Effect of sprayer boom curvature on spray distribution with horizontal test bench

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Curvatures at Belgian inspection

<table>
<thead>
<tr>
<th>Boom curvature</th>
<th>Method</th>
<th>ISO 16122-2 tolerance</th>
<th>Belgian tolerance</th>
<th>Belgian result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal boom deformation (4.8.4.2.)</td>
<td>Maximum distance between boom end nozzle and horizontal reference line</td>
<td>&gt; 2.5% of boom width</td>
<td>&gt; 50 cm</td>
<td>Rejection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>→ 45cm for 18m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical boom deformation (4.8.4.1.)</td>
<td>Maximum distance between boom end nozzle and vertical reference line/ boom width ≤ 18 m</td>
<td>&gt; 10 cm</td>
<td>&gt; 30 cm</td>
<td>Rejection</td>
</tr>
<tr>
<td>Vertical boom deformation (4.8.4.1.)</td>
<td>Maximum distance between boom end nozzle and vertical reference line/ boom width &gt; 18 m</td>
<td>&gt; 0.5% of boom width</td>
<td>&gt; 50 cm</td>
<td>Rejection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>→ 12cm for 24m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on references?
Curvatures at Belgian inspection

Key
1 boom centre

$ d $ maximum deformation from centre-frame $ \leq 2.5 \% $ of boom width

Figure 1 — Horizontal deviation of boom
Curvatures at Belgian inspection

Need of objectivaly determinate method and tolerance!
Curvatures at Belgian inspection
Methods : Boom inclinations
Methods: Boom inclinations

Back view (vertical plan)

Top view (horizontal plan)
Methods: horizontal test bench

System of rotation around central point
+ height setting
+ pressure setting

Example: 6° vertical tilt
Methods: horizontal test bench
Methods: simulation of 12 m boom
Results: Vertical inclination

- **C = 50 cm height**
  - ml values
  - 0°, 1°, 3°, 5° inclinations
  - Overflow indicated

- **C = 60 cm height**
  - ml values
  - 0°, 1°, 3°, 5° inclinations
  - Overflow indicated

- **C = 75 cm height**
  - ml values
  - 0°, 1°, 3°, 5° inclinations
  - Overflow indicated

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Legend:
- 0°
- 1°
- 3°
- 5°
Results: Working width

Impact of vertical inclination

<table>
<thead>
<tr>
<th>Angle of inclination</th>
<th>Width (cm) lost with down inclination</th>
<th>Width (cm) gained with up inclination</th>
</tr>
</thead>
<tbody>
<tr>
<td>1°</td>
<td>-20</td>
<td>+(10 à 20)</td>
</tr>
<tr>
<td>3°</td>
<td>-40</td>
<td>+(10 à 20)</td>
</tr>
<tr>
<td>5°</td>
<td>-60</td>
<td>+(10 à 20)</td>
</tr>
<tr>
<td>6°</td>
<td>-70</td>
<td>+(10 à 20)</td>
</tr>
</tbody>
</table>
**Results: Extreme values**

Values > or < 15% of average

Nozzle n°5 / Tube n°55

<table>
<thead>
<tr>
<th>Angle of vertical inclination (down)/working height</th>
<th>Delimiting point of the distribution disturbance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>N° tube</strong></td>
</tr>
<tr>
<td>3° / 50 cm</td>
<td>50</td>
</tr>
<tr>
<td>3° / 60 cm</td>
<td>35</td>
</tr>
<tr>
<td>5° / 60 cm</td>
<td>55</td>
</tr>
<tr>
<td>5° / 75 cm</td>
<td>43</td>
</tr>
<tr>
<td>6° / 60 cm</td>
<td>61</td>
</tr>
<tr>
<td>6° / 75 cm</td>
<td>48</td>
</tr>
</tbody>
</table>

Always +/- 30 cm

Vertical deviation

C = 62 cm height
Results: Horizontal inclinations

And combinations vertical+horizontal inclinations

vertical + horizontal inclinations  
3°  
3°  

vertical inclination only  
3°
Results: Sum of spray crossing

3° vertical

Vertical inclination : 3°

C = 60 cm height
Results: Sum of spray crossing

5° vertical

Sum of 2 sprays
C = 60 cm height

Each of 2 sprays
C = 60 cm height
Results: Sum of spray crossing

5° vertical

![Graph showing the results of spray crossing at 5° vertical. The graph compares the sum of two sprays and each of the two sprays, both at a height of 60 cm.](image)

- Sum of 2 sprays
  - C = 60 cm height

- Each of 2 sprays
  - C = 60 cm height
Results: Sum of spray crossing

5° vertical

Sum of 2 sprays
C = 60 cm height

Each of 2 sprays
C = 60 cm height
Results: Boom extension

Vertical inclination 3°
C = 60 cm height

<table>
<thead>
<tr>
<th>%</th>
<th>First 6 m</th>
<th>Extension 6 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.V. 6 m</td>
<td>5.44</td>
<td>5.79</td>
</tr>
<tr>
<td>C.V. 12 m</td>
<td></td>
<td>5.59</td>
</tr>
</tbody>
</table>

- 6 m
- 6+6 = 12 m

ml
N° tubes 40 44 48 52 56 60 64 68 72 76 80 84 88 92 96 100 104 108
Conclusions and perspectives

• Inclinations in horizontal plane (angle 1-6 °) have no effect on spray distribution
• Inclinations in vertical plane induce different effects following it is directed upwards or downwards
  – Upwards, inclination does not affect the distribution unless a small edge effect → negligible effect on the crop by the round trip of the tractor in the field.
  – downwards, the inclination of the half ramp of 6 m induces significant disturbances from an angle of 3°. The importance of these disturbances depends on the initial working height, the angle and the length of the boom → Downward inclination is an important point in the control of the sprayers