# SPTS High Flow Plenum for Pegasus

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# Executive Summary

- SPTS Pegasus hardware upgrades are available to improve the etch rate/scallop size relationship
- New “High Flow” Plenum Design
  - Smaller volume
  - New gas flow route
- Improves deposition step efficiency
  - Opens process window to achieve higher throughputs
  - 40% Reduction in C4F8 usage
  - 25% Reduction in overall process time
- ROI within 2 Months

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# High Flow Plenum

- SPTS have a new design for the source gas plenum
- Improved efficiency for gas transport
- Most notably for the deposition step
  - Deposition step time can be reduced
  - Deposition removal time can be reduced
  - Overall gas usage is reduced & net etch rates are increased

- The High Flow Plenum is a significant change to the module configuration.
- As a consequence, recipe tuning is required to reset process after installation
  - To take advantage of the improved gas behaviour
  - SPTS can offer process support when introducing high flow plenum

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# New Plenum Process Trials

| Process Cycle Times | Standard Plenum | New Plenum | New Plenum Modified process (less deposition) |
|---|---|---|---|
| 7s etch, 4s deposition | | | |
| Etch Rate | 13.1 µm/min | 12.9 µm/min | 14.1µm/min **(+9%)** |
| Sidewall Scallop | >600nm | >600nm | >600nm **(No Change)** |
| 1.75s etch, 1s deposition | | | |
| Etch Rate | 9.9 µm/min | 12.3 µm/min | 13.02 µm/min **(+6%)** |
| Sidewall Scallop | Not Measurable | 154nm | 117nm **(-24%)** |

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# TSV Example

## ~40:1 Aspect Ratio

| Parameter | Standard Plenum | New Plenum |
|---|---|---|
| Average Etch Depth | 143 | 163 |
| Depth Uniformity | ≤±2% | ≤±2% |
| Etch Rate | 3.3µm/min | 3.8µm/min **(+15%)** |
| Profile | 89.7º-89.9º | 89.7º-89.8º |
| Sidewall Scallops | ≤255nm | ≤200nm **(-22%)** |

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# Reduced costs, Increased Throughput

- Data captured by Manufacturing user of Pegasus PM
- Comparing gas usage between standard and High Flow plenums

| Date | C4F8 (litres) | SF6 (litres) | Dep Cycle time (sec) | Etch Cycle time (sec) | Total Process Time (mins) |
|---|---|---|---|---|---|
| Standard Plenum | 4.63 | 10.60 | 4 | 7 | 51 |
| HFP | 2.83 | 10.20 | 1.5 | 6 | 38.3 |
| HFP Advantage | -39% | -4% | -65% | -14% | -25% |

- Major reduction in gas costs
  - $C_4F_8$ usage is reduced by ~40%
- With improved efficiency of dep/etch cycles, throughput is increased substantially
  - 25% reduction in process time

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# ROI

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- Taking into account gas costs & throughput gains
- There is a 23% saving in operating costs (per wafer)
- Expected ROI within ≤ 2 months

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# High Flow Plenum Process

- The HFP is a significant change to the Pegasus PM
- There will be a process shift as a consequence of fitting the HFP
- SPTS HFP upgrade quotes will include…
  - Hardware parts required & associated labour
  - One week of process demonstration in the UK (Chargeable)
    - If process demo fails to produce a suitable process window, then no charge
  - On-site process support following install of HFP (Chargeable)
    - Due to open-ended nature, a per diem rate will be quoted
    - SPTS recommend minimum one week

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# Summary

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- SPTS has introduced the High Flow Plenum for the Pegasus PM
- Aimed at improving sidewall quality and notching
  - While maintaining or improving etch rate
  - Reduced scalloping in order of 25%
- All achieved at same or higher etch rates
  - In order of 15% improvement

- Gas usage and overall throughput improved
  - Reduces gas costs
  - Contributes to overall lower CoO

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