  
www.singulus.de

## Affiliated Companies

### Germany

HamaTech APE GmbH & Co. KG  
Tel. +49 7045 41-0  
info@hamatech-ape.com

SINGULUS NANO DEPOSITION  
TECHNOLOGIES GmbH  
Tel. +49 6188 440-417  
sales@singulus-ndt.de

STANGL Semiconductor Equipment AG  
Tel. +49 8141 3600-0  
stangl@stangl.de

**Netherlands**  
SINGULUS MASTERING B.V.  
Tel. +31 407 5014-00  
info@singulus.nl

## Sales Subsidiaries

### France

SINGULUS TECHNOLOGIES France S.A.R.L.  
Tel. +33 3 893111-29  
e-mail: singulus@club-internet.fr

### Great Britain

SINGULUS TECHNOLOGIES UK Ltd.  
Tel. +44 1793 7842-00  
e-mail: brian.walsh@singulusuk.com

### Italy

SINGULUS TECHNOLOGIES Italia s.r.l.  
Tel. +39 0717 9303-12  
e-mail: singulus.italia@fastnet.it

### Latin America

SINGULUS TECHNOLOGIES Ltda. Latin America  
Tel. +55 1121 6524-10  
e-mail: rodolfo.mignone@singulus.com.br

### Singapore

SINGULUS TECHNOLOGIES Asia Pacific  
Tel. +65 674 119-12  
e-mail: singulus@singnet.com.sg

### Spain

SINGULUS TECHNOLOGIES Iberica  
Tel. +34 936 7500-25  
e-mail: singulus@singulusib.com

### Taiwan

SINGULUS TECHNOLOGIES Taiwan Ltd.  
Tel. +886 2 274833-66  
e-mail: sales@singulus.com.tw

### United States and Canada

SINGULUS TECHNOLOGIES Inc.  
Tel. +1 860 68380-00  
e-mail: sales@singulus.com