



Two of the maintenance locomotives, each with its own 50 ton scrubber wagon are shown here in their old configuration. These 1.2 MW locomotives were manufactured by Krupp in the early '90s with MTU 12V396C13 diesel engines, using the best technology available at that time.

## A Breath of Fresh Air for Eurotunnel Maintenance Crews

### Hug filters used for Channel Tunnel maintenance locomotive retrofit project

All maintenance operations inside the two rail tunnels linking Folkestone, Kent, U.K., to Coquelles, Nord Pas-de-Calais, France, are carried out by maintenance trains of 12 to 14 wagons pulled by two diesel-electric main locomotives. These 1.2 MW locomotives were manufactured by Krupp in the early '90s with MTU 12V396C13 diesel engines, using the best technology available at that time.

To reduce soot emissions inside the two 50 km long railway tunnels, the exhaust emissions from the Krupp diesel engines are routed through scrubbers filled with water and charcoal mounted on special wagons. These 50 ton wagons, containing two scrubbers, are placed between two locomotives, thus forming a multiple unit. In spite of continuous maintenance, the scrubber's efficiency to remove pollutants has been surpassed by new technology.

After 15 years of operation, these five locomotives, which have accumulated in the range of 30 000 service hours each, have been submitted for a special overall maintenance program, carried out by Ned Train, with the objective to continue to use them for another 15-year period.

In order to lower the emissions of the engines now reconditioned "as new," and to comply with present recommendations issued by the British Environmental Safety Commission, it was decided to contact Hug Engineering of Rätterschen, near Winterthur, Switzerland — one of the leaders in filtering technology — to find a solution to the problem. The new filters not only will be able to capture 90 to 95% of the soot, but also keep NO<sub>x</sub> emissions under control.

In the past, the Swiss company has engineered retrofits of its filtration systems for several locomotives of different makes and power outputs, among which many units are similar to the ones used by Eurotunnel.

The five Eurotunnel locomotives will be retrofitted with the Hug filters at the main-

tenance yard of SBB (Swiss Railways) near Bern in Switzerland.

The Hug filters will be installed directly on the engine exhaust line, under the locomotive hood, altogether eliminating the scrubber wagon. The only modification required will be the rise of the hood height by about 200 mm which, however, will not reduce the driver visibility.

### The Mobiclean System

Hug has engineered the whole system, denoted Mobiclean, and has supervised and assisted SBB directly at their Biel works during the implementation of the new system on the locomotives. The first locomotive ended conversion in May 2007, followed soon after by the other four units.

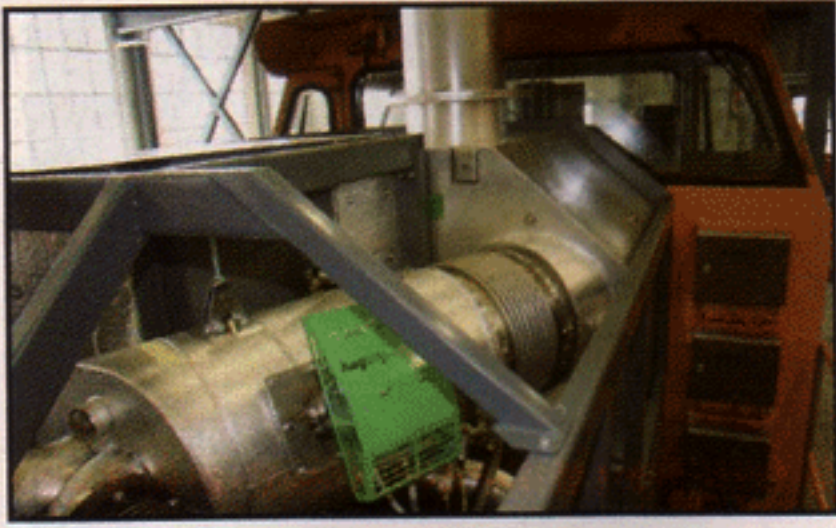
The Mobiclean exhaust gas system for the Eurotunnel locomotives consists of a silicon carbide soot filtering element followed by an SCR converter.

The honeycomb-shaped catalytic particulate trap is fitted with an active regeneration burner that automatically burns out the soot every time the head losses through the filtering elements reach a selected value set by the control unit. This also allows engine operation with low exhaust temperatures as often happens in locomotives that are kept for long periods in idling conditions.

This filter also has a noise damping effect, and in applications with space limitations as in this case, the filter can effectively replace the original silencer.

The soot filter is followed by the SCR unit which, through a spray of urea, lowers the NO<sub>x</sub> (nitric oxides) to a level that complies with environmental specifications.

The shape of these filters has been designed to fit the application utilizing the space available in the most rational way with a minimum of modifications. This is a solution typical of Hug Engineering, which develops and manufactures the whole system in-house, from the housing to the ceramic filter elements which, if necessary, can be shaped to fit the special housing. Also,



Shown is the Hug Mobiclean exhaust filtering system mounted on one of the locomotives. This new system allows the elimination of the scrubber wagon and the ability to run a shorter maintenance train using only one locomotive.

the burners and the control units are designed and produced by Hug.

**Before and After**

To understand the "revolution" in the Eurotunnel maintenance program made possible by the Hug filtration system retrofit, it is necessary to describe the maintenance procedure performed during the tunnel's first 15 years and what will be possible after the installation of the new system.

The two rail tunnels (North and South) are provided with two crossovers at one-third and two-thirds of their length so that it is possible to close one or more sections, called "intervals," to the train traffic, depending on the work to be performed and routes of the trains in both directions through the open intervals.

During weekdays the train traffic is very intense, up to 400 trains per day, which does not allow routine maintenance operations to be performed. However, during the weekends, the traffic is lower both in freight and passenger categories, and this allows the closure of tunnel intervals for maintenance.

Tunnel intervals are thus closed on Friday, Saturday and Sunday nights. The night between Saturday and Sunday is the one with the least traffic (trucks cannot travel during the weekend in France), consequently, if necessary, one entire tunnel can be closed to train traffic. All maintenance equipment is based at the maintenance yard of the Folkestone terminal, featuring a huge lay-down area, which is the starting point for all operations. The 10-hour maintenance shift starts with the

preparation of the train, implementation of all safety measures and travel of the train to the "closed interval." Actual maintenance work will be performed by the working teams for typically six hours, after which time the maintenance train will exit the tunnels and the interval will be opened again to commercial traffic.

Presently it is possible to prepare two trains — each one with two locomotives with the scrubber wagon in the middle. The fifth locomotive and the third scrubber wagon are available or under maintenance in Folkestone.

The installation of the Hug filters has allowed the elimination of the 50 ton scrubber wagon altogether, with a considerable gain in flexibility. In fact, this gives the possibility to have up to four independent maintenance trains or two long trains, but with a locomotive on each end. With the two locomotives on one end of the train, it is difficult to reverse the train and go back in the blind end direction. If the maintenance has to be performed in the first interval

on the Folkestone side at the end of the shift, the train has to travel through the entire tunnel to the French end, and stable itself in Coquelles before going back to Folkestone. With the locomotives on each end of the train, this additional mileage becomes unnecessary, thus saving in time and costs.

Elimination of the scrubber wagons also allows maintenance cost reductions, as the new Hug filters are virtually maintenance free.

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Schematic of the Hug Mobiclean designed to fit over the MTU 12V396C13 diesel with only a slight rise of the locomotive hood (200 mm).