Forward Looking Statements

This document contains statements relating to certain projections and business trends that are forward-looking, including statements with respect to productivity of our tools and systems performance, EUV system performance, expected industry trends, and EUV targets (including availability, productivity and shipments) and roadmaps. You can generally identify these statements by the use of words like "may", "will", "could", "should", "project", "believe", "anticipate", "expect", "plan", "estimate", "forecast", "potential", "intend", "continue" and variations of these words or comparable words. These statements are not historical facts, but rather are based on current expectations, estimates, assumptions and projections about the business and our future financial results and readers should not place undue reliance on them. Forward-looking statements do not guarantee future performance and involve risks and uncertainties. These risks and uncertainties include, without limitation, the impact of manufacturing efficiencies and capacity constraints, performance of our systems, the continuing success of technology advances and the related pace of new product development and customer acceptance of new products, the number and timing of EUV systems expected to be shipped and recognized in revenue, delays in EUV systems production and development, our ability to enforce patents and protect intellectual property rights, the risk of intellectual property litigation, availability of raw materials and critical manufacturing equipment and other risks indicated in the risk factors included in ASML's Annual Report on Form 20-F and other filings with the US Securities and Exchange Commission. These forward-looking statements are made only as of the date of this document. We do not undertake to update or revise the forward-looking statements, whether as a result of new information, future events or otherwise.
EUV lithography performance for manufacturing: status and outlook

Alberto Pirati

ASML Netherlands B.V., De Run 6501, 5504 DR Veldhoven, The Netherlands

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- Michael Purvis
- Alex Schafgans
- Igor Fomenkov
- Michael Lercel
- David Brandt
- Geert Fisser
EUV provides lower cost, higher yield, faster time to market

<table>
<thead>
<tr>
<th>Design</th>
<th>Critical litho</th>
<th>Wafer cost</th>
<th>Expected Yield</th>
<th>Expected Time-to-Market</th>
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<tbody>
<tr>
<td>1D</td>
<td>54x ArF immersion</td>
<td>Ref.</td>
<td>Ref.</td>
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<tr>
<td>1D</td>
<td>9x EUV + 21x ArFi</td>
<td></td>
<td></td>
<td>Ref.</td>
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<tr>
<td>2D</td>
<td>9x EUV + 19x ArFi</td>
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NXE extension roadmap to optimize capital efficiency

<table>
<thead>
<tr>
<th></th>
<th>Logic</th>
<th>DRAM</th>
<th>55 WpH</th>
<th>125 WpH</th>
<th>145 WpH</th>
<th>185 WpH</th>
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<tr>
<td>1st Shipment</td>
<td>R&amp;D</td>
<td>D1H</td>
<td>NXE:3300B</td>
<td>250W LPP</td>
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<td>20% PFR illuminator</td>
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<td>OFP 3350B→3400B</td>
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<td>UVLS - Mk2</td>
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<td>SMASH - MkX</td>
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<td>Lens thermal</td>
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<td>2019</td>
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<td>Stages, handlers</td>
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<td>2021</td>
<td>2~2.5</td>
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<td>1.5 nm</td>
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</tbody>
</table>

See: 9776-55, Jan van Schoot “EUV high-NA scanner and mask optimization for sub-8nm resolution”
Outline

- Throughput & Wafers per Day (WpD)
- Availability
- Defectivity, imaging and overlay
Wafers per day capability: multiple NXE:3300B above 1,000
NXE:3350B demonstrated 1,368

NXE:3300B at customers

Varying wafers per day for NXE:3300B systems at customers.

- Today: 6 systems in 80W configuration, 2 in 40W configuration.
- One year ago: 1x80W, 5x40W configuration.

NXE:3350B at ASML factory

- ATP test: 96 fields, 20mJ/cm²

WpD: maximum number of wafers exposed in a 24 hr period.
NXE:3300B productivity at customer: average ~800 wafers per day over multiple weeks

<table>
<thead>
<tr>
<th>Day</th>
<th>Total Wafers per day (cumulative)</th>
<th>Availability</th>
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<tbody>
<tr>
<td>1</td>
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<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Total Exposed wafers**: 11174
- **AVG WPD**: 798
- **AVG availability**: 85.7%
NXE:3350B productivity in ASML factory: ~950 wpd average over 8 days
Demonstrated 75 WpH on NXE:3350B
Further improvements with 125W settings

NXE:3300B, at customers

NXE:3350B, In the ASML factory

NXE:3500B ATP test: 26x33mm², 96 fields, 20mJ/cm²
NXE:3350B: 125W settings qualified and ready for field roll out

Mean pulse energy at Intermediate Focus ~3mJ

EUV power at Intermediate Focus 125W

Energy control Overhead ~20%
NXE:3300B productivity supports customer process development

>300k wafers exposed on NXE:3300B at customer sites
Acceleration in power scaling towards >200W builds further confidence in EUV productivity

See: 9776-21, Michael Purvis “Advances in predictive plasma formation modelling”

See SPIE 2015, 9422-10, Alex Schafgans, “Performance optimization of MOPA pre-pulse LPP light source”

- 3100 NOMO (delivered)
- 3100 MOPA (not shipped)
- 3100 MOPA+PP (not shipped)
- 3300 MOPA+PP (delivered)
- 3400 MOPA+PP (development)
Outline

• Throughput & Wafers per Day (WpD)
• Availability
• Defectivity, imaging and overlay
Availability: capability beyond 75% proven on multiple field systems
2016 focus: reduce scheduled maintenance, reduce variability

Uptime = productive time + standby time + engineering time

~ 50% of downtime is scheduled down

Maximum 4 weeks average realized in the field
Droplet Generator: Principle of Operation

- Tin is loaded in a vessel & heated above melting point
- Pressure applied by an inert gas
- Tin flows through a filter prior to the nozzle
Droplet Generator: ~2x improvements in run time, swap time
Next generation DGen: demonstrated > 1 month lifetime capability
Continuous improvements in collector protection at increasing power
100 Gpulses capability demonstrated at 125W

- **40 W configuration**: Degradation rate = 0.7% / Gpulse
- **80 W configuration**: Degradation rate = 0.6% / Gpulse
- **125 W configuration**: Degradation rate = 0.4% / Gpulse
250W feasibility proven without increase in protective Hydrogen flow
No rapid collector contamination, allowing stable droplets and >125 w/hr@20 mJ/cm²

~200W dose controlled power
EUV productivity realization on track

<table>
<thead>
<tr>
<th>Timing</th>
<th>Source power [W]</th>
<th>Throughput [Wafers/hr]</th>
<th>System availability [%]</th>
<th>Productivity [Wafers/day]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>125 ✓</td>
<td>&gt;75 ✓</td>
<td>&gt;70% ✓</td>
<td>&gt;1000 ✓</td>
</tr>
<tr>
<td>2016</td>
<td>250 ✓</td>
<td>&gt;125 ✓</td>
<td>&gt;80% ✓</td>
<td>&gt;1500 ✓</td>
</tr>
</tbody>
</table>

Done ✓  Capability demonstrated ✓  On track
Outline

- Throughput & Wafers per Day (WpD)
- Availability
- Defectivity, imaging and overlay
Front-side reticle defectivity: 10x reduction/year realized

Customer requirement for full production without pellicle
200 wafers exposed using reticle with 40W pellicle

Collaborative effort between Intel and ASML

200 wafers exposed with NXE Pellicle

Scanner modified with pellicle compatible loadlock

Reticle with pellicle tested to validate loadlock modifications

ASML Wilton

ASML Veldhoven

NXE Pellicle mounted on Intel reticle

Global transport

Multiple location handling

EUV defectivity reticle shipped

Exposure testing will continue to 1000+ wafers with NXE Pellicle

Ref: 9776-1, Britt Turkot “EUV progress towards HVM readiness”
200 wafers exposed using reticle with 40W pellicle

NO RETICLE ADDERS OBSERVED IN WAFER PRINTS

- Particles on pellicle do not appear to migrate to reticle surface
- ASML pellicle frame design is mitigating adder rate
  - defectivity assessment continuing

Ref: 9776-1, Britt Turkot “EUV progress towards HVM readiness”

EUV defectivity reticle shipped

- Global transport
- Multiple location handling

Exposure testing will continue to 1000+ wafers with NXE Pellicle
Overlay impact with NXE pellicle < 0.17 nm
Mounted on preliminary tooling; New tooling will reduce overlay further

Overlay impact
reticle + studs

99.7%
x: 0.07 nm
y: 0.08 nm

Overlay impact
reticle + studs  pellicle assy

99.7%
x: 0.17 nm
y: 0.07 nm

See: 9776-71, Derk Brouns “ASML NXE pellicle update”
NXE:3350B: 2x overlay improvement at 16nm resolution
Completed qualification for five systems in 2015

<table>
<thead>
<tr>
<th>Resolution</th>
<th>16nm</th>
</tr>
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<tbody>
<tr>
<td>Full wafer CDU</td>
<td>≤ 1.3nm</td>
</tr>
<tr>
<td>DCO</td>
<td>≤ 1.5nm</td>
</tr>
<tr>
<td>MMO</td>
<td>≤ 2.5nm</td>
</tr>
<tr>
<td>Focus control</td>
<td>≤ 70nm</td>
</tr>
<tr>
<td>Productivity</td>
<td>≥ 125 WPH</td>
</tr>
</tbody>
</table>

**Overlay set up**
Set-up and modeling improvements

**Reticle Stage**
Better thermal control
increased servo bandwidth

**Projection Optics**
Higher lens transmission
improved aberrations and distortion

**Off-Axis Illuminator FlexPupil**

**Wafer Stage**
Improved thermal control

**SMASH sensor**
Improved alignment sensor

**Spotless NXE**
Automated wafer table cleaning

**New UV level sensor**

**Improved air mounts**

**Productivity**
≥ 125 WPH
Significant improvements in lens performance

<table>
<thead>
<tr>
<th>Wavefront RMS (nm)</th>
<th>NXE:3300B</th>
<th>NXE:3350B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4nm</td>
<td>[Graph]</td>
<td>[Graph]</td>
</tr>
<tr>
<td>0.2nm</td>
<td>[Graph]</td>
<td>[Graph]</td>
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<tr>
<td>0nm</td>
<td>[Graph]</td>
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Optical transmission

<table>
<thead>
<tr>
<th>Optical transmission</th>
<th>NXE:3300B</th>
<th>NXE:3350B</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Graph]</td>
<td>[Graph]</td>
<td>[Graph]</td>
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</tbody>
</table>
Overlay and focus performance NXE:3350B
Well in specification due to Hardware improvements and new calibrations

- **Dedicated chuck overlay [nm]**
  - Systems A: 1.2 nm
  - Systems B: 0.8 nm
  - Systems C: 1.0 nm
  - Systems D: 0.9 nm
  - Systems E: 1.5 nm
  - Systems F: 1.3 nm
  - Systems G: 1.8 nm

- **Matched machine overlay [nm]**
  - Systems A: 1.8 nm
  - Systems B: 1.4 nm
  - Systems C: 1.2 nm
  - Systems D: 2.0 nm
  - Systems E: 1.6 nm
  - Systems F: 1.8 nm
  - Systems G: 2.2 nm

- **Focus uniformity [nm]**
  - Systems A: 0.8 nm
  - Systems B: 0.6 nm
  - Systems C: 0.9 nm
  - Systems D: 1.5 nm
  - Systems E: 1.2 nm
  - Systems F: 1.8 nm
  - Systems G: 2.0 nm

Details:
- 99.7% X: 0.84 nm Y: 0.81 nm
- 99.7% X: 1.59 nm Y: 1.86 nm
Matched machine overlay below 4.5nm for over a year
(NXE:3300B to ArF immersion)

Data collected over ~18 months, no calibrations executed

Courtesy of IBM
NXE:3350 Imaging: 16nm dense lines and 20nm iso space consistently achieve <1.0nm Full Wafer CDU

Illumination: Dipole 90 degrees. Dose ~45mJ/cm²
New resist materials: towards 16nm resolution at full throughput

**best results show 19% EL, 4.4nm LWR @ 18.5mJ/cm2**

<table>
<thead>
<tr>
<th>16nm Horizontal Dense lines/spaces</th>
<th>NXE:3350 Reference CAR</th>
<th>New formulation non-CAR</th>
<th>New formulation CAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEM image @BE/BF</td>
<td><img src="image1" alt="SEM Image" /></td>
<td><img src="image2" alt="SEM Image" /></td>
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<table>
<thead>
<tr>
<th></th>
<th>Dose</th>
<th>Exposure Latitude</th>
<th>DoF</th>
<th>LWR</th>
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<tbody>
<tr>
<td>NXE:3350</td>
<td>40 mJ/cm²</td>
<td>16 %</td>
<td>145 nm</td>
<td>4.6 nm</td>
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<tr>
<td>New formulation non-CAR</td>
<td>18.5 mJ/cm²</td>
<td>19 %</td>
<td>125 nm</td>
<td>4.4 nm</td>
</tr>
<tr>
<td>New formulation CAR</td>
<td>25 mJ/cm²</td>
<td>16 %</td>
<td>100 nm</td>
<td>5.2 nm</td>
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*Exposures done on NXE:3350B system with Dipole90Y illumination. LWR: Line Width Roughness*
NXE:3400B: 13 nm resolution at full productivity
Supporting 5 nm logic, <15nm DRAM requirements

**Overlay set up**
Set-up and modeling improvements

**Reticle Stage**
Improved clamp flatness for focus and overlay

**Projection Optics**
Continuously Improved aberration performance

**New Flex-illuminator**
Sigma 1.0 outer sigma, reduced PFR (0.20)

**Leveling (Optional)**
Next generation UV LS reduced process dependency

**Wafer Stage**
Flatter clamps, improved dynamics and stability

<table>
<thead>
<tr>
<th><strong>Resolution</strong></th>
<th>13 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full wafer CDU</strong></td>
<td>≤ 1.1 nm</td>
</tr>
<tr>
<td><strong>DCO</strong></td>
<td>≤ 1.4 nm</td>
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<tr>
<td><strong>MMO</strong></td>
<td>≤ 2.0 nm</td>
</tr>
<tr>
<td><strong>Focus control</strong></td>
<td>≤ 60 nm</td>
</tr>
<tr>
<td><strong>Productivity</strong></td>
<td>≥ 125 WPH</td>
</tr>
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</table>
Reduction in Pupil Fill Ratio for Contact Holes contrast improvement
16 nm staggered holes resolved

NXE 3350, CAR hexapole illumination with Pupil Fill Ratio between 10% and 40%

See: 9776-62, Jo Finders “Contrast optimization for 0.33NA lithography”
2D clips: pitch 32nm in x- and y- direction, $k_1=0.39$
Better pattern fidelity with lower Pupil Fill Ratio

Pupil Fill Ratio=40%  Pupil Fill Ratio=20%

See: 97762, Jo Finders “Contrast optimization for 0.33NA lithography”
13nm Half Pitch resolved with non-CAR resist
17% EL and 4.2nm LWR @ 31mJ/cm² dose

<table>
<thead>
<tr>
<th>13nm Horizontal Dense lines</th>
<th>NXE:3350 Baseline CAR</th>
<th>New formulation non-CAR</th>
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<tbody>
<tr>
<td>SEM image @BE/BF</td>
<td>![SEM image]</td>
<td>![SEM image]</td>
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<tr>
<td>Dose</td>
<td>~40 mJ/cm²</td>
<td>31 mJ/cm²</td>
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<tr>
<td>Exposure Latitude</td>
<td>-</td>
<td>17 %</td>
</tr>
<tr>
<td>DoF</td>
<td>-</td>
<td>150 nm</td>
</tr>
<tr>
<td>LWR</td>
<td>4.5 nm</td>
<td>4.2 nm</td>
</tr>
</tbody>
</table>

Exposures done on NXE:3350B with dipole Y illumination
20nm Contact Holes: less than 30mJ/cm² dose with non-CAR resist

<table>
<thead>
<tr>
<th>20nm Regular contact holes</th>
<th>New formulation non-CAR</th>
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<td>SEM image @BE/BF</td>
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<tr>
<td>Dose</td>
<td>29.5 mJ/cm²</td>
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<tr>
<td>LCDU</td>
<td>3.8 nm</td>
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</table>

*Exposures done on NXE:3350 with Quasar45 illumination*
Summary: EUV readying for volume manufacturing

- Completed qualification of five NXE:3350B, the 4th generation EUV exposure tool, one system qualified at 75 wph
- Multiple systems demonstrated >1,000 wafers per day capability, with one system exceeding 1,350 wpd
- 80W configuration operational in the field, 125W configuration qualification completed
- 80% system availability capability demonstrated
- Excellent NXE:3350B imaging and overlay performance at > 80W power
- Continuous progress in resist formulation promising towards enabling 13nm half pitch at high throughput