

Turner prizes for longer



semi-trailers

Six months into the UK's ten-year trial of 14.6- and 15.65-metre semi-trailers and engineers are still scratching their heads over the best way to keep weight distribution sensible while complying with strict turning-circle limits. John Dickson-Simpson and Tim Blakemore report.

A ten-year trial of trucks up to two metres longer than the normal legal maximum started six months ago in the UK. It involves up to 1,800 semi-trailers (limited by the maximum number of special permits made available by the government's Department for Transport) and is confined to articulated rigs.

The normal maximum length limit for a semi-trailer in the UK (and the rest of the European Union) is 13.6 metres, within an overall artic length limit of 16.5 metres. This trial involves up to 900 semi-trailers with an overall platform length up to 14.6 metres and 900 others with an overall platform length up to 15.65 metres. The UK already has a 44-tonnes gcw (gross combination weight)

maximum weight limit for all six-axle artics (out of step with the rest of the EU because no account is taken of whether vehicles are used on combined transport) and this is unchanged for the trial vehicles. When the details of this longer semi-trailer trial were announced last October (*Commercial Vehicle Engineer* October 2011) the government specifically ruled out any on-road trial of "gigaliners" (rigs up to 25.25 metres in length, like those being trialled in Germany) despite the best efforts over several years of Denby Transport chairman Dick Denby and his many supporters, and despite the conclusions reached by the Dutch government last year following perhaps the most extensive LHV (longer heavier vehicles)

tests anywhere.

Trailers taking part in the UK trial operate under "Vehicle Special Orders" (vso), issued on behalf of the transport secretary by the Vehicle Certification Agency (VCA) under section 44 of the Road Traffic Act 1988. All 1,800 available vso were soon snapped up by operators when they became available in January. The list includes many well-known own-account operators, including Arla Foods with 26 trailers at 14.6 metres and nine at 15.65 metres, and Waitrose with 15 at 14.6 metres and eight at 15.65 metres. Big haulage and third-party logistics fleets with the largest numbers of longer semi-trailers on trial include DHL, Eddie Stobart and Norbert Dentressangle.

All operators taking part in the trial have to agree to provide data routinely, every four months, to the DfT under headings including axle overloads, incidents and near-misses, maintenance requirements, and "training needs". The purpose of the trial is summed up by the DfT as gaining "operational evidence on the safety, manoeuvrability, economy and other characteristics of semi-trailers that exceed, by up to 2.05 metres, the current maximum permitted length."

As the semi-trailers covered by the vso begin to enter service, tentatively, it is clear that some careful engineering and mathematics have gone into the array of configurations. More and more continue to emerge as fresh ideas and risk assessments surface.

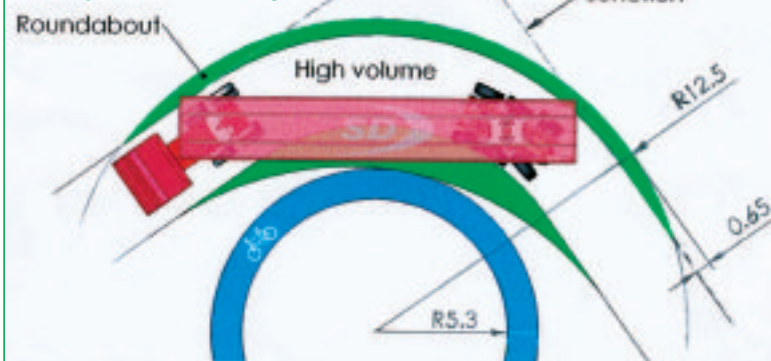
One cause of much head-scratching is the need to comply with the European Union legal "turning corridor" limits, between circles of 5.3 and 12.5m radius, while also getting weight distribution right so that overloads are avoided.

Solutions were elusive at first because it was commonly assumed that a semi-trailer's tri-axle bogie would have to meet the usual British weight limit of eight tonnes per axle. No matter how axle spacings were juggled, bogie overloads ranging from half a tonne to two tonnes kept emerging. But then the Vehicle Certification Agency confirmed some useful get-out bits buried in the tortuous regulations.

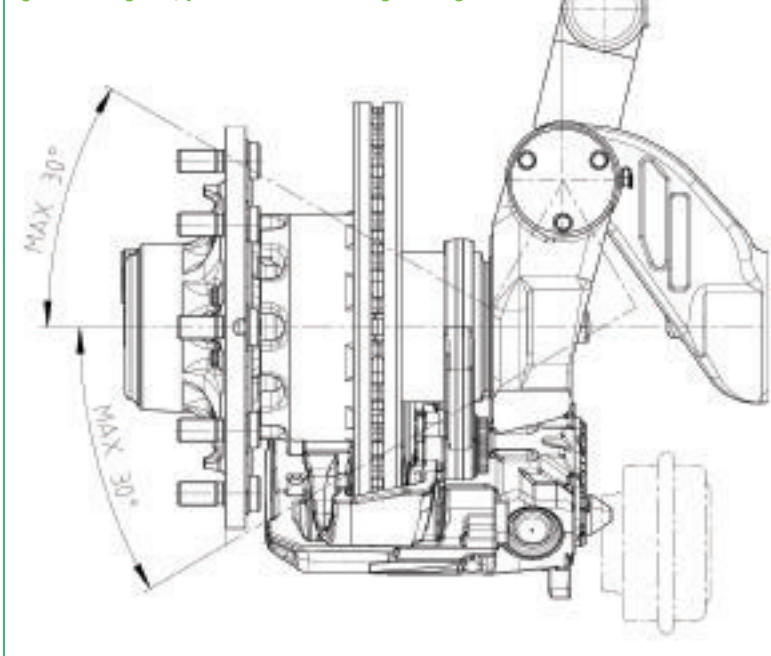
The outcome, broadly, is that a tri-axle formation actually can have nine-tonne axles – within the existing load capacity of popular 365/65 tyres. Indeed interpretation of the regulations can be even more generous, it turns out.

When the total spread of three axles is more than 3.25m, the set's overall gross weight can be raised from 24 tonnes to between 26 and 30 tonnes – tyres permitting. This is the result of

Turning point for Silvertip: a Don-Bur prototype with Silvertip self-steering bogie boasts generous nearside clearance for cyclists and only moderate tail swing-out.



Degree qualification: this self-steering axle from SAF can go to 30 degrees, points out IMS of Loughborough.



bogie carrying 16, 18 or 20 tonnes with a separate single axle trailing behind. The law allows this tagged-on single axle to go to 10 tonnes.

This clarification is seen as a get-out-of-jail card for weight distribution. To meet the turning-circle rules the last axle has to steer, even on an economically appealing 14.6-metre semi-trailer. Weight added by the steering axle (probably a self-tracker) is a tolerable 150 to 200kg.

But a heavier steering axle capable of taking 10 tonnes and providing a steering angle of 27 degrees rather than 16 is needed for the more demanding manoeuvrability of a 15.65-metre trailer. An axle with a 32-degree steering angle could soon become available, according to Tony Sturgess, chief designer at SDC Trailers of Nottinghamshire and Northern Ireland. Already there is an SAF self-steering axle with a maximum angle of 30 degrees, points out IMS, the Loughborough-based UK and Irish Republic distributor of SAF-Holland truck and trailer equipment.

"This specifically-designed, wide-angle, self-steering axle demonstrates the commitment from SAF to not

modify existing axle systems to comply with changing UK legislation, but to develop and produce them," says IMS sales manager Arran Leatherland. "SAF has the solution and is able to fulfil a full complement of technical design requirements, where self-steering systems for 14.6 and for 15.6 metre trailers are preferred by operators. SAF also has command-steering axles systems available for those who prefer this option. All systems are available with drum or disc brakes in wheel sizes 17.5, 19.5 and 22.5in."

SDC Trailers has been enthusiastic about the longer trailer trial from the word go, announcing towards the end of January that its complete range of "high-volume" trailers had satisfied the VCA's practical turning-circle tests.



SDC Trailers: enthusiastic about the longer trailer trial.



Pieced together: this straight-frame, 15.65-metre Cartwright curtain-sider has an emphatically offset rearmost axle. The aim is to combine a short turning circle with a long virtual wheelbase and get more weight towards the front.

“We are delighted to be the first manufacturer to achieve our LST (longer semi-trailer) model report which makes our range of trailers road legal,” said SDC managing director Mark Cuskeran. “SDC have been working on this project for over three years and we have been testing prototypes for 18 months. Only by extensive testing and certain amounts of trial and error were we able to produce these five trailers. It is a credit to our research and development team that we have achieved this approval, especially as the DfT has insisted that the ‘deemed to comply’ calculation is not sufficient. We were quite confident that our trailers would pass the physical testing carried out by the VCA.”

When a semi-trailer’s third axle is set back more than about two metres from the rearmost axle of the tandem bogie the tighter steering angle has obliged trailer-makers to use positive steering such as the Jost Tridec kit which connects a turntable carrying the axle to a front-end turntable keyed into the tractor’s fifth wheel. This is attractive for its direct steering backwards as well as forwards and for self-correction of trailer slewing. But it is inevitably heavy and costly by comparison with a self-tracker.

All long trailers with a steering axle still scrub tyres on tight turns, and their tails swing out quite seriously, especially when turning from a straight road. When moving out of a line of closely parked trucks, drivers have to watch that the rear corner does not rip the side of an adjacent vehicle.

Furthermore, nearly all 15.65-metre trailers underload the tractors pulling them. This is a pity. There is plenty of carrying capacity in hand on three-axle tractors and they suffer from drive-wheel spin. Drive-axle weight often falls short of nine tonnes. The reason for this is that the trailer wheels cannot be as far back as desirable because they have to comply with turning-

Guidance on LST Combination Weights, Axle Weights & Spacing

Department for Transport

1. Authorised Weight Regulations (AWR)

1.1. Schedule 2 – Maximum Permitted Combination Weights

LST & 2 Axle Tractor = 40t (Schedule 2, Paragraph 1, Table 3, item 8)

LST & 3 Axle Tractor = 41t (Schedule 2, Paragraph 1, Table 3, item 11, see also Paragraph 1(4))

LST & 3 Axle Tractor = 44t (Schedule 2, Paragraph 1, Table 3, item 13, see also Paragraph 1(4) & 1(5))

1.2. Schedule 3 – Maximum Permitted Axle Weights

Single (non driving) axle on LST



Maximum permitted weight on axle

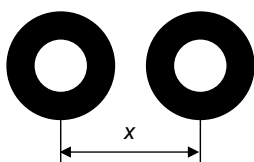
Steerable axle without load compensation arrangement with other axles = **8.5t**

(C&U Regulation 23(4) as amended)

Otherwise = **10t**

(Schedule 3, Paragraph 1, Table 5, item 2)

Tandem¹ (non driving) axle on LST



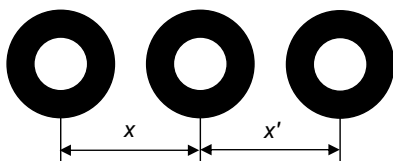
Where $x \leq 2.5\text{m}$

Maximum permitted weight on axles

= **20t**

(Schedule 3, Paragraph 1, Table 5, item 5)

Triaxle² on LST



Maximum permitted weight on axles

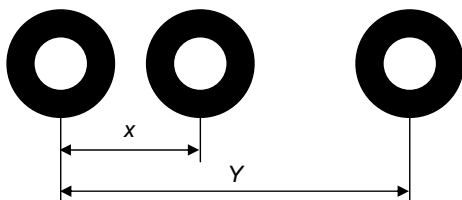
If x OR $x' \leq 1.3\text{m}$ = **21t**

(Schedule 3, Paragraph 2, Table 6, item 6)

Otherwise = **24t**

(Schedule 3, Paragraph 1, Table 5, item 6)

Tandem + Single (2+1) on LST (derived from AWR)



May apply only where $Y > 3.25\text{m}$, then;

Maximum permitted weight on axles

	Tandem	Single	Total
If $x < 1\text{m}$	11t	10t	= 21t
If $1.0\text{m} \leq x < 1.3\text{m}$	16t	10t	= 26t
If $1.3\text{m} \leq x < 1.8\text{m}$	18t	10t	= 28t
If $1.8\text{m} \leq x$	20t	10t	= 30t

(Tandem: Schedule 3, Paragraph 2, Table 6, item 3, 4 or 5, OR Schedule 3, Paragraph 1, Table 5, item 5, PLUS

Single: Schedule 3, Paragraph 1, Table 5, item 2, but also see C&U Regulation 23(4) which may limit to 8.5t)

Definitions abstracted from The Road Vehicles (Authorised Weight) Regulations 1998, SI 1998 No. 3111, Regulation 2:

¹ “tandem axle” means a group of 2 axles not more than 2.5m apart so linked together that the load applied to one axle is applied to the other; a “non-driving tandem axle” is a tandem axle where neither of the axles comprising it is driven;

² “triaxle” means

(a) a group of 3 axles in which no axle is more than 3.25m apart from any other axle; or

(b) a group of more than 3 axles in which no axle is more than 4.6m from any other axle, and

in either case so linked together that the load applied to one axle is transferred to both or all the others;



circle rules. This is why some long trailers hang out the third axle farther from the tandem pair.

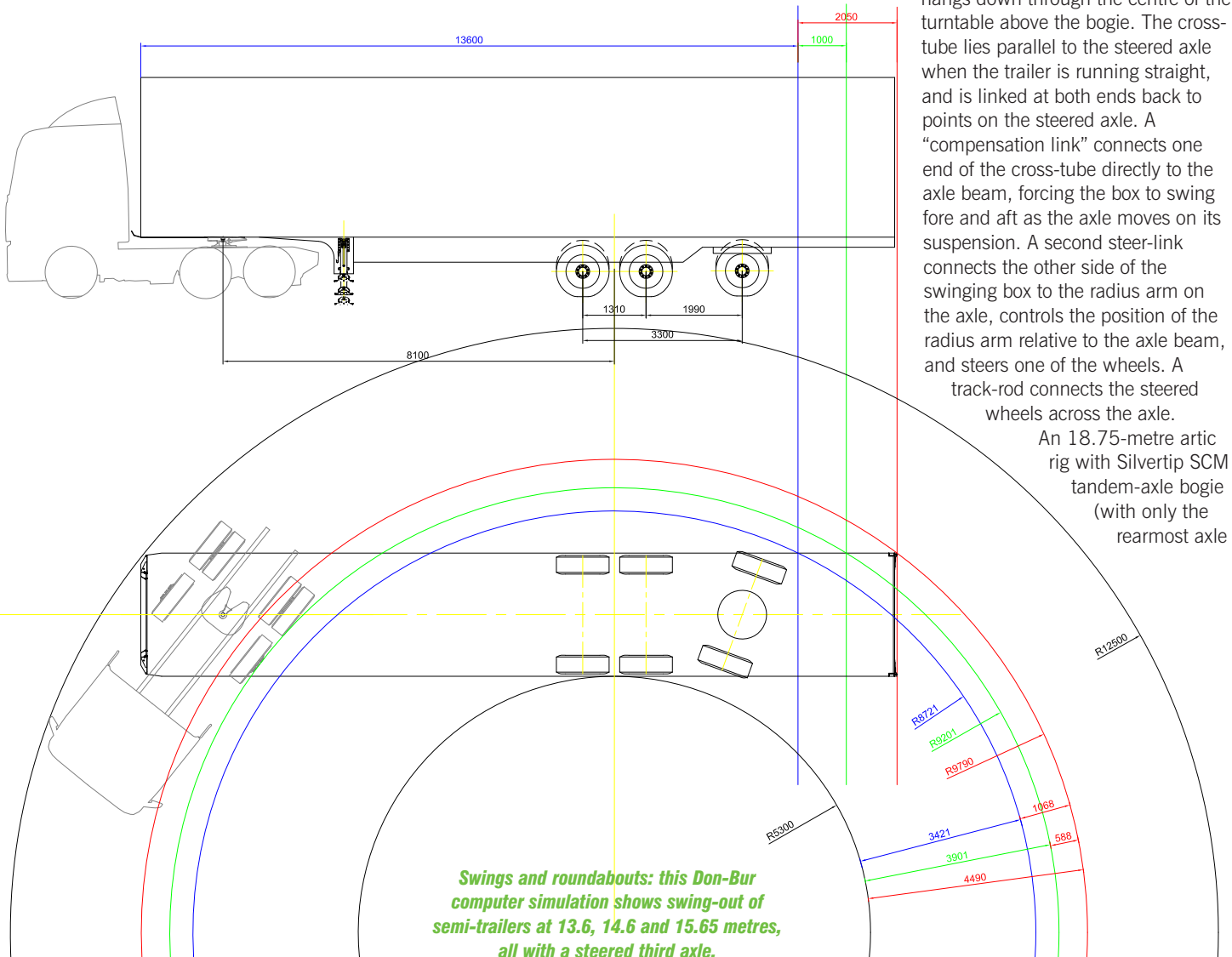
One design to mitigate these concerns comes from Silvertip Design of Richmond, North Yorkshire, headed by energetic entrepreneur Carl Henderson. The clever Silvertip SCM (steering correction mechanism) self-steering trailer made its first appearance in public fully 12 years ago. Its capabilities were demonstrated convincingly at the British Transport Advisory Consortium (BTAC) trials at the MIRA (formerly Motor Industry Research Association) proving ground in Warwickshire in 2005. There it was shown how a 16-metre tandem-axle Don-Bur semi-trailer with Silvertip SCM tandem-axle bogie could negotiate corners with less cut-in than a conventional 13.6-metre tri-axle trailer.

Wincanton Group: permits for 68 longer trailers, equally divided between 14.6 and 15.65 metres.

So impressed were the judges of the pan-European Trailer Innovation Awards scheme (including *Commercial Vehicle Engineer* editors) with the Silvertip SCM system that they awarded it first prize in the "concept" category of the biennial awards scheme in 2007.

At the heart of the SCM system is a lightweight fabricated assembly described as a "swinging box" and comprising two vertical arms and an interconnecting cross-tube. The swinging box pivots from the underside of the trailer chassis and hangs down through the centre of the turntable above the bogie. The cross-tube lies parallel to the steered axle when the trailer is running straight, and is linked at both ends back to points on the steered axle. A "compensation link" connects one end of the cross-tube directly to the axle beam, forcing the box to swing fore and aft as the axle moves on its suspension. A second steer-link connects the other side of the swinging box to the radius arm on the axle, controls the position of the radius arm relative to the axle beam, and steers one of the wheels. A track-rod connects the steered wheels across the axle.

An 18.75-metre artic rig with Silvertip SCM tandem-axle bogie (with only the rearmost axle swings and roundabouts: this Don-Bur computer simulation shows swing-out of semi-trailers at 13.6, 14.6 and 15.65 metres, all with a steered third axle.



Swings and roundabouts: this Don-Bur computer simulation shows swing-out of semi-trailers at 13.6, 14.6 and 15.65 metres, all with a steered third axle.

Light touch: a gross weight of 40 tonnes is more than enough to accommodate the bulky loads carried by this 15.65-metre trailer, but still the longer trailer trial rules demand three axles. So Eldiss Transport has gone for 445/45 19.5in tyres, to keep the height down.



steered) is claimed to be as manoeuvrable as a conventional artic of half that length.

So far, trailer-makers seem to have been discouraged by cost from flocking to the Silvertip system. But now its time may have come. It is operationally attractive because its bogie is near the back. This results in only half a metre of tail swing-out and load bias up front – good for traction and stability. It is tolerant of mixed-density loads, which accounts for keen interest by Morrisons supermarket. Fleet manager John Ward is acutely conscious that pallet weights in his operation vary considerably, from 600 to 1,300kg.

One big road-safety-related attraction of the Silvertip SCM design is its metre and a half nearside clearance when cornering to the left.

Yet still there are obstacles from the government. The Silvertip design puts less weight on a bogie, so it can use smaller wheels and indeed can perform perfectly well in tandem-axle form at 40 tonnes gross combination weight. This suits carriers of light and bulky products (the main *raison d'être* for seeking the efficiency of longer semi-trailers). But for reasons that are hard to fathom, the government insists that every semi-trailer



Arla Foods: trying 26 trailers at 14.6 metres and nine at 15.65 metres.



longer than 13.6 metres in this trial must have three axles.

Such lack of common sense in government edicts on transport policy is not unusual, unfortunately. Loading ubiquitous Anglo-American one-metre pallets in a 15.65m trailer leaves well over half a metre of wasted space. And rows of 0.8m wide “euro-pallets” also fail to fit the available length. Only a 16.2-metre platform length could take full loads of Anglo or euro pallets. Transport efficiency lost. But no one with the power to end such waste at a stroke seems to care. □



Knights of Old: in the trial with nine trailers at 15.65 metres. This double-decker from SDC is on 19.5in wheels and is 4.87 metres tall.