

LINEA

Inline Wet Process Equipment for
c-Si Solar Cell Production



STANGL & SINGULUS – Smart Solutions to Drive the Future

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Inline Wet Process Equipment for c-Si Solar Cell Production

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.

With STANGL continuing to experience strong growth rates, SINGULUS TECHNOLOGIES has made the decision to rapidly expand the solar segment.

SINGULUS TECHNOLOGIES has developed a new solar coating machine named SINGULAR, which is being marketed since the beginning of 2009. The SINGULUS Group will expand the business segment solar continuously.



Features and Benefits of LINEA Inline Series

- _ Strongly modular, highly integrated design
- _ Throughput fitted to line capacities of appr. 30/60 MW
- _ High availability (uptime > 95 %)
- _ Low breakage rate (< 0,1 %)
- _ Wafer thickness (down to 150 μm)
- _ Newly developed, sophisticated low-contact wafer transport system (patent pending)
- _ No mechanical contact on top side during processing
- _ Up to 6 lanes 156 mm/125 mm wafer CZ/MC Si
- _ Homogeneous reproducible etching process by high volume chemical up- and downstream distribution system
- _ High chemical exchange rate on wafer surface
- _ Automatic chemical bath management (replenishment, mixing, bleed and feed)
- _ Internal rinse water re-use
- _ Complex process parameter control and data management
- _ Single side etching capability
- _ Network communication support
- _ Conclusive safety concept, compliant to international safety regulations
- _ Line integration via optional automated loading/unloading modules

Stangl Wet Process Machines in c-Si Solar Cell Production Lines

Today's dominating solar cell concept is based on cells made from crystalline silicon.

STANGL provides complete automated dry-in-dryout solutions for wet treatment of Si-wafers in standard and high-efficiency cell lines.

While batch-type working Wet Benches (SILEX-series) are the first choice for cleaning and alkaline texturing of monocrystalline wafers, the manufacturing lines of multicrystalline solar cells preferably apply acidic texture processes on inline-working machines. PSG Removal processes are running

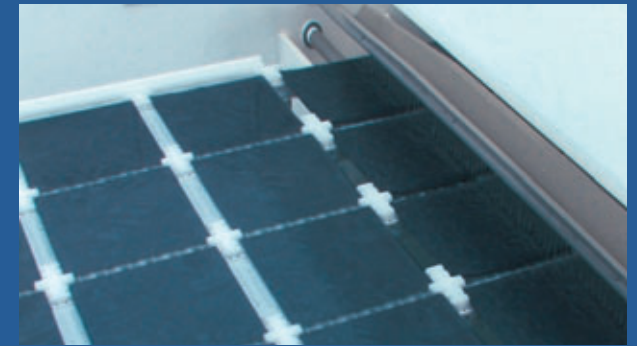
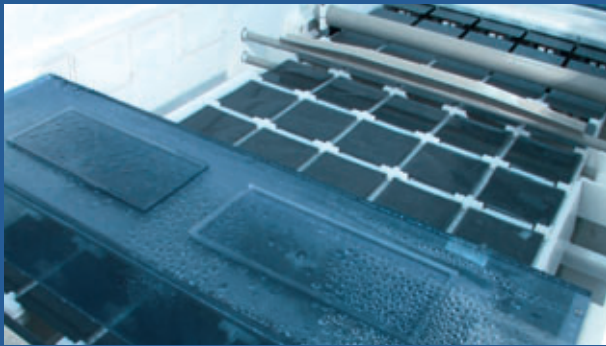
successfully in batch and inline-type equipment, following more or less the philosophy of the whole manufacturing process.

Additionally inline equipment permits single-side etching, applicable for edge isolation or side-selective surface treatment.

Si-Cell Production Step-by-Step: ■ STANGL - LINEA ■ STANGL ■ SINGULUS - SINGULAR



LINEA - Inline Wet Process Equipment for c-Si Solar Cell Production



LINEA is a horizontally working inline wet process platform for cleaning and etching of crystalline solar wafers. STANGL's LINEA inline etching system can be configured up to max. 1,700 or 3,400 wafers per hour (156 mm) which equals a production capacity of 30 and 60 MW. LINEA completes the portfolio of STANGL's integrated wet process solutions for solar cell manufacturing lines.

The LINEA design is based on a newly developed sophisticated transport system and a special chemical flow system to process the wafers horizontally with a very low breakage rate and a high etching uniformity. STANGL's new system LINEA follows the trend towards handling solar wafers down to 150 μm .

The highly integrated design, high throughput, high availability and low breakage rate make LINEA attractive for solar cell manufacturers worldwide.

Furthermore, LINEA is characterized by its high flexibility with regard to wafer type, size and thickness as well as its reduced chemical consumption.

Main Components

1 Housing

- _ Stable modular main frame, completely covered by PP-panels
- _ Integrated systems for bath management, electrical cabinets and process control units

2 Load/Unload Conveyor

- _ Automated feed-in of a wafer alignment by optional multiplex transfer unit
- _ Automated take-out of wafers by optional single or multiplex pick-and-place unit
- _ Safety interlock of automation interaction

3 Wafer Transport System

- _ Motor-driven plastic conveyor chain in interaction with O-ring based belt transfer sections guarantees a reliable and gentle wafer motion and a minimum of mechanical wafer stress
- _ 6 transport lanes, designed for 156 mm or 125 mm wafer
- _ Effective media carry-over protection system between process sections
- _ Transport speed adjustable

4 Acidic Saw Damage Etch and Texturing (ISOTEX)

- _ Removal of crystalline surface defects by using HF-HNO₃ composition

- _ Fluidised bed process by adjustable up- and downflow streams of acid mixture
- _ High-flow bath recirculation in association with the effective chilling system
- _ Excellent temperature and etch uniformity control

5 Porous Si-etch (PorSi)

- _ Short etching process of porous Si layer in cold alkaline solution

6 Cleaning

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

7 Oxide Etch (PSG removal)

- _ Removal of P-SiO₂-layer from wafers, formed during previous diffusion process
- _ ambient cleaning operation for subsequent Antireflective Coating
- _ Self-limiting HF etch step

8 Edge Isolation/Emitter Etch (EE)

- _ Single side etch of wafer rear side without front side treatment
- _ Excellent edge isolation and parasitic emitter etch, using chilled HF/HNO₃ compositions

9 Rinsing

- _ Intelligent combination of highly effective flow and spray rinse
- _ Cascade system with partial water re-use

10 Drying

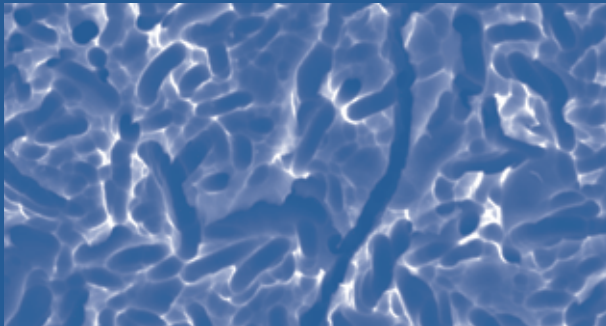
- _ Air jet system, using clean ambient air ensures smooth, perfect uniform and spot-free drying of wafers

11 Integrated Process 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
- _ Transport speed control
- _ Optional online/offline analysis of chemical compositions by titration, conductivity measurement and/or IR Spectroscopy
- _ DI water resistivity measurement
- _ Process data storage and logging
- _ Single wafer tracking

12 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
- _ Safety gas transmitter system (NOX, HF)

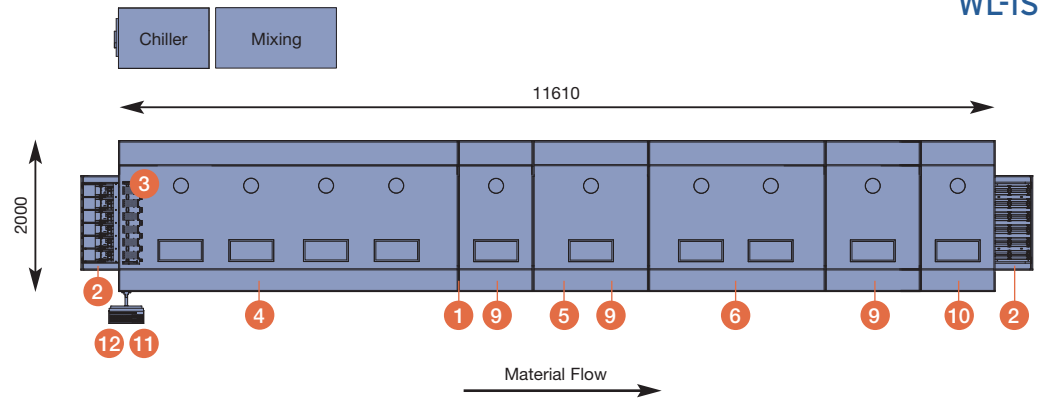


Main Features	LINEA WL-ISOTEX1500	LINEA WL-ISOTEX3000
Dimension L/W/H mm:		
Wet Line	8640/2000/2300	11610/2000/2300
Chiller Station	1000/600/1500	1200/800/1500
Mixing Tank	800/800/2300	1600/800/2300
Option Sump Pump Tank	2000/500/600 per unit	2000/500/600 per unit
Capacity:		
156 mm	6 Lanes/1700 wph	6 Lanes/3400 wph
125 mm	6 Lanes/2000 wph	6 Lanes/4000 wph
Wafer Material:	Si MC, 125x125 mm, 156x156 mm, >150 μm	
Utilities:	N ₂ , CDA, DI Water, PCW, HF, HNO ₃ , KOH, HCl, (Additive) Waste Drains Electrical Power 400 VAC/3/PE	
Exhaust:	5000 m ³ /h	6500 m ³ /h
Typical Ablation/Side:	4-6 μm	4-6 μm

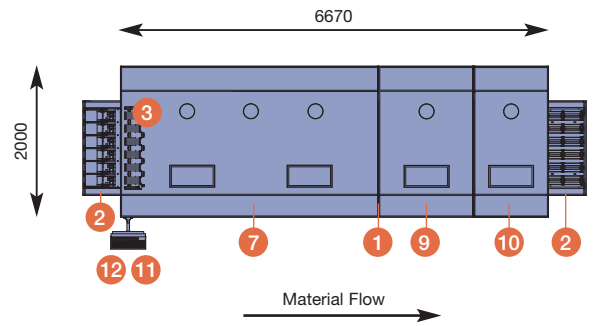
Main Features	LINEA WL-PSG1500	LINEA WL-PSG3000
Dimension L/W/H mm:		
Wet Line	4590/2000/2300	6670/2000/2300
Option Sump Pump Tank	2000/500/600 per unit	2000/500/600 per unit
Capacity:		
156 mm	6 lanes/1700 wph	6 lanes/3400 wph
125 mm	6 lanes/2000 wph	6 lanes/4000 wph
Wafer Material:	Si MC, CZ, 125x125 mm, 156x156 mm, >150 μm	
Utilities:	N ₂ , CDA, DI Water, HF Waste Drains Electrical Power 400 VAC/3/PE	
Exhaust:	2500 m ³ /h	3200 m ³ /h
Typical Ablation:	50-250 nm	50-250 nm

Main Features	LINEA WL-PSG-EE1500	LINEA WL-PSG-EE3000
Dimension L/W/H mm:		
Wet Line	9180/2000/2300	12420/2000/2300
Chiller Station	1000/600/1500	1200/800/1500
Mixing Tank	800/800/2300	1600/800/2300
Option Sump Pump Tank	2000/500/600 per unit	2000/500/600 per unit
Capacity:		
156 mm	6 Lanes/1700 wph	6 Lanes/3400 wph
125 mm	6 Lanes/2000 wph	6 Lanes/4000 wph
Wafer Material:	Si MC, CZ, 125x125 mm, 156x156 mm, >150 μm	
Utilities:	N ₂ , CDA, DI Water, PWC, HF, HNO ₃ , KOH, Waste Drains Electrical Powe 400 VAC/3/PE	
Exhaust:	5500 m ³ /h	7000 m ³ /h
Typical Ablation:	2-4 μm	2-4 μm

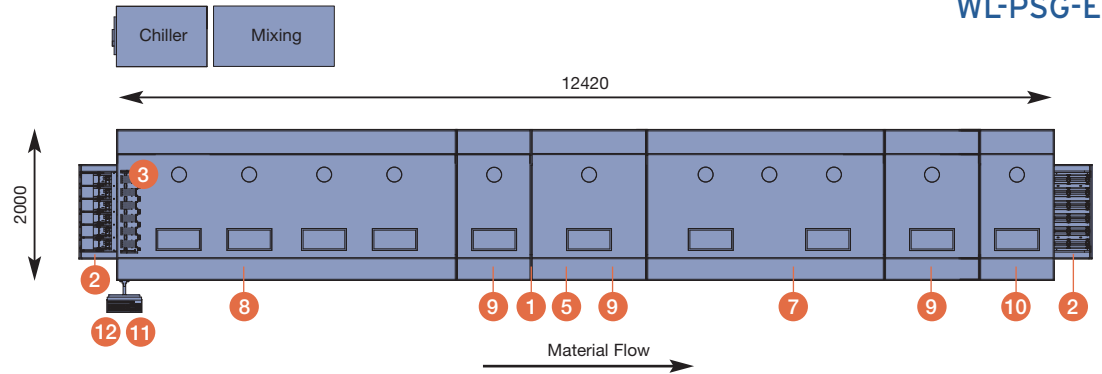
WL-ISOTEX



WL-PSG



WL-PSG-EE





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