Agricultural Trailer Braking Study
- In-Service Assessment of Agricultural Trailer / Trailed Appliance Braking System Condition & Performance

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Brakes never seem important …… until you want to stop
• Tractor power and trailer size increases … (8-10 tonne → 12-14 tonne)
• More 4wd tractors in use
• 40 km/h (25 mph) ‘conventional’ tractors become popular in UK
• ‘Single-line’ hydraulic trailer braking an accepted industry standard
• 25% (trailer) braking efficiency & operation linked to tractor brake pedal if trailer mass over 14230 kg (UK Road Vehicle Construction & Use Regulations, 1986)
Current Ag. Tractor – Trailer Braking Systems

**Tractor**

- Inboard (oil-cooled) or external (air-cooled) disc brakes
- Hydraulic or power operated
- 4wd engagement upon braking and/or additional brakes on front axle (driveline or axle ends)

**Trailer**

- Drum brakes in universal use
- Overrun brakes (<3500 kg trailer mass) or power-applied (hydraulic or pneumatic)
- 25% braking efficiency up to 20 mph (32 km/h). Ag. Tractors not permitted to exceed 20 mph by UK Law!
The Reality

75%  25%

- UK max. permissible gross train weight (GTW) = 24390 kg (24 tons)
  - Trailer max weight = 18290 kg
  - Tractor max weight therefore = 6190 kg (typical 100 – 150hp 4wd)
  - Typical 14-16 tonne trailer + 200hp 4wd tractor = ~30,000 kg GTW … ~25% overweight!
- Up to 75% of combination kinetic energy comes from the trailer
- Max UK road speed = 20 mph (32 km/h) – despite EC tractor Type Approval to 40 km/h
- UK requires suspended axles and Commercial Vehicle braking performance above 20 mph
The Need for Speed (1)

- Most UK tractors travel at 40 km/h
  
  → increasing number fitted with 50 km/h 'Economy' transmissions ............... Are they really driven at 40 km/h ?

- Industry lobbying for 'conventional': 'fast' tractor breakpoint to be 50 km/h or even 60 km/h (currently 40 km/h) but EC unlikely to budge

- Kinetic Energy (KE) = ½ mv²
  
  @ 32 km/h = 1
  @ 40 km/h = 1.6
  @ 50 km/h = 2.4

- 'Ag. Spec.' trailer brakes (as opposed to 'Commercial' high-speed) designed to operate at 32 km/h / 20 mph max. speed

- Current (legal GTW) tractor-trailer combinations generate nearly 150% more energy when travelling at 50 km/h ...... Can older (Ag. Spec.) trailer braking systems cope?
The Need for Speed (2)

- Use of Ag. Spec trailers at higher speeds:–
  - Inadequate trailer braking performance
  - Excessive wear & premature failure
  - Leaves the tractor to do more (or all) of the braking
  - Prematurely wears the tractor system
  - Increased accident risk

- ~70% of premature tractor brake wear warranty claims originate from UK / Eire

- Selection & maintenance of appropriate-spec. trailer brakes could avoid this

- Braking performance of current trailers likely to remain a problem. New EU Legislation only applies to new equipment. No mandatory requirement to upgrade equipment already ‘in-use’

- But more tractors will travel faster; more brakes will wear rapidly; more cost will be incurred ………

  Until a significant accident necessitates Government action??
- Ag. Spec. brakes (left) = 300mm diameter x 90mm wide
- Commercial ‘High-Speed’ brakes (right) = 420mm x 180mm wide
Commercial 'high-speed' brakes:-

- Generate greater braking effort
- Dissipate heat more effectively
- Suffer little in-service wear in agricultural tractor–trailer transport applications
Future EU Braking Requirements

- **EC tractor & trailer braking requirement being revised:-**
  - Transport Research Laboratory (TRL) commissioned by EC to undertake practical trials to assist revision of the (76/432/EEC) ag. vehicle braking directive
  - Likely to become UK national requirement for new vehicles (tractors and trailers) by ~2010-11
  - TRL report highlights future potential braking performance disparity between ‘new’ tractors and ‘old’ (existing) trailers

- **Practical requirements include:-**
  - Substantially greater trailer braking performance
  - Failsafe trailer brakes (upon accidental disconnection)
  - Trailer brake system to be applied when tractor handbrake applied
  - Trailer & towed equipment braking systems will require Type Approval testing *(currently no assessment of new trailer braking performance before sale)*
Future EU Braking Requirements

- braking efficiency

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<thead>
<tr>
<th>Speed (v)</th>
<th>Tractor</th>
<th>Trailer</th>
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<tbody>
<tr>
<td><strong>Current</strong></td>
<td></td>
<td></td>
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<tr>
<td>$v \leq 30 \text{ km/h}$</td>
<td>35%</td>
<td>25% (UK)</td>
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<tr>
<td>$30 &lt; v \geq 40 \text{ km/h}$</td>
<td>45%</td>
<td>25% or commercial vehicle?</td>
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<td><strong>Future</strong></td>
<td></td>
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<tr>
<td>$v \leq 30 \text{ km/h}$</td>
<td>45%</td>
<td>50%</td>
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<tr>
<td>$v &gt; 30 \text{ km/h}$</td>
<td>50%</td>
<td>50%</td>
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- Existing spec. (25%) trailers may continue to be used following introduction of the new requirements, but will cause braking performance compatibility problems:
  - Typical trailer frontline service life = 15 – 20 years
  - Many new tractors already meet proposed new (50%) braking requirements
The Action Required

- Need to identify the extent of the problem
  - Can existing (in use) ag. trailers comply with forthcoming braking legislation?
  - What options available to enable existing equipment to operate safely & cost-effectively?

- Raise user awareness regarding:-
  - Economic & safety benefits of selecting adequate braking systems when purchasing new trailers and trailed equipment
  - Scope for (and real benefits of) voluntarily upgrading existing trailer braking systems to meet new performance requirements
  - Need for regular maintenance of agricultural trailer braking systems

- Recent (HSE/DfT-funded) BAGMA study did not assess trailer braking performance
The Agricultural Trailer Braking Study (ATBS)

- Study funded by:
  - Health & Safety Executive
  - Department for Transport
  - UK Industry (coordinated by AEA)

- Contributing Tractor Manufacturers:
  - John Deere, AGCO, CNH
  - McCormick, Claas & JCB

- Investigation timescale: 9 months - July 2007 – March 2008

- Findings to be launched at joint HSE / DfT / Industry agricultural vehicle / transport conference in Spring 2008
  - Backed up by publicity campaign during Spring - Summer 2008
The Investigation

- Obtain 10 representative examples of ag. trailers & trailed appliances from UK farms
- Assess braking performance in ‘as-found’ condition
- Following typical ‘on-farm’ servicing & fault rectification, re-assess braking performance :-
  - To current requirements;
  - To forthcoming performance requirements
- Predict likely trailer braking system performance & service life if operated with tractors capable of max. speed of:-
  - 32 km/h (current UK ag. tractor max. speed limit)
  - 40 km/h (current EU conventional ag. tractor max. speed)
  - 50 km/h (max. speed capability of many new UK tractors)
- Identify the nature (and likely cost) of any modifications required for the trailers / trailed equipment to meet the forthcoming braking legislation
The Deliverables

- **Realistic information concerning:**
  - Ability of current equipment to comply with the new regulations
  - Practicality of upgrading existing trailers
  - Likely costs & benefits to industry if trailers or towed equipment is upgraded or renewed

- **Body of information to support HSE / DfT / Industry publicity campaign:**
  - Economic & safety implications of trailer braking system selection & maintenance (particularly given forthcoming legislation)
  - Ways to upgrade existing trailers & towed equipment to meet the new regulations
  - Publicise via:
    - Agricultural magazines (Farmers Weekly, Profi, Classic Tractor, etc)
    - HSE SHADs; Agricultural shows & demonstrations (Cereals, Grassland, etc)
Pros & Cons of Better Trailer Brakes
(25% → 50% efficiency)

Cons

- Slightly greater initial cost
- Need for load sensing and/or ABS systems on trailer to avoid excessive tyre wear during unladen braking

Pros

- Safer tractor-trailer operation, on and off-road .... Reduced jack-knifing risk due to majority of braking effort coming from the tractor
- Eliminates overloading / excessive wear of tractor braking system
- Reduced trailer brake wear / lower maintenance costs (due to adequately-sized components)
- Overall lower cost of ownership / operation