STALL, problem and solutions

- High frequency vibrations (blades & hub)
- Stimulation of natural frequency
- Cracking by fatigue
Content

- What is stall?
- Typical axial fan curve
- Reasons for rotating Stall
- System requirements
- Solutions – Pros and Cons
What is STALL

- Disturbance causes the air flow to separate from one or more of the blades.
- This blocks the air flow through the corresponding blade cell.
Typical axial fan curve

The STALL zone for axial fans in parallel often is much larger than expected!
Several fan suppliers do not show or do not know in detail the STALL area at their fan curves. 

- **Curve of one fan**
- **Summary curve of two fans**
- **Stall area of one fan**
- **Stall area of two fans (summary curve)**
- **Max. allowed system resistance without any safety margin**
Typical axial fan curve

Summary:
Always ask for fan curves starting at 0m³/s
Reasons for Rotating Stall at fans

- Turbulent inlet or outlet flow at the fan
- Increased system resistance because of unexpected aerodynamic behaviour
- Wrong system design / calculation
- Short-term pressure pulses
General requirements for Stall-free fans

- Restricted space in the ventilation building
- Heat resistant
- Up to 100% reversibility
- Highest possible volume flow at parallel operation
- Highest possible efficiency
- Cost-efficient (not too expensive)
- High operational safety (robust against system fluctuations)
### Solution no. 1: Centrifugal Fan

#### Pros
- STALL-free
- High pressure
- Extremely heat resistant

#### Cons
- No Reversibility
- Low air flow
- Large space requirement
- Optimised for one duty-point only
- Price
Solution no. 2: Variable pitch in motion

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>▪ Adjustable in motion</td>
<td>▪ Not Stall-free</td>
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<tr>
<td></td>
<td>▪ Operational safety (hydraulic system, bearings at each blade)</td>
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<td>▪ Expensive maintenance</td>
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<td>▪ Price</td>
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Solution no. 3: STALL-free fan curve

Anti-Stall device

Parallel operation (trouble-free)
Solution no. 3: STALL-free fan curve

Pros
- Stall-free also in parallel operation!
- Operation safety – simple & robust
- Low space requirement
- Fully Reversible
- Price

Cons
- Medium (compared with centrifugal)
- Several duty-points only with VSD possible

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