Upsizing Wafer Fab UPW Needs to 450mm Demands

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Our Focus is on Facilities

- UPW OEM System
- UPW Loop / Laterals
- UPW Hook-Up
- DI- / Specified-Water OEM System
- Process Cooling Water
- Vacuum
- UPW Treatment
- Specialty Waste

UPW OEM System
Moore`s Law from a facilities point of view

- Moore`s Law will most likely continue to drive the whole game like we`ve seen it since the 1970`s.
- The Current 10-11% IC Unit Growth (8-10% IC Capacity Growth) can be expected to continue in the Long Term.
- If the higher levels of the Electronics Industry fail to think of new applications for Semiconductors then the whole value Pyramid could come crashing down…
- As costs for further node shrinkage and technical challenges increase exponentially we will see a slow down of Moore`s Law and High Volume Manufacturing will take longer to implement than in the past.
- However, we will not go back to using pencils and paper.
Our link to High Purity Piping Conduits

According to Klaiber’s Law\(^1\), the diameter of the largest conduit necessary to convey the required volume of ultrapure water in a wafer factory is approximately equal to the diameter of the wafer being cleaned.

The road to 450mm is getting rocky
Somehow similar to the early 1980’s?

In the early 1980s, the complexity of microchip circuitry was compared to the roadmap of Manhattan.

One defect the size of a manhole cover would cause the entire roadway (circuit) system to stop working.
Up to now – Continuous progress drives the game

Today’s complexity has increased by orders of magnitude. The analogy now is that the freeways of the entire United States represent the circuits of one microchip and defects can’t be greater than the size of a car (or hubcap, your choice).
What can we contribute focusing on facilities?

Satisfy the Industry's Need for Lots of Clean Water
What can we contribute focusing on facilities?

G450C pilote line 450mm in ~2015

EEMI450 pilote line in ~2016

Our prime goal is to supply safe and reliable High Purity Piping Systems for UPW conveyance in 450mm High Volume Manufacturing.
Update on our 450mm efforts

As you know, the qualification for 450mm UPW Piping Conduits for Semiconductor manufacturing was completed in 2012.

Since then we focused on:

• Details like ideal flow velocity etc.
• Improved purity to keep pace with increasing ITRS requirements
• Completely controlled manufacturing
• Concept - Product Range Fittings
• Semiconductor Industry references as proof of concept
Details – Flow Velocity / Reynolds Number Discussion

- The increase in single wafer processing tools and overall size of Fabs is forcing a second look at minimum acceptable velocity to get more out of a Fab’s design.
- These lower flows amplify the UPW contact time with the piping material, which translates to a heightened importance of cleanliness of the conduits and installation methods.
- Ultimately, manufacturing such piping systems require revolutionary methods to ensure the cleanliness levels as the size of the pipe and fittings increase.

- What will be the future Standard?
- Min Flow velocity 5f/s ?
- Re=3000 design basis ?

\[
Re = \frac{\rho \cdot v \cdot d}{\eta} = \frac{v \cdot d}{\nu} \quad \nu = \frac{\eta}{\rho}
\]

\[v \text{ in m/s, } d \text{ in m, } \mu \text{ in n. Viscosity in m}^2/\text{s or } 1\text{E}-6 \text{ for water at } 20^\circ\text{C}
\]

We understand the truth will be somewhere in between: \( \sim 0-5-0.8 \text{m/s} \)
Details – Improved Purity

• SEMI F57 has a long standing history of allowable contamination limits for Ultrapure Water (UPW) and Liquid Chemical Distribution System (LCDS) piping components, such as pipes, fittings and valves.

• When the Risk Profile Number is applied it is obvious that allowable Calcium, for example, is in need of being lowered to mitigate the risk recognized by ITRS.

• Since conception of SEMI F57 the allowable limit of Calcium has been unchallenged at $\leq 30 \, \mu g/m^2$.

• Following a review of the ITRS RPN it was obvious that a stricter value was warranted.

• The outcome is that SEMI F57 lowers the Calcium value to $\leq 20 \, \mu g/m^2$. 
Details – Improved Purity

Georg Fischer SYGEF Plus PVDF High Purity

* SEMI F57 is currently being ballot to lower the Calcium spec from 30ug/m² to 20ug/m²
Details – Completely controlled manufacturing

Manufacturing better class 6 (1000)

Inspection / Packaging better class 5 (100)

- PVDF HP Piping System range and IR-welding technology up to D450mm
- 100% QA/QC and traceability
- Superior purity performance due to our dedicated 4000m² Fluoropolymer Manufacturing Cleanroom for HP Pipes, Fittings, Valves
Details – Fittings Concept – endless combinations

- Possibilities for Bends 90° and 45°

- Possibilities for Tee’s

Tee 90°  Tee reduced  Sampling / Instrument-Fitting  Short dead-leg “Zero static-valve” assembly
Details – Product Range Fittings
Semiconductor Industry reference - proof of concept
A reality and running since 08-2012!
Semiconductor Industry reference - proof of concept
A reality and running since 08-2013!

UPW Header d355 – Leading High End Microchip Manufacturer in the US
The 450mm Elephant is out the door!
At least looking at Facilities...

Thx for your attention!
Questions?