Minibus engineering

When Lancashire County Council's fleet manager engaged bodybuilder Mellor to design and build easy-access buses to Type Approval standards, it opened a can of worms. Brian Tinham reports

Nine- to 16-seat accessible minibuses may yet desert their few-off, custom-fabricated roots and move into mainstream manufacturing, thanks to the determination of one specialist bodybuilder and a county council that share a vision of achieving Type Approval. The bodybuilder is Mellor, and Lancashire County Council, its customer, the driving force – yet the outcome could benefit local authorities, schools and other organisations, able to tap into better engineered, but lower cost, production vehicles, without the usual effort and compromises.

The issue around minibuses stems from the UK's derogation, under Section 19 (small bus) Permit Regulations 1985 and 2009, that allows minibuses of more than eight and up to 16 seats to be driven by non-vocational drivers, with D1 licences, as opposed to full PCV (passenger carrying vehicle) licences. In Europe, that's not the case, so minibus manufacturers chasing the pan-European market focus their design and production investments on eight- and 20-seaters, not 16-seaters – with the result that British buyers are forced to go the custom route, with specialist converters and assemblers.

"We've operated minibuses built by small companies on very low production runs for many years, but the fact is they mostly have commercial limitations and generally assemble vehicles without much certification," comments Eddie Hart, fleet manager at Lancashire County Council. "There is guidance on safety in the 1985 Minibus Act, Schedule 6, and there's also the certificate of initial fitness (COIF) route. But neither is that demanding of the vehicle structure, layout or safety devices – and we were concerned about that."

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Eddie Hart

Hart says the authority knew that, while there was adequate certification for the floor structure, there are few standards covering, for example, rear of passenger seat crash protection and wheelchair restraints. With massive loads during sharp braking, that meant a potential for failures in the load path from the seat-mounting rail systems to the vehicle structure itself. "We needed to go further and find a system capable of bringing in better engineering disciplines around more than just the vehicle structure," he explains.

Hence Lancashire's decision to embark on a project to specify and build low-floor accessible minibuses in 6x2 and 4x2 formats, capable of carrying both mainstream passengers and those requiring accessible transport, but under Whole Vehicle Type Approval for buses and coaches. Although not mandatory for most vehicles until October 2011, it does require robust processes, and not just around vehicle structures.

"European Type Approval is also very demanding, in terms, for example, of floor space, wheelchair weights and sizes, access widths, dimensions for wheelchair movements, safety restraints and other parameters," says Hart. "So the aim here was to follow the standards and then bring in the major manufacturers and the European component suppliers – which would, in turn, bring economies of scale."

That, he says, is one of the reasons for specifying the Al-Ko chassis mated to Fiat's Ducato Maxi cab, with Al-Ko manufacturing in Germany, but assembly

Mellor's minibuses sit on an Al-Ko chassis that is mated to a Fiat Ducato Maxi cab

in the UK. "They're both big names and the Fiat front end has one of the highest payload capacities on the front axle for its class, which is always a critical design issue for PCVs using smaller front vehicle derivatives," explains Hart.

Looking in a little more detail, however, reveals the extent of the Mellor/Lancashire achievement. "The fact is we've achieved excellent accessibility, in terms of step heights, hand rails and gangway width, despite the difficulty on 16-seaters where you don't have the full 2.5m coach width," asserts Hart. "We've been able to build to 2.3 metres width, coping with the wheel arch restriction. We've also been smart about the positioning of seats and restraints. And we've used folding seats, so we can accommodate wheelchair passengers, say, on the way out, but change the bus quickly to provide seating for able-bodied passengers on the way back, without the problem of detachable seats."

What about specifics? Hart points to the new tail-lift guard that prevents driver/operators from toppling out of the open rear of the minibus, having forgotten that the lift is in the down position from the previous wheelchair. "The vehicle has a sensor system on the tail-lift, as well as an automatic barrier arm that activates as soon as the tail-lift leaves the top parked position. The barrier doesn't extend right across the rear – regulations require a 300mm gap, in case of emergency – but it's enough."

And there is a novel twist to the automated climate control. "We worked with Ebersbacher/Diavia and they devised a system that maintains ambient cabin temperature via a single switch that operates the air conditioning and heating, but doesn't require the driver's attention. The heating also continues running for one hour after the engine has been switched off, to provide passenger comfort during stops. That interfaces with the vehicle's digital CANbus network through an Intellitec interface, which also looks after the lighting, fans and boost cooling on the radiator unit," says Hart.

It's not all new. Hart explains that the new minibus shares technology developed for some of Lancashire's other specialist vehicles, including its

fleet of 7.5-tonne library vehicles. But, unusually for this size range, it also adopts some standard bus industry construction features, such as one-third thickness colour gel coating on the body, to ease repairs, and bonded windows to improve body rigidity. "It's all part of taking these minibuses into the mainstream: even the usual maintenance issues with Clayton rubbers have been eliminated."

"We're also using GRP composites for the roof, canopy and rear, alongside machine manufactured rigid GRP for the side panelling, so we anticipate a very good service life"
Dave Terry

Engineering issues

Mellor first considered independent development of an easy-access 16-seater vehicle several years ago, according to director of engineering Dave Terry, who draws the distinction between 'low floor' (single step 250mm entry) and 'easy access' (still low, but two steps of 220mm each). The company had done some initial design work, but its project halted with the advent of the Mellor-Mercedes-Benz partnership, building the Evo bus low-floor Sprinter conversion. "But, when that finished, we were open to suggestion and, as some of our smaller competitors began to founder, the time seemed right," says Terry.

From an engineering perspective, however, there were always going to be challenges. Terry cites, for example, the requirement for durability and its implications, in terms of choice of chassis, the way the body should be assembled and selection of the body materials.

"Alko offered what we needed: they have an excellent reputation for reliable, lightweight galvanised chassis. When mated to the Fiat front end, which now has a front axle capacity of 2,100kg, up from the earlier 1,850kg, we get a good, strong forward loading and driveline," explains Terry. "We're also using GRP composites for the roof, canopy and rear, alongside machine-manufactured rigid GRP for the side panelling, so we anticipate a very good service life."

And he continues: "That combination also gives us the best overall dimensions, drop and width – with a good, wide rear track and clear space for the low floor – which, in turn, means we don't have to worry about the complication, expense and weight of lowering or tilting suspension." Just as important, it enabled the Mellor team to design the base vehicle with enough flexibility to match potentially different customer requirements – such as, in Lancashire's case, 16 seats for able-bodied passengers, but also provision for quick and easy conversion for wheelchair users, with two spaces and a standard gangway across the vehicle width.

But well thought-through technical specification is one thing; achieving Type Approval is quite another. Terry: "Whole Vehicle Type Approval demands attention to a wide range of technical issues, such as emissions, noise and lighting. Among them is 2001/85/EC – the bus directive, now ECE Regulation 107 – which also details requirements for passengers and wheelchairs, including space requirements, gangways, tail-lifts and other peripheral equipment, whatever the bus size."

He concedes that Mellor had to experiment with several vehicle layouts, and run the weight calculations to optimise those aspects and meet the customer use requirements, while staying within Type Approval guidelines. "But that work defined the dimensions and the specifications for production, including those for the tail-lift, folding seats and ancillary equipment," says Terry.

Mellor's stumbling block, now resolved, turned out to be the front passenger door. "The [Type Approval] procedure involves a 'worst case' meeting with the DfT's Vehicle Certification Agency to review the bus design. We had clarified several aspects and were into final production when the DfT had a change of consideration over the door. In fairness, we were the first to use Type Approval for this type of vehicle, so we were breaking new ground, but the upshot was that the door – which was universally agreed to be safe and what the market expected – did not meet the wording."

In essence, a manual plug door, pivoted to the rear, was deemed unsafe, because for Type Approval it must swing to closed, in the event of forward motion – even though it would have passed the old Certificate of Initial fitness rules. "We had an interlock on the vehicle, so that it couldn't be driven with the door open, but that wasn't enough. We now have the same door, but pivoting from the front, so that, if the vehicle runs away and it strikes an object while open, it will swing to closed." TE

Extra engineering efforts were made to ensure that the minibuses gained Type Approval