Contributions to the Development
Oil Supply Analyses / Swivel Test Bench
Contents

- Swivel Test Bench
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- Oil Supply Analysis
- Oil Level Variation
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Swivel Test Bench

- Swivel Angle: max. 50°
- Engine Self-Weight: max. 1 ton
- Coasting Mode: max. 350 kW
- Equivalent Acceleration: 1.2 g in all directions
Correlation Driving Dynamics

Constant Drive

Acceleration/Deceleration

Swivel Level

\[ \tan \alpha = \frac{a}{g} \]

<table>
<thead>
<tr>
<th>Acceleration/Deceleration [g]</th>
<th>0,00</th>
<th>0,09</th>
<th>0,18</th>
<th>0,27</th>
<th>0,36</th>
<th>0,47</th>
<th>0,58</th>
<th>0,70</th>
<th>0,84</th>
<th>1,00</th>
<th>1,19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swivel Angle Degree</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
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</tbody>
</table>
Swivel Test Bench / Metrology

- Gas Content Measurement (TMT, Flucon, DSI)
- Blowby Measurement (with additional Air Injection)
- Oil Pressures and Temperatures
- Standard Measurands
- Special Measurands according to Customer Request
- Video Control - maximum of 8 Cameras
Limit Values for Oil Pressure and Gas Content

- at maximum swivel angle
  (driving dynamics, longitudinal and lateral acceleration)
- at extreme oil levels (MIN, MAX, underfilling and overfilling)
- at maximum oil temperature

Targets

- No oil throw
- No oil behind oil separator
Oil Level Variation

Constant:
- Fitting position
- Speed
- Torque
- Oil temperature

Abort Criteria:
- Maximum gas content
- Minimum oil pressure
- Oil throw

Foaming / Oil Pressure by Oil Level Variation

Gas Content [%] vs. Oil Volume [l]
- Gas Content [%]
- Oil Pressure [bar]

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Crank Case Ventilation

Option A

Option B
Crank Case Ventilation

Option A
- Maximum oil level
- Speed = speed_{max}
- Torque = 0

Result
"Oil throw" within right turn
Crank Case Ventilation

Option B

- Maximum oil level
- Speed = speed_{max}
- Torque = 0

Result

No "oil throw"
within 45°-circle,
increased gas content
Versions of Optimization

Measures at critical Operating Conditions (Oil Throw/Gas Content):

- Adjustment of minimum and maximum oil levels
- Adjustment of oil grade / quality
- Modifications of design:
  - Oil pump (point of suction, delivery rate)
  - Oil pan
  - Oil baffle
Versions of Optimization

Refinement of Crank Case Ventilation System

- Adjustment of minimum and maximum oil levels
- Modifications of design:
  - Oil return channels
  - Oil separator (Centrifuge, labyrinth, etc.)
  - Valve bonnet
Versions of Optimization

Original Blowby Channels

Blowby Channels with "Splash Guard"