

A NEW RETENTION TANK DESIGN FROM VOSSLOH KIEPE UK**Fleet upgrade delivered**

Vossloh Kiepe UK has completed the refresh of 111 Mark 3 coaches representing the bulk of Abellio Greater Anglia's inter-city fleet, used on services between London and Norwich. Following completion of this project, passengers see new lighting using energy-efficient LED technology, new at-seat power sockets, re-finished internal surfaces including internal doors, vestibules, bodysides and draughtscreens, new seat coverings, new tables and a completely new, low-flush toilet system.

Less obvious to travellers on these trains, but of considerable benefit to those working on the maintenance of both carriages and track, is the installation of a controlled emission toilet (CET) tank to the underframe of the 105 coaches which offer toilet facilities. Fitment of retention tanks to stop the effluent being flushed directly on to the track – and on to the vehicle underframes – is a UK government requirement with a deadline at the end of 2019 and the successful completion of this installation programme gives a new option to owners and operators of similar stock.



Vossloh Kiepe UK's CET tank design ready for installation (Vossloh Kiepe UK)

Modernising Mark 3s

The Mark 3 coach design is used in both locomotive-hauled and High Speed Train formations. The vast majority of Mark 3 vehicles in service are not fitted with CET tanks, but a significant number of these are planned to continue operating beyond the end-2019 deadline.

Some variants of the Mark 3 coaches were among the first rail vehicles in Britain to be fitted with an early design of CET tank in the early 1980s. However, Vossloh Kiepe UK's detailed analysis of the current engineering standards, and of the underframe structures and condition of the particular coaches involved after thirty-five

years or more in front-line service, concluded that an entirely new design would be preferable both for the tank and the mounting arrangements.



A train of Mark 3 coaches forming an Abellio Greater Anglia service (Photo: Joshua Brown. [Licence](#))

Approved for service

The new CET tank design has been developed and designed in-house by Vossloh Kiepe UK. It is fully engineered and approved for use on the British rail network and offers increased capacity, and hence a longer period between emptying, compared to other tanks available for the same application.

Part of a wide-ranging fleet refresh, the CET tank development is indicative of the capabilities of Vossloh Kiepe UK in railway rolling stock upgrades.

Vossloh Kiepe UK's CET tank

The key features of the Vossloh Kiepe UK CET tank are:

- 350 litre capacity, equivalent to approximately four days' use between emptying when combined with modern low-flush toilet systems
- Level indicators and discharge pipes fitted on both sides of the vehicle underframe
- Detection of fill condition (a visual indication is made when 75% full and the water supply to the toilet cubicle is shut off when 95% full)
- Thermostatically controlled heater mat to prevent freezing of contents in winter
- Mounting directly on to the vehicle solebars; the strongest elements of the underframe structure

The engineering development involved considerable work to ensure that the end result was robust. Rail vehicle design in the 1970s, which included the Mark 3 coach structure, took place in a different environment to that of today. Vossloh Kiepe UK's work included the review of three different structural engineering load cases that had been issued since the Mark 3 vehicles were built in order to ascertain the most suitable method for demonstrating the integrity of both the tank itself and its interface with the vehicle structure under realistic stresses. Finite element analysis was undertaken by a subcontractor under the leadership of the Vossloh Kiepe UK's engineering department.



CET tank before fitment, showing the corner mounting brackets (Vossloh Kiepe UK)

Significant structural engineering and design

The design of the tank and its integration with the solebar was subject to several challenging constraints. It was desirable to mount the tank on to the solebars. However, the shape of underframe equipment is limited by gauging considerations which required the main part of the CET tank to be located inboard of the solebars. Furthermore, the tank itself had to be mounted below solebar level in order to allow space for breathers on the top and to avoid complex changes to the pipework and other fittings present in the same area of the underframe. The solution was to develop – and analyse in great detail – separate brackets to provide the necessary “reach” between the solebars and the tank, both laterally and vertically.

An essential element to consider was the tank installation process, including allowance for possible future removal and refitting for maintenance or repair. The specification required that other systems should not be removed to when installing the CET tank, leaving little room for manoeuvre and access. Structural calculations included assessment of the jig on which the tank was supported in the correct position by a fork lift truck during installation. The interface with the solebar allows little space for the mounting brackets and their fixings, and access for tightening the

fixings dictated their location. The final design was assessed by finite element analysis and demonstrated not to be subject to excessive stress.

On first class vehicles, equipment was mounted in the space needed for the CET tank. Here, a new crossbar was installed on which to mount the relocated equipment in order to avoid adding loads to existing crossbars.

The tank itself consists of separate parts fabricated to form a strong structure with the minimum number of joints. The main exterior is formed of a single folded steel sheet rather than made up from separate sheets for each side. The size of the tank was limited by the space available and the load capacity of the mounting arrangements; nonetheless its capacity is greater than other recent solutions developed for the Mark 3 vehicle design.

Rolling stock technical services for the industry

The CET tank product demonstrates the capabilities that Vossloh Kiepe UK brings to the rail industry: technical expertise, attention to detail, design for installation, maintenance and operation, and in-depth analysis to produce the best all-round solution.

Vossloh Kiepe UK's offer to the railway rolling stock world offers this capability to all the projects undertaken for its customers, be they product development (as with the CET tank), vehicle upgrade and refresh (as with the fleet project of which it formed a part), or the delivery of turnkey projects, managed installation contracts, technical support or material logistics and supply.

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