



**Scarlett Research Ltd**

# **Agricultural Trailer Braking Study**

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

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Scarlett Research Ltd

## Ag. Tractor – Trailer Braking



- Brakes never seem important ..... until you want to stop



## Ag. Trailer Braking – the 80's & 90's



- 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

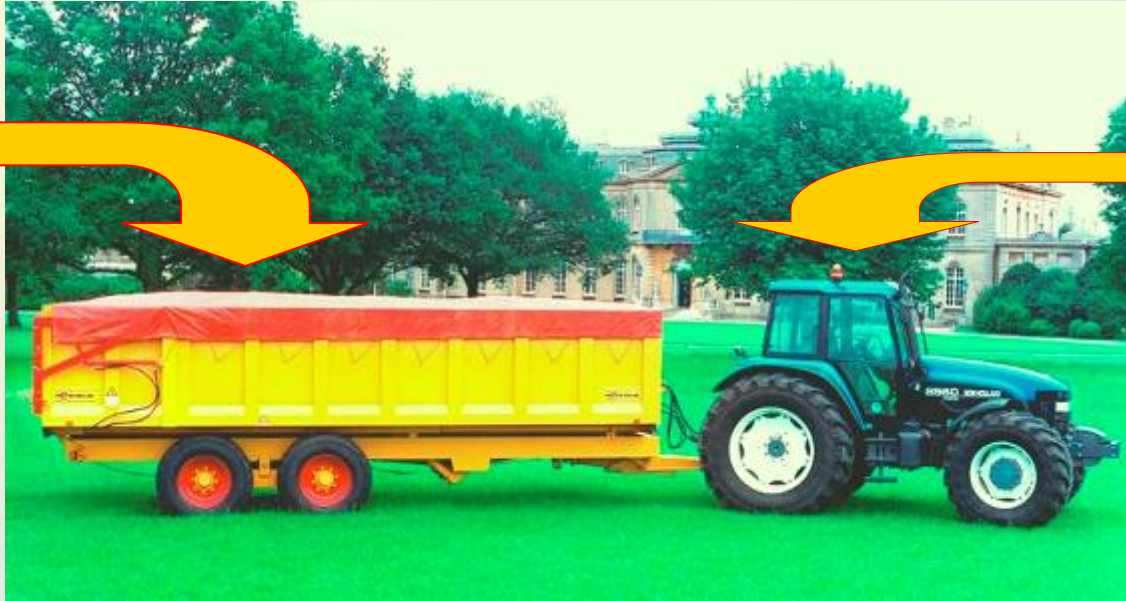
- Drum brakes in universal use
- Overrun brakes (<3500 kg trailer mass) or power-applied (hydraulic or pneumatic)
- 25% braking efficiency up to 20 mph (32 km/h). Ag. Tractors not permitted to exceed 20 mph by UK Law !





## 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) =  $\frac{1}{2} mv^2$ 
  - @ 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. Trailer Braking Hardware (1)



- Ag. Spec. brakes (*left*) = 300mm diameter x 90mm wide
- Commercial 'High-Speed' brakes (*right*) = 420mm x 180mm wide



## Ag. Trailer Braking Hardware (2)



- 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*

	Speed (v)	Tractor	Trailer
<b>Current</b>	$v \leq 30$ km/h	35%	25% (UK)
	$30 < v \leq 40$ km/h	45%	25% or commercial vehicle?
<b>Future</b>	$v \leq 30$ km/h	45%	50%
	$v > 30$ km/h	50%	50%

- 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 trailed 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

