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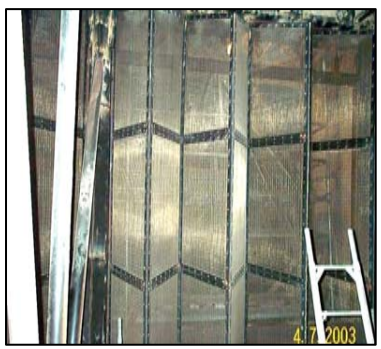

Large Particle Ash (LPA) Screen Retrofits at Coal-fired Units in Indiana and Ohio

Hans Sobolewski, STEAG LLC
Michael Harrell, Dayton Power & Light, J.M. Stuart Electric Generating Station
Joseph Jancauskas, Dayton Power & Light, J.M. Stuart Electric Generating Station
Marilynn Martin, STEAG LLC

2006 Environmental Controls Conference
Sponsored by
U.S. Department of Energy's National Energy Technology Laboratory
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Pittsburgh, Pennsylvania

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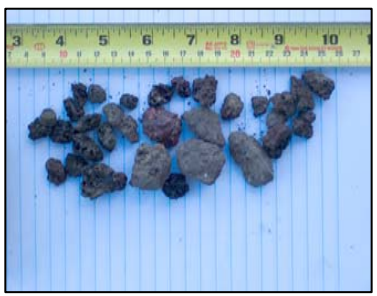

Large particle ash (LPA) also known as popcorn ash forms in the boiler and easily carries over into the SCR reactor causing:

- **Catalyst pluggage which leads to:**
  - **Flue gas maldistribution**
  - **Loss of SCR performance through loss of available DeNOx potential**
  - **Unacceptable NH_3 slip**
  - **Excessive pressure drop**
- **Catalyst erosion damage**

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Large Particle Ash Screen Development

- CFD and physical modeling performed to address root cause of LPA formation and carry over to SCR reactor
- Modeling addressed specific issues:
  - Geometric scale
  - Relationship between model and full-scale installation including pressure drop
- Results lead to modifications and/or additions to
  - Boiler's economizer hopper
  - Economizer outlet and
  - Downstream ductwork
- LPA screen developed in 1996 which reliably and continuously prevented intrusion of LPA into the SCR reactor

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LPA patented design features:

- **Pleated Design**
  - Ensures advantageous angle of LPA capture
  - Low flue gas flow velocity = low pressure drop
- **Hinged Design**
  - Allows frequent LPA screen rapping
- **Modular Design**
  - Allows different types of screen materials
    - Uncoated or coated stainless steel wire mesh
    - Uncoated or coated stainless steel perforated plates
    - Uncoated or coated stainless steel wedge wire

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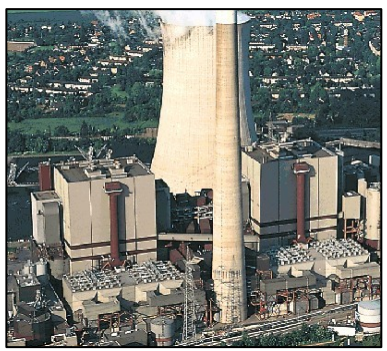

Steag's Voerde Power Station Unit 3 and 4 (Germany)

- 2 units, 760 MW each
- Coal ash content up to 15%
- Flue gas velocity up to average 45 ft/sec
- Uncoated wire mesh screen inlays
- Installed in winter 1996
- 25% of the screen inlays replaced in 2004
- No LPA intrusion in SCR system since installation

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DP&L's Stuart Generating Station Units 1, 3 & 4 (Ohio)

- 4 units, 600 MW each
- Coal ash content up to 15%
- Flue gas velocity up to 80 ft/sec

- Unit 3: installed in spring 2005, coated wire mesh and uncoated wedge wire screen inlays (only locally in high velocity areas); no significant pluggage or operational problems

- Unit 1: installation in spring 2006, uncoated wedge wire screen inlays

- Unit 4: installation in fall 2006, coated wire mesh and uncoated wedge wire screen inlays (only locally in high velocity areas)

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Plant in Indiana

- 1 unit, 320 MW
- Coal ash content up to 12%
- Flue gas velocity up to 60 ft/sec
- Uncoated wire mesh screen inlays
- Installed in spring 2005
- No operational problems reported
- Recent inspection showed no signs of erosion or damage
- No screen inlays replaced

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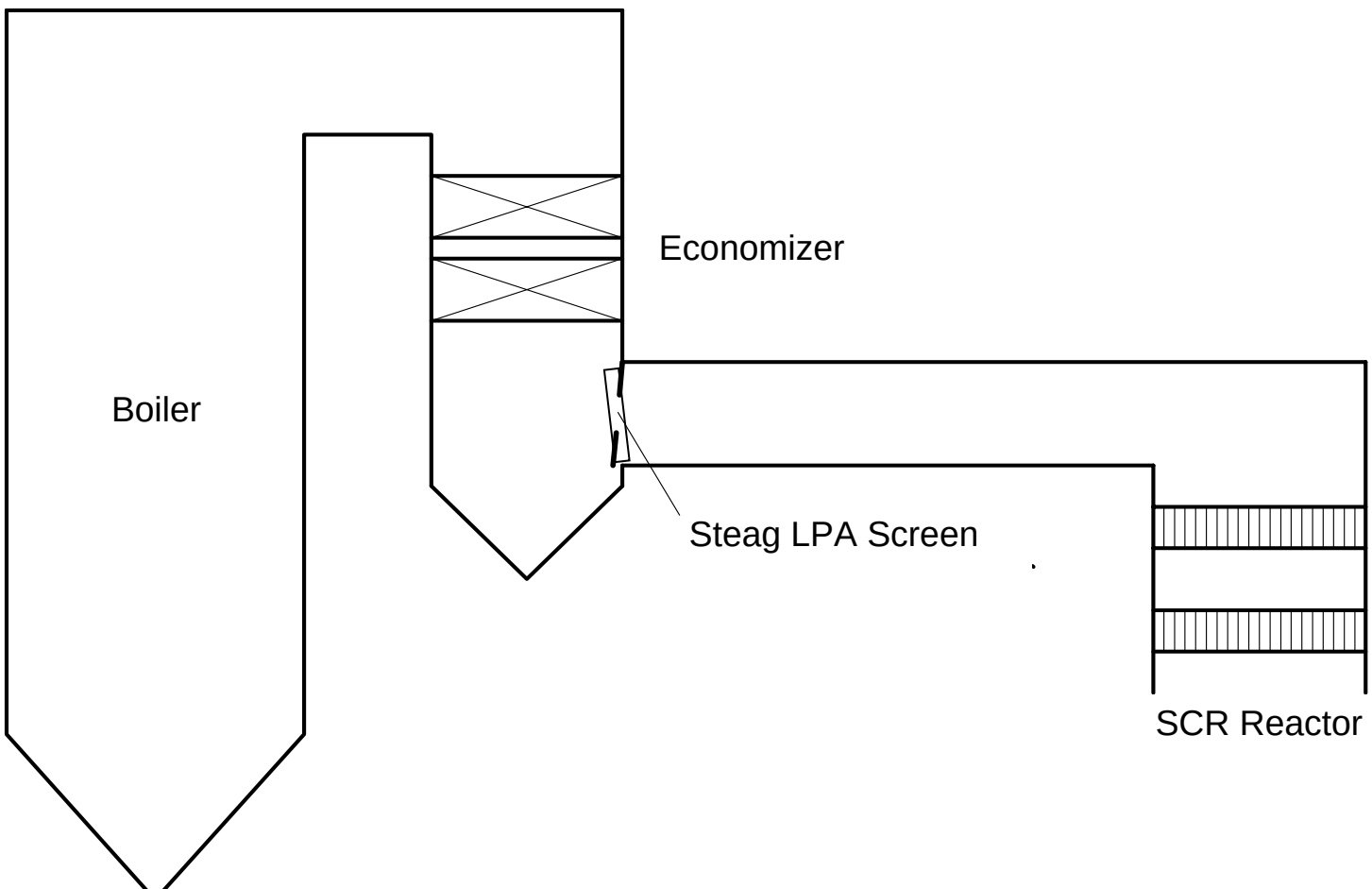
LPA Screen – Location of Installation



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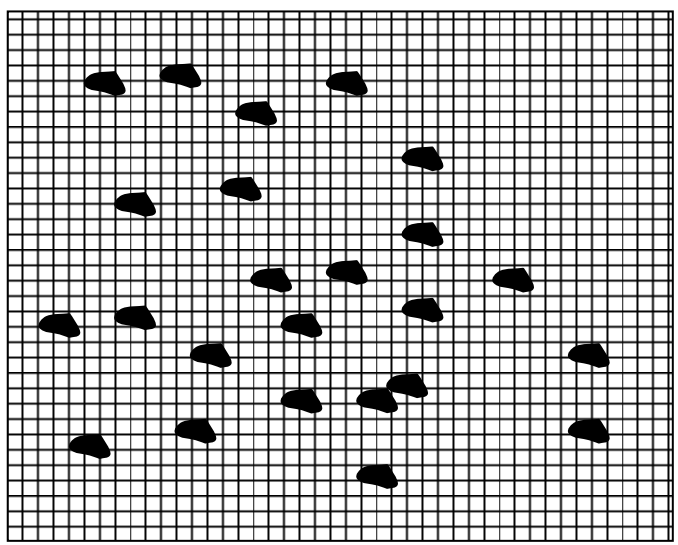
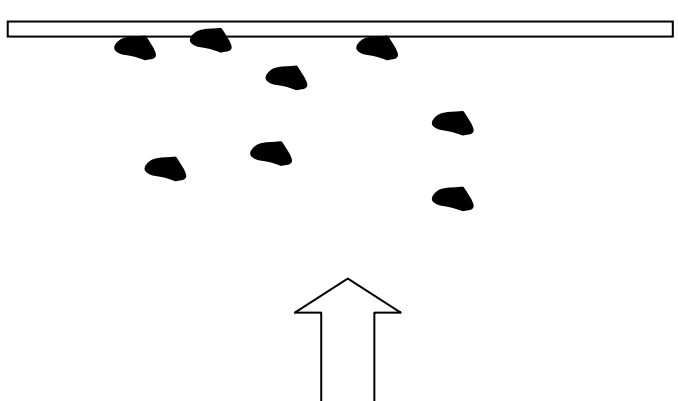
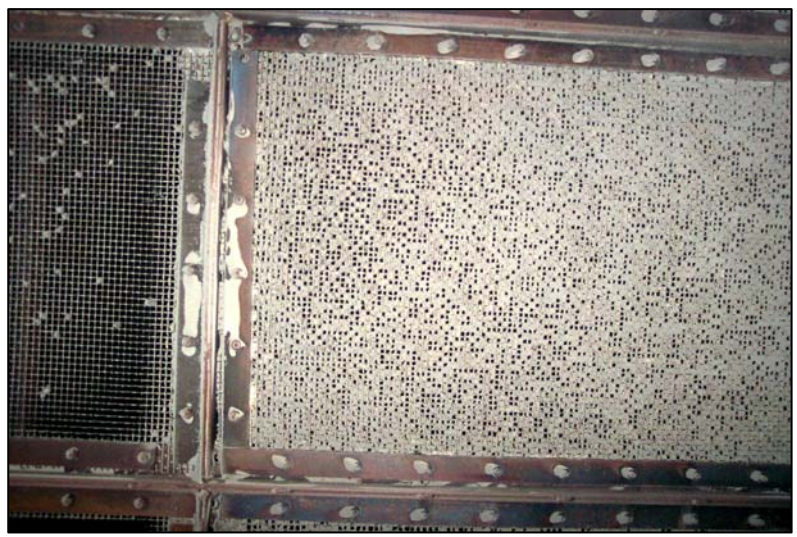
Common Flat LPA Screen







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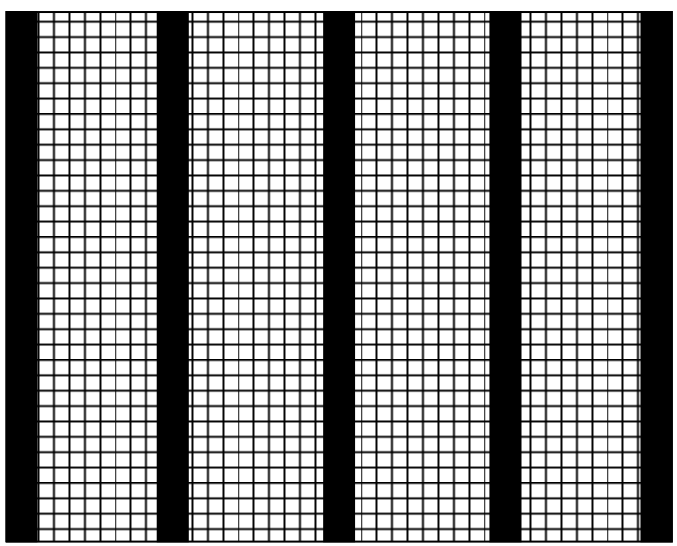
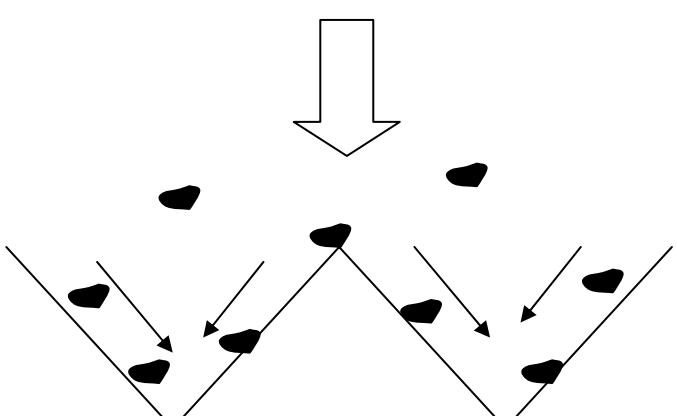
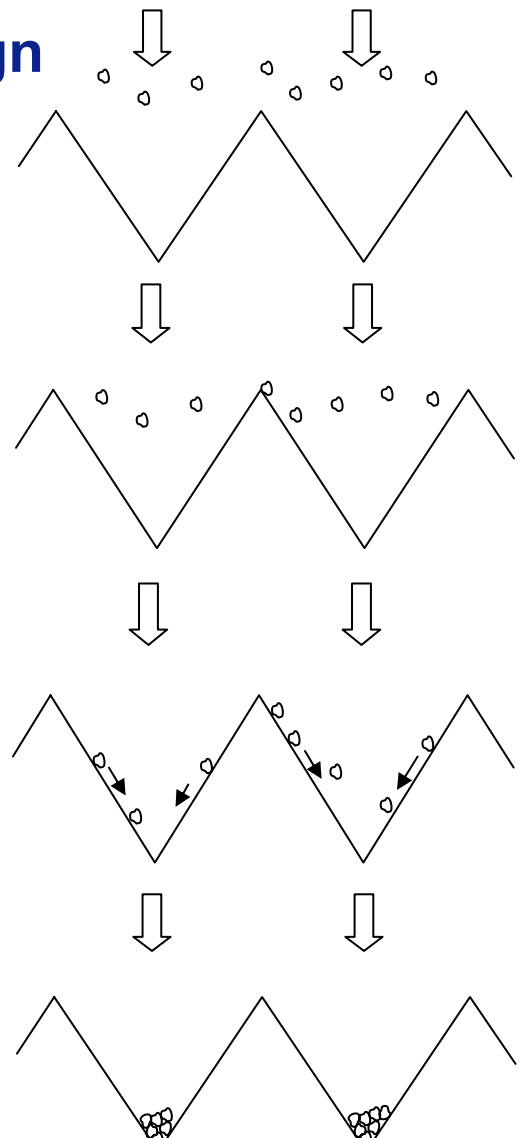
Steag's Pleated LPA Screen Design







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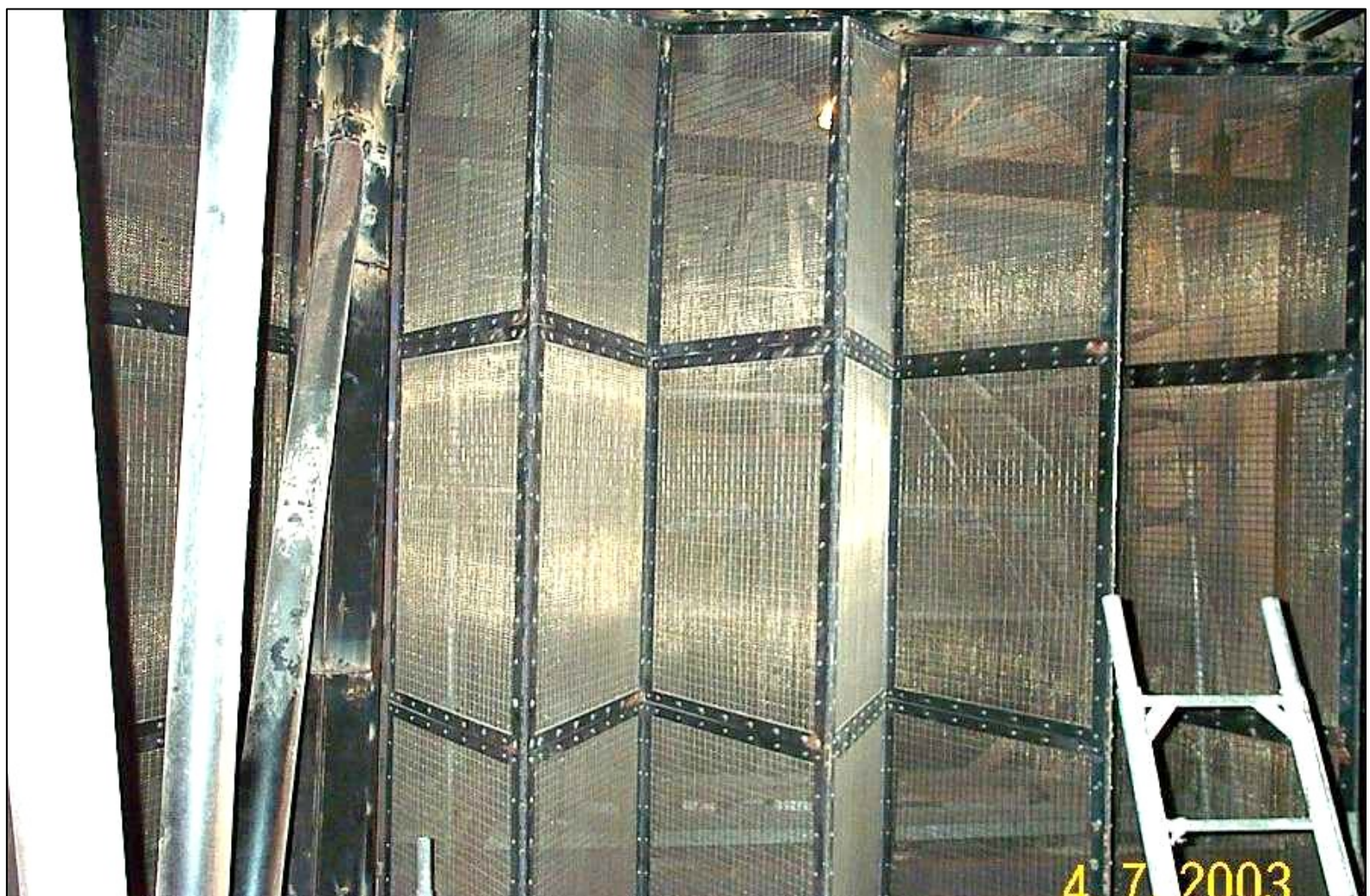
Pleated LPA Screen Design



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Pleated LPA Screen Design

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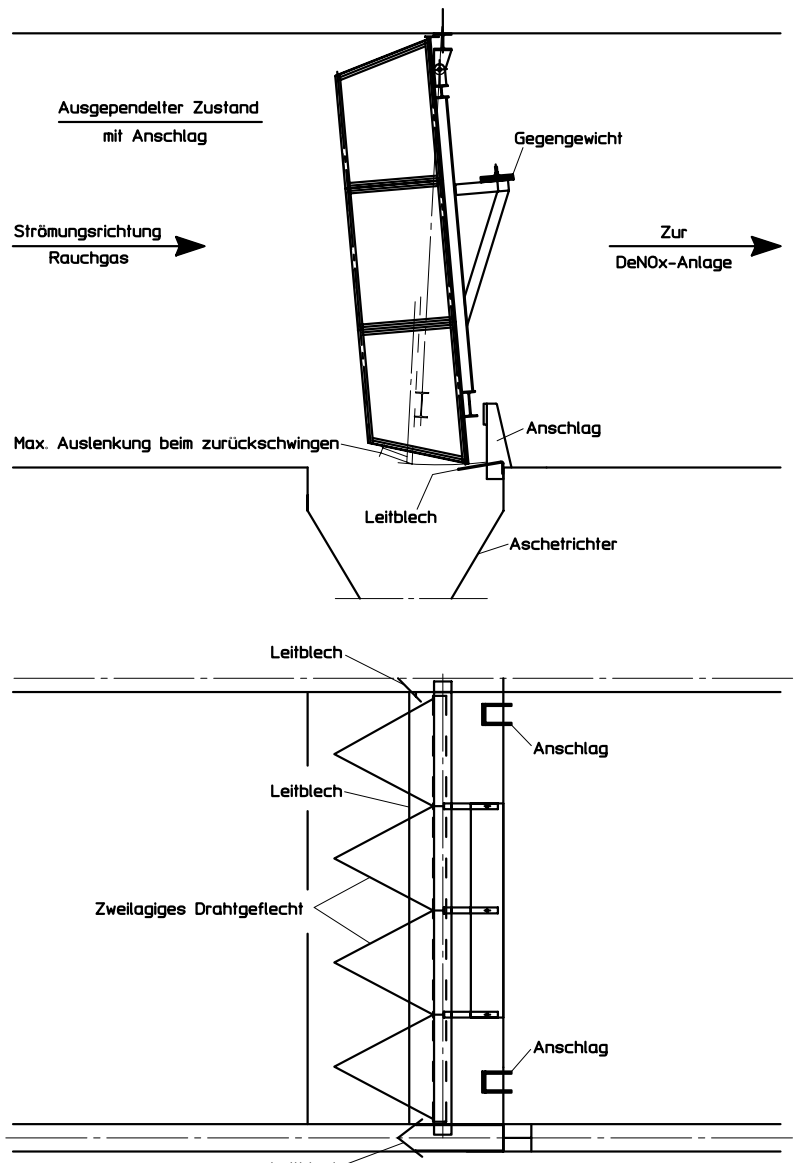
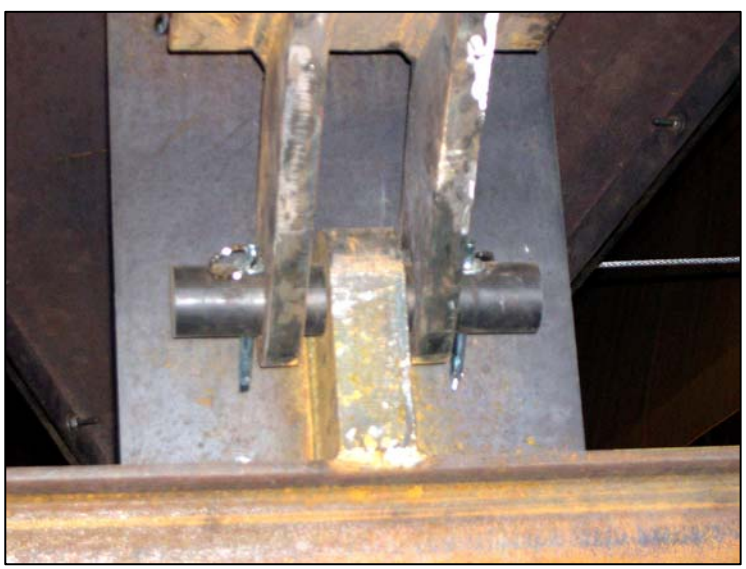


LPA Screen – Hinged Design



Screens are free swinging for self cleaning motion.

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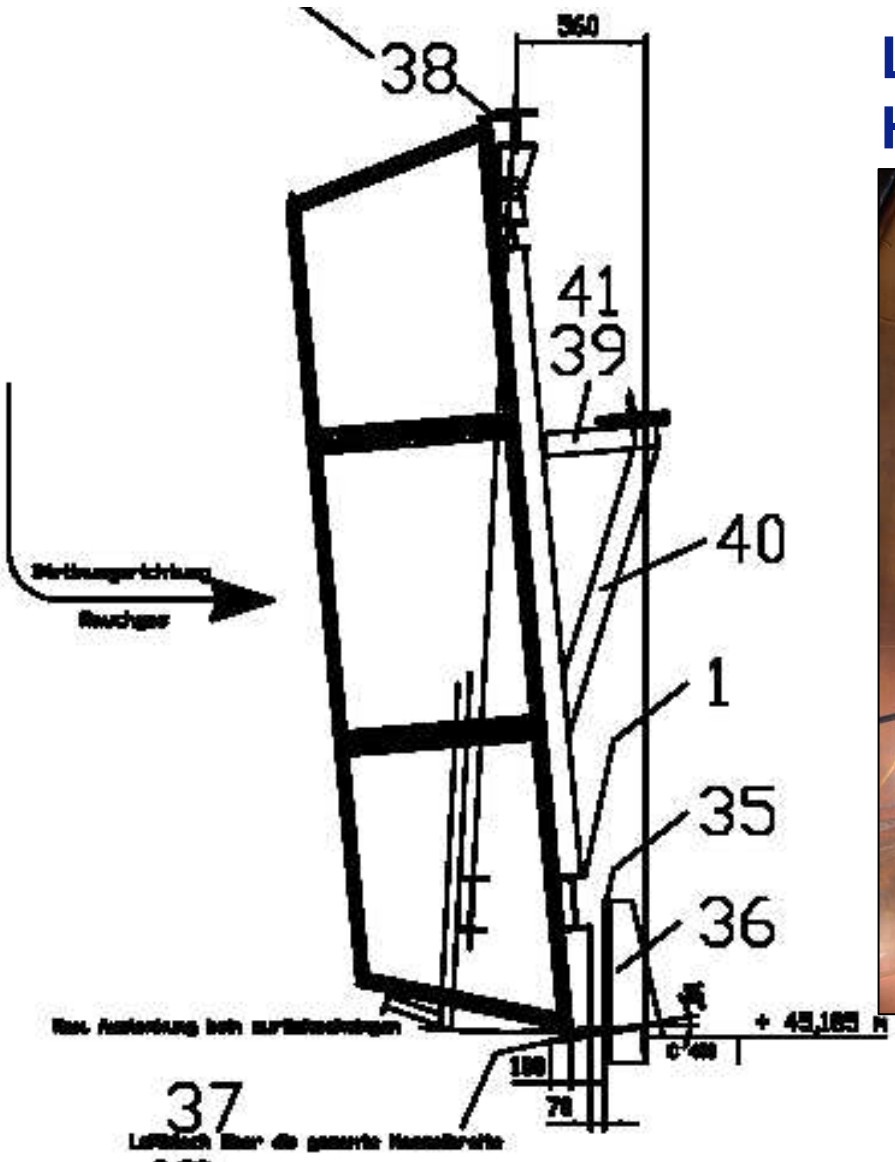
LPA Screen – Hinged Design



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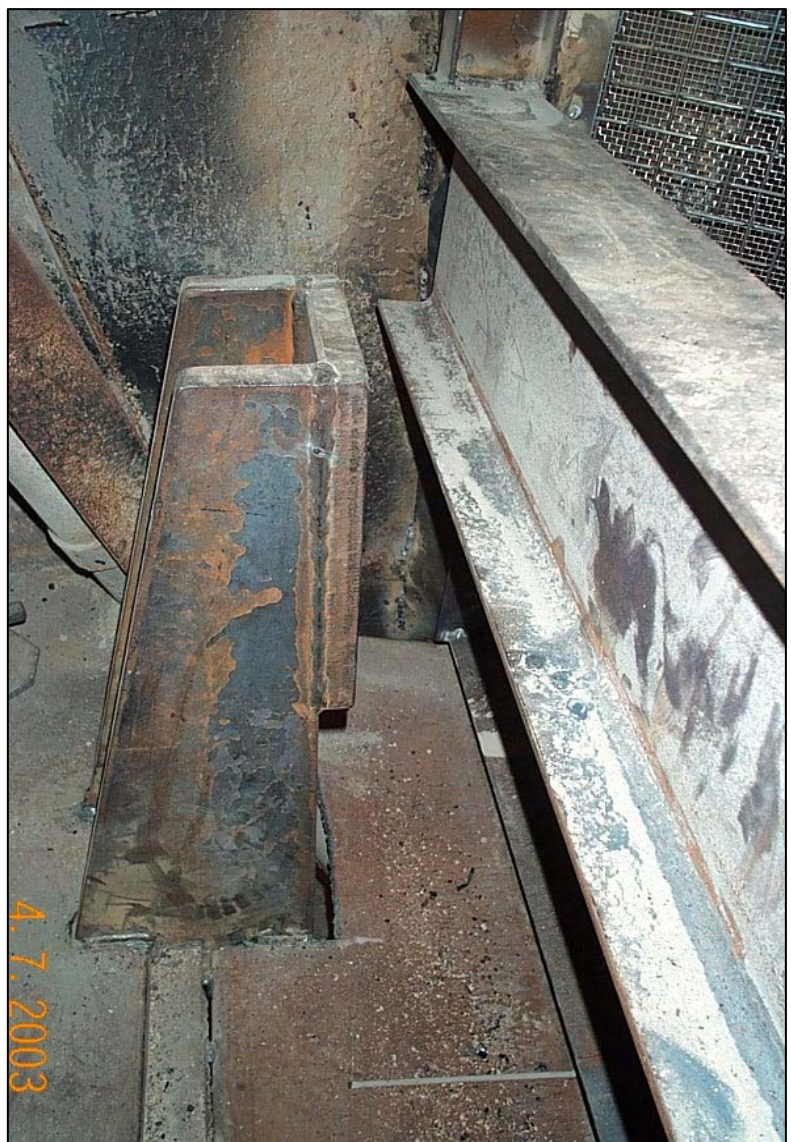

LPA Screen – Stops

Step 1:
Free swinging screen gets pulled away by a rapper.

Step 2:
When released from the rapper, screen swings back against the stop (anvil).

Step 3:
Hitting the stop induces a strong impulse and vibrating motion in the screen. LPA caught in the screen gets released and drops down.

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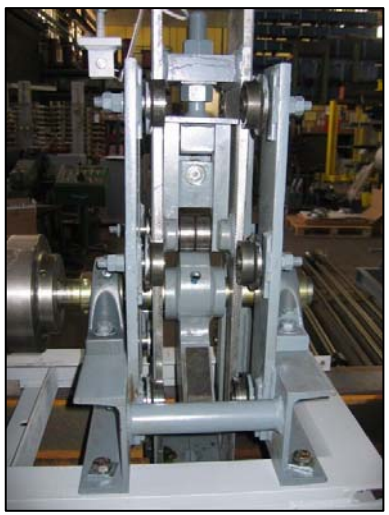

LPA Screens – Fully Automated Rappers

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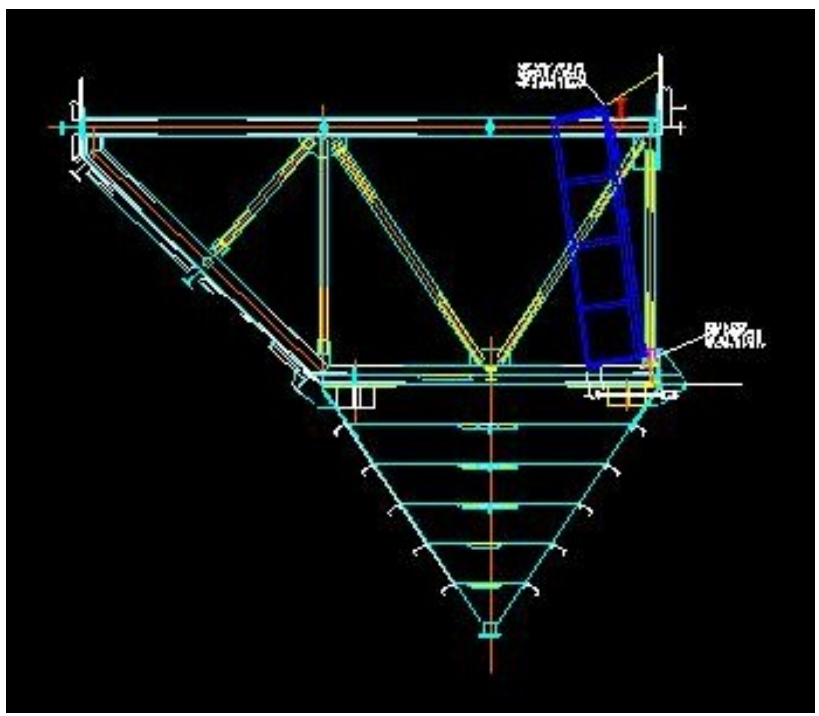
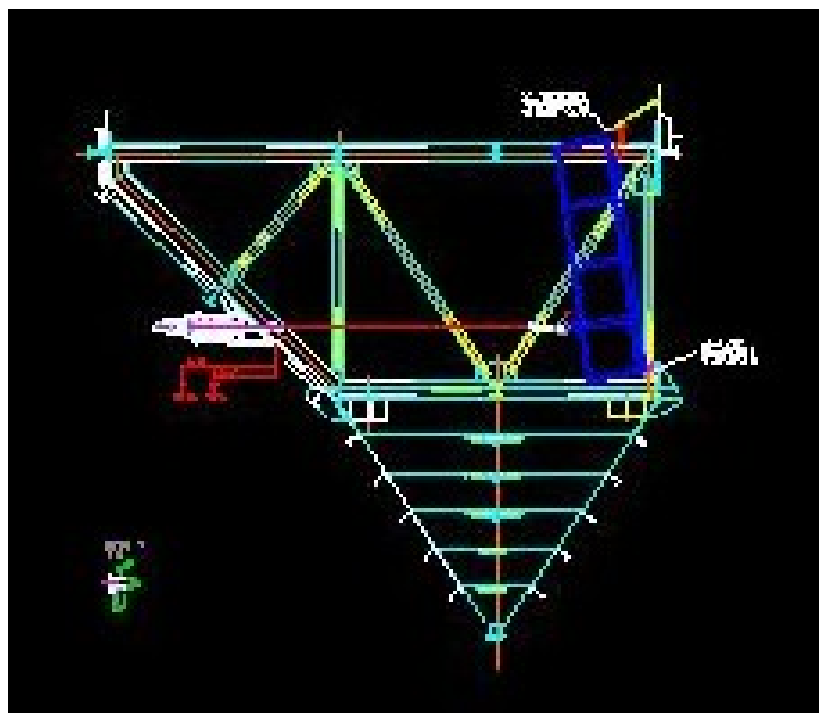
LPA Screens – Fully Automated Rappers





Pneumatic Rapper

- Actuated pneumatic cylinder
- Pushes screen from stop
- Standard solution
- 100 psig compressed air

Camshaft Rapper

- Gear motor driven camshaft
- Pulls screen from stop
- Optionally supplied
- 110 VAC or 480 V 3-phase

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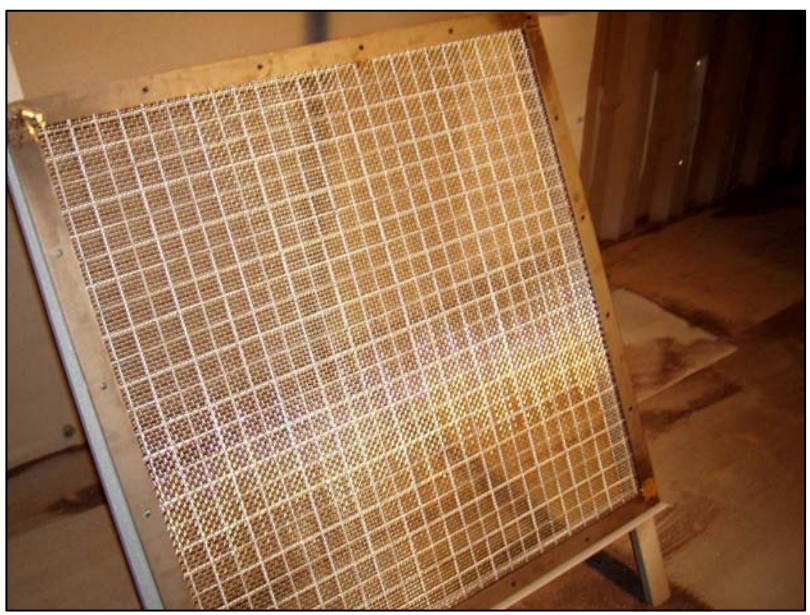
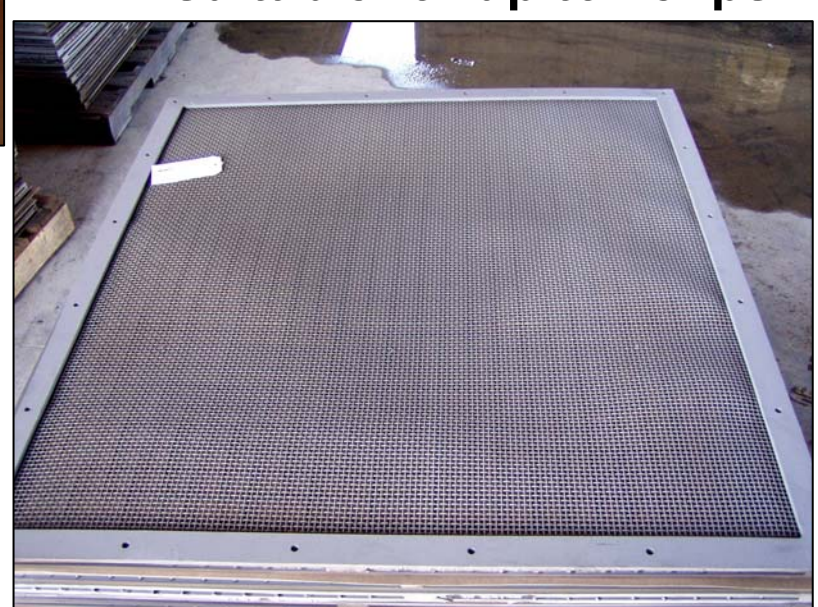
LPA Screen Inlays – Double Wire Mesh Screen Design



Uncoated double wire mesh
– suitable up to 60 fps

Coated double wire mesh
– suitable for up to 75 fps



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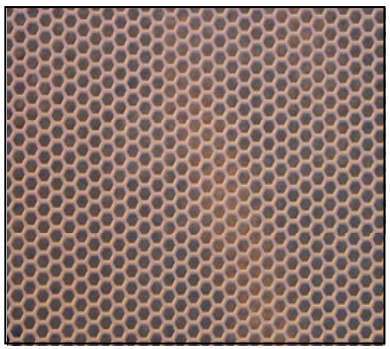
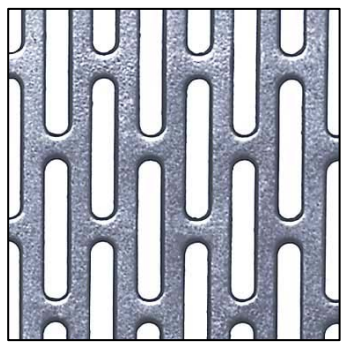


LPA Screen Inlays – Perforated Plate Design

Uncoated perforated plate – suitable for up to 70 fps



Slotted, square or hexagonal holes

Coated perforated plate – suitable for up to 85 fps

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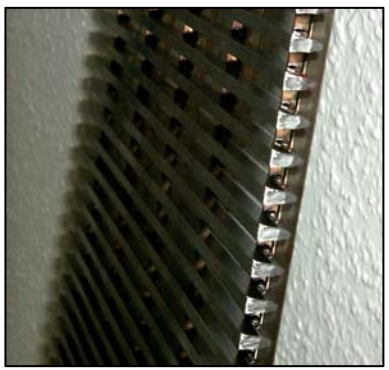
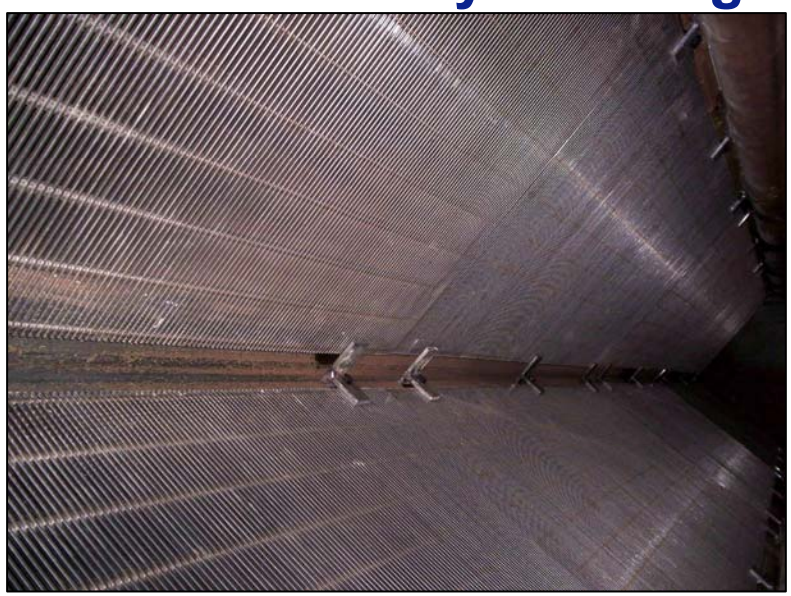
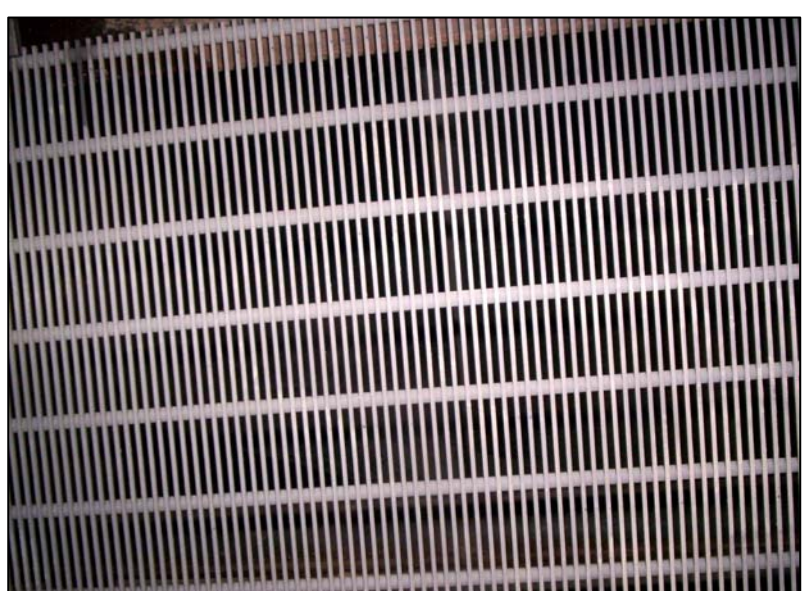


LPA Screen Inlays – Wedge Wire Design



Uncoated wedge wire – suitable for about 70 fps

Coated wedge wire – suitable for about 90 fps



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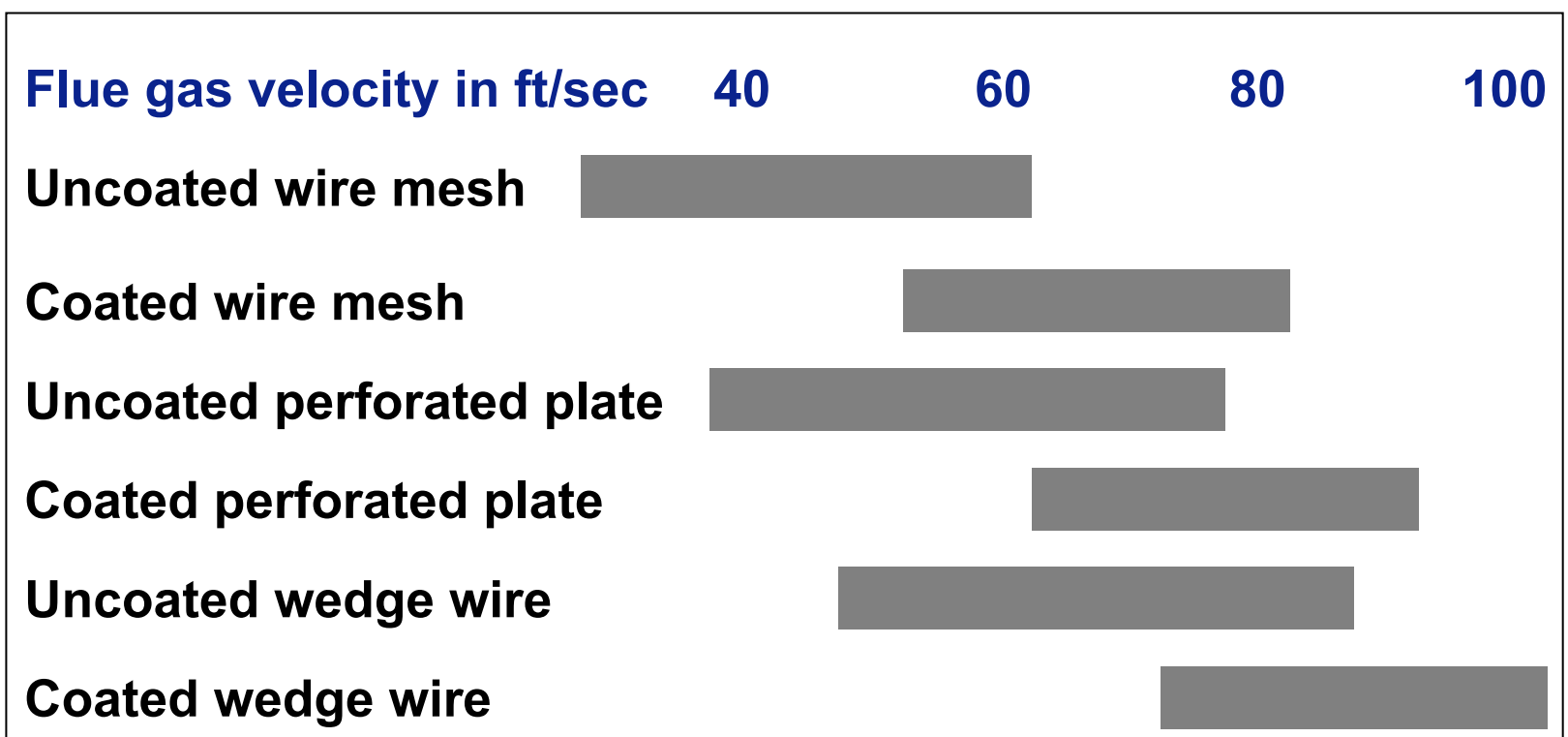
Suitability of various screen inlay materials depending on the average flue gas velocity in the economizer outlet duct:



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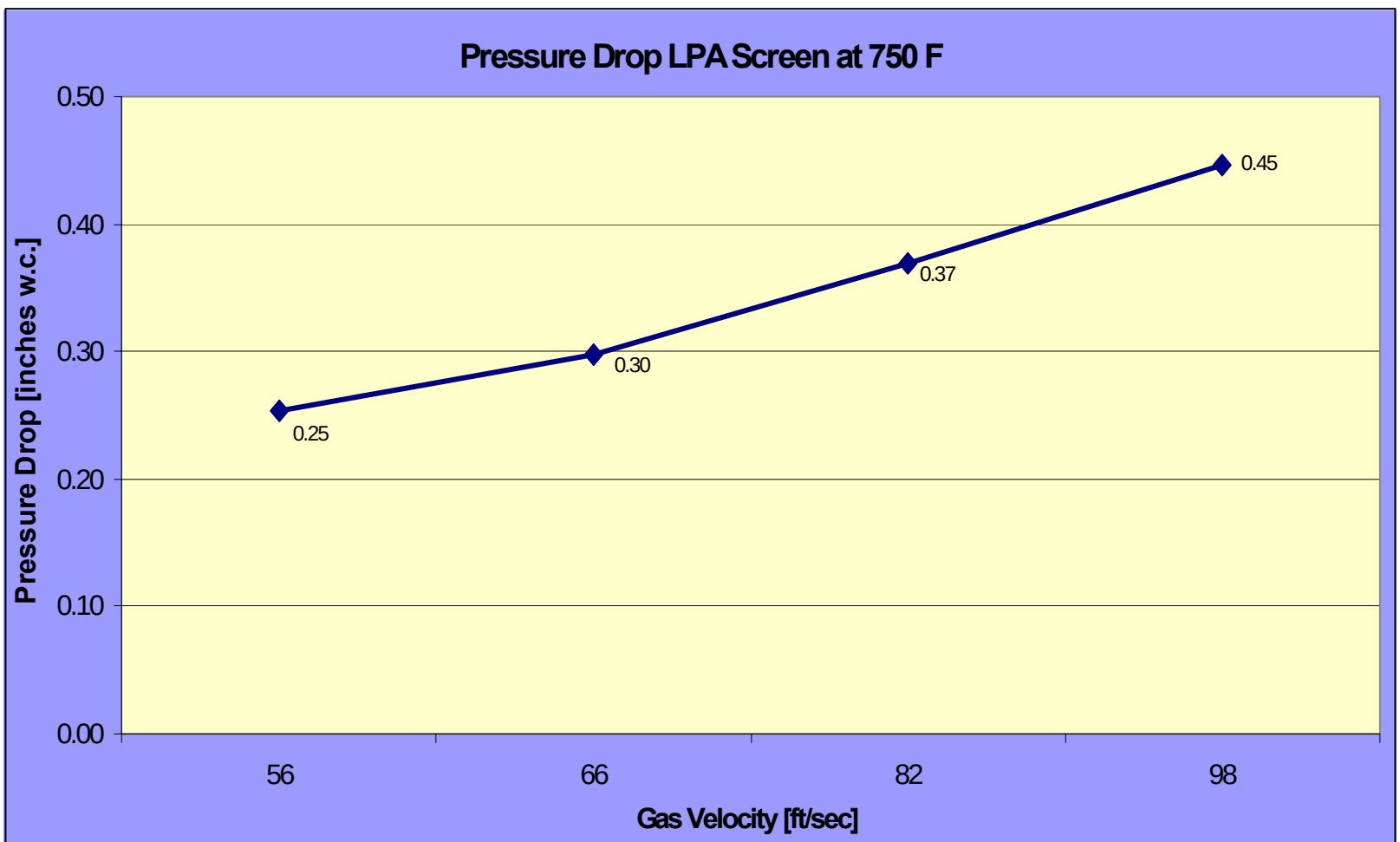
Large open surface area and slow flue gas velocity through the screen ensure a low pressure drop across the LPA screen



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LPA Screen – Scope of Services

- Clarification of all interfaces to existing flue gas duct work and ash hoppers.
- Structural calculations for the I-beams, which support the LPA screens inside the flue gas duct.
- Discussion about constructability and installation procedure.
- Detailed design and engineering of the LPA screens.
- Supervision of fabrication and manufacturing of the LPA screens.

Options

- Material procurement, fabrication and pre-assembly.
- Supervision of installation on site.
- Support during start-up and commissioning of initial operation of the LPA screens.

The structural calculations for the flue gas duct is <u>not</u> included. It is recommended to turn to the original supplier of this ductwork for structural questions concerning static and dynamic loads.

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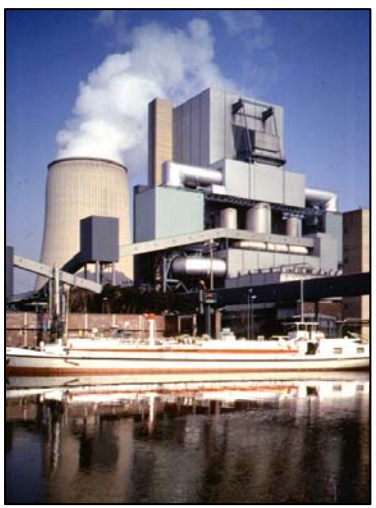

LPA Screen – Schedule

Design including site investigation	4 – 6 weeks
Manufacturing	12 – 14 weeks
Installation	2 – 4 weeks

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Questions?