

Even before delivery of the locomotive a technological assessment is made and a timetable for the overhaul process prepared. After the locomotive's arrival a preliminary cleaning of the frames and motion is undertaken, and the boiler is washed out.

The locomotive is then brought to its stand in the erecting shop using the traverser. There follows the dismantling of the driving and coupling rods, motion and valve gear, all steam-, water- and air- delivery pipes, and removal of the cab, coal bunker and water tanks.

The locomotive is lifted from its wheels using a crane or jacks and the boiler moved to the boiler shop.

All parts are cleansed, some in an automatic metal-washing machine and selected parts, such as frames, boiler, wheelsets, rods, cab, are grit-blasted ready for detailed examination and/or repainting, and distributed to the various workstations.

The boiler determines the overhaul timetable. It is examined by boiler and pressure vessel experts, and the amount of work needed is determined. At a main overhaul a change of tubes, superheater, a number of stays, work on the tubeplates and platework on boiler or firebox as well as refurbishment of fittings are foreseen. The boiler inspector supervises the repair work, and together with the welding engineer evaluates the material test reports, X-ray and ultrasound findings of welds made, and after completion undertakes a hydraulic test of the boiler.

On the frames, cracks are welded, axlebox, wedges and bolt-holes corrected and draw- and buffing- gear refurbished. The frames are then weighed and measured. For this the tie-bars must be mounted, to avoid bending the frames. The frame measurements form the basis for the refurbishment of the axleboxes.

For the wheelsets, the measurement and ultrasound examination of cones and axle shafts, the correction of linear and angular deviations at the crank pin and repairs of cracks or fitting of new tyres are undertaken.

The 'Deutschland-Bank' lathe at Meiningen can handle wheels up to 2,000mm in diameter. The axleboxes are filled with white metal, drilled out, and matched to the burnished uprights.

In the workshop, the driving and coupling rods are examined for cracks and sanded. The rod bearings are filled with bearing metal and, to the specifications for journal diameter, drilled out at the 'Strassmann-boring machine'. This is a single-purpose machine typical for steam locomotives, on which the coupled rods of a locomotive can be bored and measured with precision. High accuracy is crucial to the faultless running of the bearings.

The cylinder attachments to the frames are checked, cylinder and valve bushes checked – and if need be drilled – the cylinder covers newly sealed, and the inside moving parts refurbished.

As part of the motion refurbishment, the slidebars are hardened and ground, the crosshead sliding plates replaced and the pistons, after examination, fitted with new piston rings. Outside motion components are measured and refurbished.

Overhaul of the brake gear is undertaken to a 'brake revision Br3', under which the pneumatic parts (air valves and indicating instruments) are replaced and the mechanical parts (brake beams, rods and hangers) are measured, straightened, welded and in part replaced to ensure they are in safe operating condition. Springs and compensating gear are overhauled and tested on the spring testing machine. Large areas of the cab, water tanks and coal bunker have platework renewed or, in the case of advanced corrosion, are replaced. The pipes are usually worn out and must be renewed.

All fittings of the boiler and the superstructure (safety valves, steam extraction and supply valve), pumps (feed pumps, air pumps, presses, lubrication) and alternator are dismantled in the instrument shop, overhauled, and tested before being refitted. Once the boiler has been approved by the expert, insulation is fitted in the cab area, cladding fitted and painted and the fittings replaced. Thereafter the boiler is moved to the locomotive's stand in the erecting shop.

After the already-complete ashpan has been fitted, the boiler is placed into the frames and connections made to the firebox, smokebox and shuttle carrier plates. Installation of steam inlet and exhaust pipes and

the blastpipe follow. Now the chimney can be mounted and lined up with the blastpipe - a measure that is of great importance for later fire and steam production.

In the meantime, the various workstations have completed the necessary components and assemblies, so that assembly, separated into superstructure (boiler fittings) and 'bottom end' can start. The superstructure work includes refitting of the cab, tanks and the running board, the fitting of pumps and pipes. On the 'bottom end', the slidebars are mounted at a fixed distance to the cylinder centre, the crossheads mounted, pistons inserted into the cylinder and closed-in by the front cylinder cover. The pistons are pushed out and the dead-centre positions marked on the slidebars. Before the locomotive is wheeled, brake parts are mounted, as is the axle compensation.

Wheeling of the locomotive is among the most important assembly operations. Depending on the size of the locomotive, this can be done with jacks or by a crane. The frames, complete with the boiler, are raised to the extent that the wheels can be rolled under the frames.

The wheeling requires precision work, because the axles must be placed to the millimetre when the frame is lowered. After the locomotive is back on its own wheels, verification of axle shaft centre-to-centre measurements, dimension "z" (centre of axle to top of frame cut-out), and buffer heights takes place. The superstructure and 'bottom end' work continue. Remaining parts of the brakes, motion, various pipelines and finally the rods are mounted. Measurement of the distance between piston and cylinder cover mark the initial end of the assembly work.

Final 'cold' testing by the competent person will already be taking place and notes of any necessary work will be hung on the locomotive. These controls cover deficiencies specified by the operator, the correct fitting and proper interaction of all components and connections, the proper marking (stamping) of containers that must be inspected, and concludes with the release of the locomotive for the raising of steam.

The locomotive is moved from its stand in the erecting shop, via the traverser, for steam to be raised.

After about eight to ten hours there is sufficient steam pressure in the boiler to blow through the valve housing with the locomotive's own steam. This removes impurities before the valves are installed. Thereafter, air and feed pumps are tested to blow through the cylinders in order to also remove impurities there.

Now the cylinder drain cocks can be fitted and the boiler safety valves adjusted and given their seals by the experts. Setting the safety valves is not only a great responsibility but also very noisy work, and cannot be undertaken without hearing protection. A test for leaks gives assurance that the steam engine and all steam-powered units and pathways are functional and do not hinder sight when the locomotive is moving. With the mounting of valve setting instruments you are ready to set the valves.

Upon successful completion of inspection, the valve setting run can begin. The engine moves again for the first time under its own power. Usually only short moves are undertaken, to achieve the optimum setting of the valves and achieve the distinctive even exhaust beats. The valve-setting chart is made at maximum steam chest pressure at a speed of around 20km/h (12mph). The resulting indicator charts provide information on the distribution of steam through the piston valve and the timing of entry and outflow. This light engine move cannot verify all the important criteria for operation in service. The decisive factor is ultimately the behaviour of the engine under load. For this reason, a trial run hauling a train is essential. For standard gauge locomotives the Works' own staff take the locomotive on a run in the direction of Eisenach or Erfurt. Narrow gauge engines undertake their loaded trials at their lines, in co-operation with the customer. During this trip the locomotive's smoothness, correct operation of the steam engine, the function of all the units and auxiliary equipment, the production of steam and the effectiveness of the brakes can be tested. During stops, the temperatures of axle and rod bearings can be checked by touch using the back of the hand or, in cases of doubt, determined by temperature measuring instruments. After returning from the trial defects can be remedied using a controlled process.

After completion of all remaining work, the locomotive is painted according to the customer's wishes, and lettering applied. Level of repair, date and 'DLW' (for Dampfkloswerk Meiningen) are inscribed on the bufferbeams. The date of the brake inspection is inscribed under the cab; locomotives with steel fireboxes receive an additional red dot.

Finally, the work performed is confirmed in the locomotive's record book. This includes certificates of examination and testing, material certificates, documentation of performance tests and their results. After checking all the documents, the compliance professionals of the Federal Railway Authority (Eisenbahn-Bundesamt - EBA) produce an acceptance protocol for the repaired steam locomotive and confirm that it has been subjected to a main overhaul.