

OPERATING MANUAL



D5000-D5113 (later 24001-24113)
BRITISH RAILWAYS SULZER TYPE 2
4mm : 1ft (1:76.2) scale working model



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OPERATING MANUAL

For the Sutton's Locomotive Workshop
4mm:1ft scale working model of the
British Railways/Sulzer Type 2 locomotive

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RAIL EXCLUSIVE

Finescale Model Collection

Special acknowledgement must go to my Personal Assistant and RAIL EXCLUSIVE's General Manager, Jamie Walsh, without which this project would have never come to fruition. An able research assistant, she has provided valuable input, enthusiasm, and much-needed cajoling whilst maintaining an efficient and smooth-running front office. There are several others to thank for their assistance (you know who you are), having provided invaluable advice, background information, and access, in most cases completely unknowingly! This model is dedicated to 'Hawker', the office cat, who was ever-present during the design phase, providing welcome company during long winter nights in front of the computer screen, especially when it became hard going.

1. Preface

THE IMPETUS behind the launch of Sutton's Locomotive Workshop (SLW) is a long-running frustration with existing model railway products. This project was initiated at a time when, in contradiction to the upward trajectory of other hobbies, models of my interest period were actually in decline – in quality, in detail, and in accuracy. With 30 years of railway modelling and journalism under my belt, I have seen plenty of lame reasons offered for this inexcusable situation. Having commissioned items from every mainstream manufacturer in recent years, the general disinterest in product development and detail enhancements has been readily apparent, with the frequent response to requests of 'Sorry, but that's just not possible'.

For too long, enthusiasts of the diesel era have been pushed to the bottom of the pile. My heavily critical, pro-diesel stance at manufacturers' trade presentations quickly marked me out as a source of irritation. That labelling made me think. Next came a deliberate policy of dumbing-down models with its attached 'design clever' tag line. Then the revelation came that the fitting of detail such as sprung buffers was regarded as being prohibitively expensive. All this was regurgitated as fact by the model railway media without question. Was I the only one who translated what I saw as 'marketing spin' covering an excuse to charge higher prices for less detail? That really did make me think again. The final straw came with a dispute over a crucial commission and the total disregard for accuracy and timescale by the contracted manufacturer.

There must be a better way. *Better design. Better fidelity. Better craftsmanship. Better quality.* Why not produce a premium model by pushing tried and tested engineering principles to their limits and then introduce some simple, long-wanted, innovations? By virtue of getting the basic shape correct and making a 'proper job of it' the result should be a definitive, value-for-money product that is effectively future-proofed. So, as the saying goes: If you want something doing properly, then do it yourself. This is exactly what the SLW team has done. Meticulously researched using only primary sources and designed in England (by an enthusiast, not by committee), we then searched worldwide and recruited the very best engineers and toolmakers who, along with our skilled factory technicians, have brought this model to fruition.

But enough of what some may interpret as a crusade. This model has, quite simply, been made to museum-quality standard (and our engineers say an obsessive level of detail) in order to satisfy the demands of the intelligent

modeller/collector and often forgotten early diesel aficionado. We have worked to a specification, not to a price, and have endeavoured to reduce the areas of compromise to a minimum. Yes, manufacturing costs have risen, but not to the degree that the big manufacturers would have you believe. It's the profit expectation that causes the real pain your the pocket. By accepting a much smaller margin (SLW has lower costs, no shareholders, no middlemen and no big premises) and paying the going rate for what is an incredibly high element of hand assembly, we have been amazed at what can be achieved by investing in a world-class manufacturing set-up.

With a love of the mundane, the BR/Sulzer 'Derby' Type 2 was an obvious starting point. One of those 'bread and butter' designs that led the way as part of the well-documented Pilot Scheme it continued in production for a decade resulting in a build total of 478 machines with an incredibly diverse geographical spread. 'Ugly ducklings' they may have been (outside design consultants said they wouldn't even attempt to make a silk purse out of this pig's ear) but they heralded the difficult transition from steam to diesel. Enjoy this model, released shortly after the 175th anniversary of the rail industry in Derby, where the first locomotive of this type was designed and built. Our first model also serves to mark the important role these particular machines, and the men that built and operated them, played in the modernisation of Britain's railway.

Apart from an official contemporary report on the first locomotive, we have refrained from providing a comprehensive history of the type. Such background articles have been relatively commonplace and we leave the excitement of research to the customer. A word of caution is, however, advised with many newer books and magazines perpetuating inaccurate information. A useful start can be made with *Sulzer Diesel Locomotives of British Rail* by Brian Webb, David & Charles, 1978 and *Sulzer Types 2 & 3* by ATH Tayler, Ian Allan, 1984. A visit to David Hill's superb *Derby Sulzers* website at www.derbysulzers.com is also highly recommended.

Please support this bold venture into R-T-R model manufacturing, with its radically different philosophy that flies in the face of current trends. We need the support of *every one of you* to thrive in a crowded market dominated by large multi-national and foreign concerns. Making a success of these first few releases will ensure we can tackle even more projects. Please do not hesitate (in fact we positively encourage you) to contact us with sensible suggestions for future model variations and areas for improvement.

Philip Sutton

King's Cliffe, East Northamptonshire. December 2015.

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2. Prototype overview

By way of nostalgic introduction to the prototype, no description could be better provided than by reproducing the official trade press handout that accompanied the official unveiling of the first locomotive - No. D5000 - in 1958 for formal inspection by General Sir Brian Robertson, Chairman of the British Transport Commission.

**BRITISH RAILWAYS
TYPE 2 1,160h.p.
DIESEL-ELECTRIC LOCOMOTIVE**

**On view at
MARYLEBONE STATION
24th July 1958**

By courtesy of the British Transport Commission

The locomotive which is exhibited at Marylebone Station today is the first of a batch of 30 which are being built at British Railways' Derby Locomotive Works. The total number of locomotives to be erected by British Railways workshops, incorporating B.T.H. electrical apparatus and Sulzer 6LDA28 engines, is now 114*.

** The 'pilot scheme' build was for 20 locomotives placed in 1955. In June 1957, a further 10 locomotives were ordered for the Eastern Region. Just a month before this presentation, in June 1958, an additional 84 machines were authorised (66 for ER and 16 for the NER). So much for the plan to gain in-service experience before placing big orders!*

At the beginning, the first 15 of these 30 locomotives will be allocated to the Southern Region. There they will be used to implement this Region's policy whereby steam traction will be eliminated as soon as possible from their Eastern and Central Sections. Afterwards, when the 1,550hp locomotives on order with the Birmingham Railway Carriage & Wagon Co., also with Sulzer diesel engines, arrive, these 15 built at Derby will be re-allocated.

Mechanical Design

These locomotives, Nos. D5000 – D5029, are being designed and constructed to the requirements of the British Transport Commission under the general direction of Messrs. R. C. Bond and S. B. Warder (Chief Mechanical Engineer and Chief Electrical Engineer respectively, of the British Railways Central Staff, British Transport Commission), the detailed design and supervision of construction being the responsibility of Mr. J. F. Harrison (Chief Mechanical and Electrical Engineer, Derby, London Midland Region). The whole design has been co-ordinated with the British Thomson-Houston Co. who are the main contractor for the power equipment, and with Sulzer Brothers, the diesel engine manufacturers.

The locomotives are of the Bo-Bo type having a designed weight in working order of 75 tons. Each locomotive is of the full width body type with a driving cab at each end. It has multiple unit equipment enabling it to operate in multiple, not only with locomotives of the same design but with all locomotives for the British Railways modernisation scheme equipped with BTH, Crompton-Parkinson or English Electric electrical equipment. This feature, the result of co-ordination with other firms, should be a great aid to the flexibility of British Railways operating arrangements.

The principal data of the locomotives

Wheel arrangement	Bo-Bo
Maximum weight in working order.	75 tons
Maximum axle load in working order.	18¾ tons
Diesel Engine HP at continuous rating	1,160 hp at 750 r.p.m.
Maximum tractive effort	40,000 lbs.
Continuous tractive effort.. .. .	21,300 lbs.
Speed at continuous tractive effort and full engine output	15 mph
Maximum speed.. .. .	75 mph
Driving wheel diameter.. .. .	45 inches
Length over buffers.	50 ft 6 inches
Distance between bogie centres	28 ft
Bogie wheel base.	8 ft 6 inches
Fuel oil capacity (engine and boiler)	630 galls.
Water capacity for boiler	600 galls.

Locomotive Structure

In order to achieve a light construction, the weight carrying properties of the vehicle are shared between the underframe and a girder structure to which the body sides are attached. Buffing and draw loads, however, have not been neglected and the underframe is designed for buffing loads of 200 tons. In the first place, the locomotives are being fitted with double buffers and a central screw-link coupling. Provision, however, has been made for the later addition of automatic central couplers.

The underframe consists of two longitudinals, each consisting of two standard channel sections. These channel sections are placed back to back and the intervening space is covered top and bottom by plates, so forming ducts for the traction motor ventilating air, thereby avoiding fragile sheet metal ducts and considerably simplifying the underframe arrangement.

The longitudinals form the foundation for the four-point mounting of the engine generator set. They are tied together by the two main transoms which carry the bogie pivots and by other substantial members. The side girder frames are affixed to these transoms and tied together at the top by steel sections which also form the roof framing. Cables and pipework have been kept away from each other on opposite sides



of the locomotive. The cables are laid in a duct outside the main longitudinal member and this duct is covered in on all sides. The pipework is fitted in a similar manner.

Despite the presence of the side girder structures, access to the interior is satisfactory. Due to the slim in-line engine, there is provision for moving from end to end of the locomotive on both sides of the diesel engine, and inspection doors are fitted on each side of the engine room to facilitate handling of equipment at overhauls such as exchange of fuel injectors, filter elements and so forth.

For major overhauls, there is a large removable section of the roof through which a complete engine generator set can be installed and removed. This section has a small hatch for removal of engine cylinder heads and pistons, and there are also smaller hatches through which the boiler auxiliary equipment and control gear can be installed or removed.

A sealing plate fitted to the underframe receives any leakage from the engine room or boiler compartment. This drains into a centrally placed spillage tank, which may be emptied from time to time. In addition, clean fuel spillage is kept completely separate and is ducted back to the main fuel tank.

All air coming into the engine room is filtered through 2-inch deep Air Maze filters located in the body sides. The whole of the engine room therefore becomes a clean air compartment from which air is drawn for the traction motor blowers, engine, main generator and all auxiliary equipment. In addition to the engine room filtration, which is of a type designed for low air resistance despite severe contamination, the engine has its own high efficiency filter of the Vokes oil wetted, bonded hair type. In accordance with the usual method adopted by Sulzer, the hot air exhausting from the generator is expelled downwards out of the engine room so that

there is no recirculation. Special care has been taken in sealing all possible sources of leakage of unfiltered air in the engine room and in this respect, the air-tight design of the radiator ducting on both sides of the panels is especially noteworthy.

Bogies

The bogies are of welded and riveted construction with box frames. They are of the spring bolster type and are equalised. The primary suspension consists of two sets of coil springs arranged on each equalising beam each of which is damped by a shock absorber. The bolster rests on the spring plank through two nests of coil springs, the motion of which is also damped by shock absorbers. The spring plank is hung from the bogie frame by four swing links which are pin jointed with hardened steel bushes at the top and knife edged at their connection to the spring plank at the bottom.

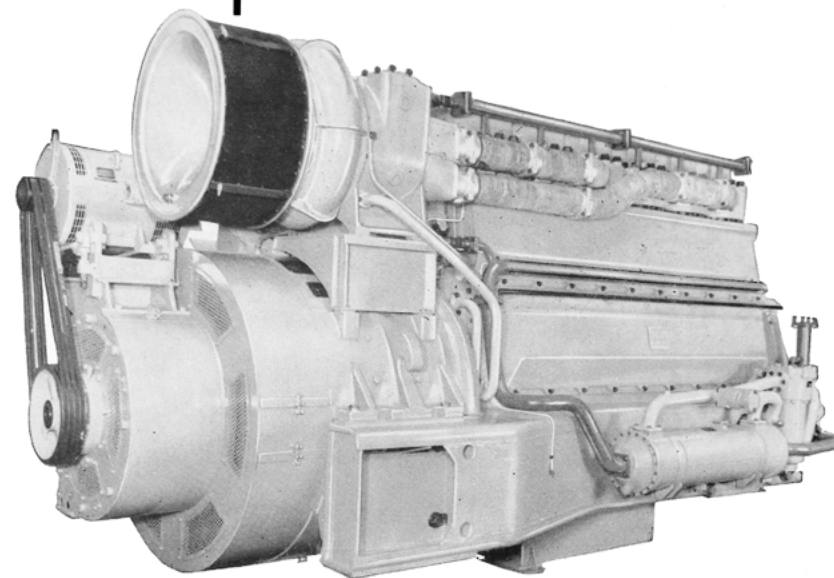
Cab Equipment

The cabs are most spacious. The two doors are placed behind the driver's and assistant's seats and there is sufficient room to move freely in and out without disturbing the crew. Comfortable adjustable seats are provided and the controls and indicators present a very neat appearance. The driver is confronted with the minimum of instruments, namely speedometer, load ammeter, Duplex vacuum gauge, main reservoir, pressure gauge and straight air brake gauge.

A cab heating and ventilating device combined with a screen demister is fitted. Fresh air is blown by an electrically driven blower through heating elements fed from the engine cooling system and can be controlled by the driver. The unit can be used for blowing cool air in exceptionally hot weather.



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On the right lines with Vokes. One of the new British Railways' Type 2 (D 5000) diesel electric locomotives fitted with Vokes air filters.

Photos by courtesy of Sulzer Bros. (London) Ltd.

Vokes air intake filters are fitted to the Sulzer engines powering British Railways' Type 2 (D 5000) diesel electric locomotives.

These filters, specially designed for use on Sulzer engines and accepted after an extensive test programme in competition with many other types of filters at Winterthur, make a marked contribution to longer engine life and lower maintenance costs.

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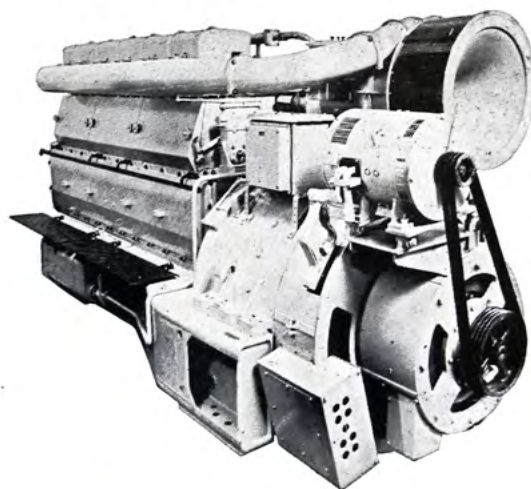
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Engine and Accessories

The engine is the Sulzer 6LDA28, pressure-charged, six cylinder, four stroke in-line engine rated at 1,160 hp at 750 rpm with a testbed one-hour rating of 1,276 hp at 750 rpm. Five of the engines of the 30 locomotives are being supplied from Sulzer Brothers Works in Switzerland, but the majority are being built to Sulzer orders at Messrs. Vickers-Armstrong's Works at Barrow.

The design needs little further description. The crankcase and cylinder block with their cast steel transversals welded to mild steel top and side plates and the crankcase and engine generator mounting as an integral structure, are well known.

The forged aluminium pistons are fitted with oil cooling channels behind the rings in order to ease their working conditions. Precision bearings are fitted in the crankshaft main bearings and big ends. These are of a trimetal type developed by Sulzer Bros. and consist of a steel backing, coated with copper lead with a top layer of soft bearing metal. This top layer is thick enough to last the life of the bearing. Shims are not used in these bearings and no hand fitting or adjustment is required. C.A.V. fuel injection equipment is fitted. It has been made in consultation with Sulzer Brothers and the Sulzer double helix type plunger, by which means both the injection point and the cut-off can be controlled, is retained.

Accessibility of the engine components has always been a prime Sulzer consideration and the British Railways engines incorporate improved fastening arrangements for all covers to reduce the work entailed in releasing them, whilst retaining the characteristic oil tightness and cleanliness of the engines.

Cooling water circulation, lubricating oil priming and fuel transfer pumps are all driven by a single traction type auxiliary electric motor. Thus they can be operated independently from the engine, enabling circuits to be primed before starting the engine and providing even cooling of the water jackets, pistons and bearings after stopping.

Lubricating oil is cooled in a Serck heat exchanger by the cooling water. The heat exchanger fits closely and neatly to the engine and thus no major oil piping leaves the engine. The main advantage of heat exchanger cooling is, however, quick warming up and good temperature control.

Tanks are fitted under the radiators to drain the water from the panels as soon as circulation ceases, and in this way freezing of the elements in cold weather is avoided and quick warming up by complete bypass of the radiator is possible.

The air filtering scheme is described earlier in this article. Detailed attention has also been paid to liquid filtration. Besides Knecht fine wire wound self-cleaning strainers in both the fuel and lubricating oil system, there is a full flow Purolator paper type fuel filter and a high capacity Fram waste packed bypass lubricating filter taking approximately 20% of the total flow to keep the oil in good condition.

BTH Electrical Equipment

Generator and Auxiliary Machines

The generator unit comprises three machines – a main generator, an auxiliary generator and a differential exciter. The main generator is a single-bearing, 12-pole, separately-excited, self-ventilated machine solidly coupled to the diesel engine and mounted on an extension of the engine underbed. It is a 735 kW machine rated at 750/525 Volts, 980/1400 Amps, 750 rpm. The armature is built on a fabricated cylinder, a stub shaft being provided at the bearing end. The drive from the engine is taken on the full diameter of the cylinder, ensuring great torsional rigidity and freedom from the effect of cyclic variation of torque. The BTH 'Pollock Type' commutator construction is used which obviates the possibility of loosening of segments in service.

The brushes are split in pairs with equalised pressure on each brush. Pressure is applied through an insulated roller so that it is impossible for the brush arms to carry current from the top of the brush. Brush pressure is adjustable and compensated between the two half brushes.

The auxiliary generator is an 8-pole, separately-excited, constant-voltage machine of 50 kW, 110 Volts, 500/750 rpm; the armature is mounted on an extension of the shaft of the main generator. In order to reduce the length of the set to a minimum, the auxiliary generator is accommodated partly within a recess in the main generator commutator.

The exciter is a 4-pole machine with separate, self and differential series excitation windings. It is mounted upon an adjustable platform on top of the auxiliary generator frame, and is belt-driven from the main generator shaft extension. The output of the exciter is controlled by the engine load regulator.

Traction Motors

The four nose-suspended, series-wound traction motors drive through single-reduction gearing. Each motor as a one-hour rating of 209 hp, 490 Volts, 375 Amps, 505 rpm and a continuous rating of 213 hp, 525 Volts, 350 Amps, 560 rpm. They are force ventilated by two separate blowers which are driven by a single 12.2 hp, 110 Volt, 2,600 rpm motor; each blower provides ventilating air to a pair of motors.

The motors are axle hung and nose-suspended by Metalastic chevron rubber units which whilst providing a soft vertical suspension, effect a large measure of lateral control of the motor irrespective of side movement of the axle, thus reducing flange wear and improving the riding of the locomotives. The gear wheels are of resilient construction, and consist of a hub and toothed rim connected through rubber bushes which cushion mechanical shocks due to accelerating forces and track irregularities.

AEI DIESEL ELECTRIC POWER EQUIPMENTS



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Control Equipment

The control unit is mounted in a dust-tight compartment in the body of the locomotive at the generator end of the engine room. It is thus convenient for cable runs and at the same time away from engine piping. On this control frame are located all the contactors, relays and switch devices. Separate contactors are provided in each motor circuit. The reverser is of the butt contact type, having silver-faced main contacts; it is electro-pneumatically operated.

The driver's control equipment comprises a master controller and instrument panel, in each cab, together with alarm identification panel, engine instrument panel, lighting switch boxes and fire alarm unit.

The battery is contained in four pull-out boxes suspended from the underframe. With the engine running, it floats across the 110 Volt supply from the auxiliary generator, controlled by a Brown Boveri sector-type regulator.

Control Scheme

The characteristic of the combined generator-exciter unit is that of the well known three-winding generator. The exciter had a differential series winding which carries the main traction current, and also a separately excited winding which is externally controlled both by the driver's controller and the automatic load control. Due to the low value of excitation current in this small machine, small control devices can be employed. The shape of the characteristic is the familiar drooping curve, the

excitation being proportioned so that there is a definite maximum limit to the current which can be delivered to the traction circuit at standstill, and so that at this point, the demand on the engine is less than its rated output. The section of the characteristic which intersects the contact HP curve of the engine is artificially controlled by varying the separate field of the exciter by means of a rheostat.

This rheostat is controlled by an oil servomotor which is incorporated in the engine governor. This arrangement automatically varies the generator loading so that it agrees with the predetermined engine output at any particular engine speed. The four traction motors are connected in parallel across the main generator with two stages of motor field weakening.

Complete control of the main traction equipment is obtained by a self-lapping air valve operated from the master controller. On moving the power handle away from the 'O' position, the load regulator first runs up, increasing the excitation and therefore tractive effort. At a certain point, the main engine characteristic is reached and thereafter, engine speed and power rise together, until the full rated HP is reached. The scheme covers the control of tractive effort at starting and of locomotive power afterwards, all without the use of 'notching' contactors.

Maximum tractive effort is reached at a very low engine speed so that racing the engine to start the train is completely unnecessary. Field weakening is introduced in stages initiated by the generator load regulator.

Protective Devices

The protective devices provided on this locomotive are of two types: (1) apparatus for the safety of the locomotive in traffic; (2) apparatus to protect the engine and transmission equipment.

Under category 1 there is the deadman's pedal with its corresponding push-button on the opposite side of the cab, which permits the driver to cross the cab to observe signals. Also air-operated switches are provided to prevent the locomotive from being driven until there is sufficient compressed air and vacuum to operate the locomotive and train brakes. In addition, the new BR type of automatic train control is fitted.

Protective devices in the second category include provision for the engine to be automatically stopped in the event of low cooling water or lubricating oil pressure, and the appropriate latched relay operates on the identification panel of the locomotive affected. An 'engine-stopped' light at the driving position indicates if any one engine is stopped when running in multiple unit. This alarm also serves as a guide when starting engines on locomotives couple in multiple, since the start push-button is merely held depressed until the 'engine-stopped' alarm becomes normal.

Earth leakage causes the earth leakage relay to operate and the traction circuit to be opened. Provided the earth fault has cleared, the relay can be reset by moving the

driver's controller to 'off' but a flag on the relay remains displaced until reset by hand, thus indicating to the shed staff that an earth fault has occurred at some time during service. In the event of traction motor blower failure or high water temperature, the alarm indication is made at the driving position by an indicator light, whilst a latched relay operates on the alarm identification panel of the locomotive affected. When the engine 'alarm' light indicates trouble, the driver can then go back to the engine compartment where a detailed indicator shows which actual part of the apparatus is giving trouble. A wheel slip indicator light is fitted at each driver's position. All indicator lamps glow dimly under normal operating conditions but light up brightly under fault conditions.

Brakes

The brake equipment is of the Oerlikon type manufactured by Davies & Metcalfe with Westinghouse brake cylinders. Air brakes are supplied for the locomotive and provision is made for vacuum braking on the train. The brake control is vacuum operated and an air brake is applied to the locomotive through a proportional valve. In addition to this system, there is an independent air brake for the locomotive. A trigger on the independent air brake valve enables the locomotive brake to be released whilst still holding the brake on the train and is of value when coupling or uncoupling.

Each bogie carries four 8-inch Westinghouse horizontal brake cylinders incorporating a slack adjuster. Air for the locomotive brakes and for air operated control equipment is provided by a Westinghouse DVC2 compressor. Vacuum for the train brakes is provided by two Westinghouse 4V110 exhausters.

In addition to conventional sanding, the Swiss anti-slip brake, already well established on the Continent, makes its first appearance in this country. This greatly assists heavy starts under bad adhesion conditions without the wear caused by sand in the locomotive running gear and in points. Separate operating switches are provided for the anti-slip brake and for sanding.

Steam generator

A Stone-Vapour boiler is installed having a capacity of 1500 lbs of saturated steam per hour. The apparatus is automatic and fully protected.

...

3. Spotting features

For what, outwardly, what looks like a relatively homogenous group of the locomotives the BR/Sulzer 1,160hp Type 2s encompass a surprisingly large number of design changes or in-service detail variations. In order to enhance your experience of our model, it is a fascinating exercise to outline some of these differences to illustrate the extraordinary lengths we have gone to. As with any machine that had a service life of more than two decades there are numerous minor changes. We will faithfully re-create all significant changes, and most of the smaller ones too, over the course of our release programme.

Bodyside air intakes

There was some experimentation, within the pilot scheme build of 20 locomotives, on the number and position of the small bodyside air intakes/filters. These were adjusted several times on the first built (D5000) over the first few months and, on D5018/9, the layout even changed between sides. This is the first model ever to represent these variations. Standardisation, with fewer grilles, was maintained throughout the production build and thus we have modified our tooling irreversibly to match, effectively making our early pilot scheme models limited editions.

Radiator grilles

The first half dozen machines had the bodyside radiator grille fabricated with one deeper horizontal bar designed to accommodate the original pin strip livery (which did not find favour after D5000). These grilles were sometimes replaced or moved onto other locomotives during the course of repair or overhaul. Both early and later types of radiator grille are modelled.

Axlebox variation

Ten of the pilot scheme locos (D5010-9) were initially fitted with 'Athermos' plain-bearing pressure lubricated axleboxes. These were large and distinctive assemblies with bolted cover facings featuring the 'Athermos' brand name. The variation was not perpetuated, with SKF roller bearings being adopted as standard. This interesting variation is modelled where appropriate.

Silencer and exhaust port

A major problem became apparent not long after introduction, with a number of serious fires in the roof area at the No. 2 end. The expansion box and resonator silencer - which receives the hot exhaust gases from the turbocharger before venting to the atmosphere - was being contaminated by oil leading to pyrotechnics and explosions. A modification programme took place at Derby Works during the mid-1960s to remove both components and add a new 'straight-out' exhaust stack,

placed above the power unit. Dependent on period/livery, the models either display the original resonator silencer with its raised, curved surface and circular exhaust port, or a later plated-over roof section and simplified direct outlet.

Frame fairings

Aesthetics, it could be argued, was not of high importance with these Derby Type 2s. However, one concession was the contoured fairings that enclosed the longitudinal frames and their associated pipe and cable runs at solebar level. Hinged in sections, to give access for maintenance, they were subject to regular damage and became a hindrance. They were removed at half-life overhaul, leaving the frames with a very utilitarian appearance. The fairings were dropped completely from the later Class 25s.

Underslung fuel and water tanks

Weight limitations and operational requirements led to several arrangements of underslung fuel and boiler water tank. The diesel fuel tank, at the No. 1 end, was reduced in capacity (and physical height) from 630/546 to 520/500 gallons whilst the water tank was reduced in capacity (and length) from 600 to 450 gallons both from D5050. In addition, sight glasses were quickly superseded by circular gauges. On the freight only locomotives employed on Tyne Dock-Consett iron workings, and in later years when boilers were isolated, the water tanks were removed completely.

Bogie cab footsteps and sandboxes

Both two and three-rung bogie footsteps exist. The former (original) design was restricted to pilot scheme and early production locomotives before the arrangement was changed due to experience (the steps were too widely spaced to making climbing awkward). A revised shape of sandbox, to simplify fabrication, was also introduced with the later Class 25. Component swaps and repairs quickly led to the mixing of these designs to the extent that some locos sported different sandboxes at each end!

Bodyside footsteps and battery isolating switch cover

As a direct result of spreading overhead electrification, the bodyside footsteps/hand holds were plated over to prevent access to the roof. At the same time a small cover was placed over the coolant overflow outlet adjacent to the roof scavenger fan. The exterior battery isolating switch cover was found to work open due to vibration and so was secured by a more foolproof locking bar. All these in-service modifications are included where necessary, most commonly on blue-liveried locos.

Boiler pressure relief valves and roof water filler cover

Several arrangements of steam pressure relief valves exist (linked to equipment routing and different workshops) in segments cut out of the roof, above the boiler compartment. Our models allow for these variations to be represented. The hinged cover for the roof-mounted boiler water filler point is also included as a separate etched item. This component was quickly dispensed with in service due to its fragility.

High-level air pipes

In 1964, the Tyne Dock-Consett iron ore trains were taken over by Type 2s working in multiple, replacing steam traction. NER-based locomotives D5102-11 were allocated to this role having been modified with an air compressor and control equipment in place of the boiler. The water tanks and steam heat piping was removed and new high-level air pipes installed on the front ends in order to provide a supply for the compressed air-operated hopper doors on the wagons. The distinctive pipes remained in situ when the locos were transferred away after the traffic ceased. If you wish to model these locos, contact us for a special upgrade pack, containing revised underbody details and a pair of high-level pipes.

Removal of front end doors

As was convention at the time, these locomotives were built with front end gangways intended for crew access when running in multiple. It was found to be a little used feature and the doors were soon locked out of use. As a constant source of drafts and water ingress, they were first covered by strips on some Scottish-based machines before a prolonged Works programme of removal and re-sheeting took place. Derby and Glasgow Works had differing techniques, the latter choosing to reposition the middle marker lights and discs on the centre-line. Not all locos were treated before withdrawal, many retaining the front end doors.

Headcode boxes and headlights

It was not until well through the build that a redesign of the front end took place with the adoption of train reporting number apparatus (headcode box) on the cab roof. The simplified front end, albeit still with doors, was now devoid of headcode discs and marker lights leaving just two low level tail lights. This change took effect from D5114 onwards. A batch of these locomotives was allocated to Scotland and was subsequently fitted with a pair of headlights on the central nose section at each end.

4. Model description

This model will give you many years of reliable operation if it is handled with care and periodically inspected and serviced. It has been created as a working replica for adult modellers and collectors, and should not be regarded as a toy. The standard model is intended to operate off conventional 12V direct current, supplied from a model railway controller. A decoder blanking plug is fitted. Digital sound versions feature a ZIMO decoder connected via the PluX22 (NEM 658) connection and require a DCC control system for full functionality.

Fine detail - handle with care

The model comprises 350 individual components, all of which have been painstakingly hand assembled. A range of different materials have been utilised including injection-moulded plastics plus cast and photo-etched metals. The high number of parts is in contradiction to the recent trend towards simplification, and is a direct result of the quest for greater detail. Many parts are fragile and if the model is handled, it should be done so with great care. We cannot be held responsible for any damage during use.

Designed for smooth operation

A die-cast zinc alloy metal chassis has been employed for superior adhesive weight and houses our smooth-running 'Black Cat' five-pole motor. The centrally-mounted motor, mated to two brass flywheels, supplies movement via carden shafts running to both bogies. The tolerances and free-running of any drive-train have a dramatic impact on responsiveness. Our requirement has therefore resulted in a low-friction specification which comprises worm reduction drives feeding spur gears linked to all axles. These are housed in a machined metal gearbox, designed to avoid any twisting and binding problems that are common with deformed or less-than-rigid plastic components. All axles run in lightly lubricated stepped brass bearing bushes.

Minimum recommended radius

The wheelsets nominally provided are set for 'OO' (16.5mm) gauge track. The model will run over commercial track systems down to a minimum radius of 16 inches (400mm) but, due to the finescale RP25 wheel profile, more satisfactory running will be achieved over curved track formations of a larger radius. The use of this locomotive is not recommended on 'vintage' or coarse-scale trackwork.

Good haulage capability

The mechanism provides a haulage capacity that meets most demands. Remember that the rolling resistance of stock varies considerably. Because of the deliberate omission of 'traction tyres', please do not expect performance to match that of older models. Tests have shown this model to be easily capable of hauling over 14 modern bogie carriages on level track and seven carriages up a 4% gradient.

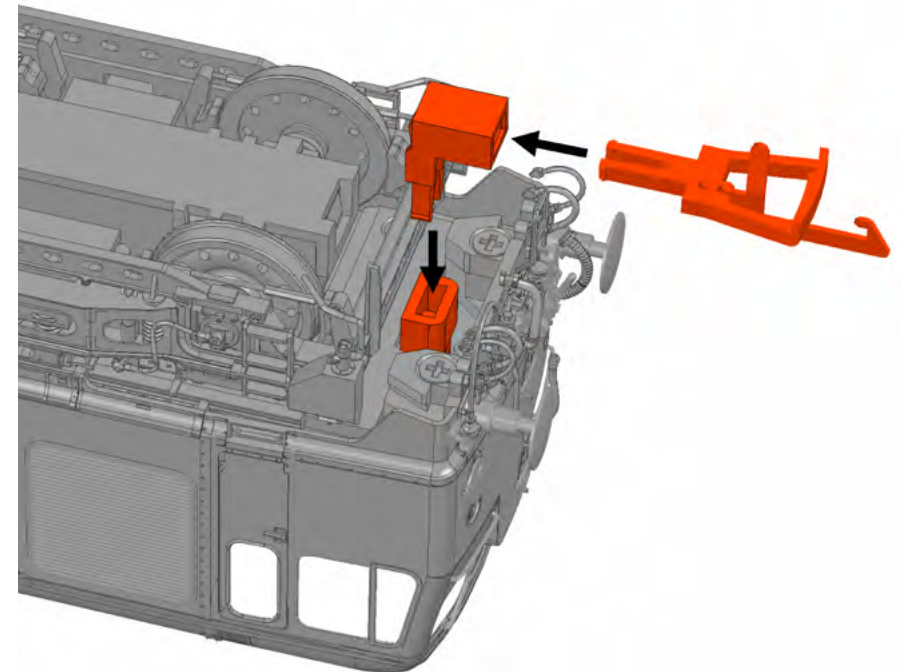
5. Display and set-up

The model is supplied in its own display case which also acts as secure packaging during transit. This case has been provided for collectors who may wish to display the locomotive as part of a larger collection or perhaps as an individual executive desk feature. You will note that by the use of three flangeways, this base accepts wheels set to 'OO', 'EM' or 'P4' gauges.

To extract the model from the case, lift off the transparent cover and remove the plastic blister support and protective polythene sheet. Undoing the two long mounting screws from the underside of the base will release it from the plinth.

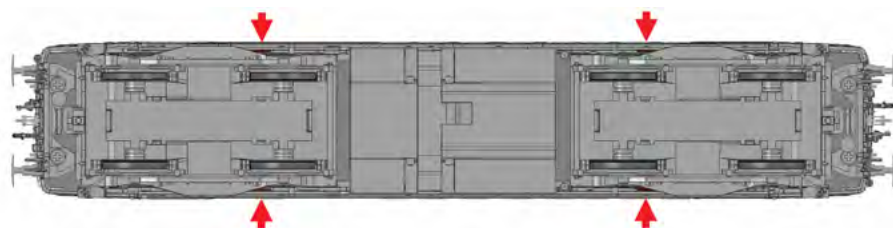
As supplied (in display mode), the model has fully detailed bufferbeams with representations of the screw-link couplings and various brake hoses, control cables and ladders. To run with the UK 'tension lock' system, please fit the additional parts as supplied with the packaging: The coupling plugs into a right-angle NEM 362 pocket that, in turn, is seated in the coupling apparatus behind the bufferbeam. A hidden kinematic movement system (in the chassis) is employed that automatically extends the coupling as the vehicle enters a curve.

Note: To work effectively and reliably it may be necessary to remove or cut away any pipes or detail that restrict free movement of the 'tension lock' coupling.



There should be no need to access the interior of the model in normal use. Access to the chassis, motor and printed circuit board is gained by removing the bodyshell. There are four small securing lugs moulded on the inside of the bodyshell, positioned above the inner axles on both sides. These interface with similar positioned rebates in the die-cast chassis' sides. Gently ease the body apart from the chassis along its lower edge at these points - this can be done by inserting some home-made 'wedges' formed from plastic sheet or chopped-up hot drink stirrers (if you don't have access to long female fingernails!). The chassis can then be gently drawn out by gravity or a exerting a light downward separating force. Fit and use the original mounting screws for this purpose - do not be tempted to hold the fuel/water tank area.

Note: Extra caution is needed on the models fitted with solebar fairings. It is recommended these parts are carefully removed first by easing downwards with a thin blade. Because of the number of components involved, the fuel tank area will not take a separating force without breaking, and should not be used for purchase when removing the body.



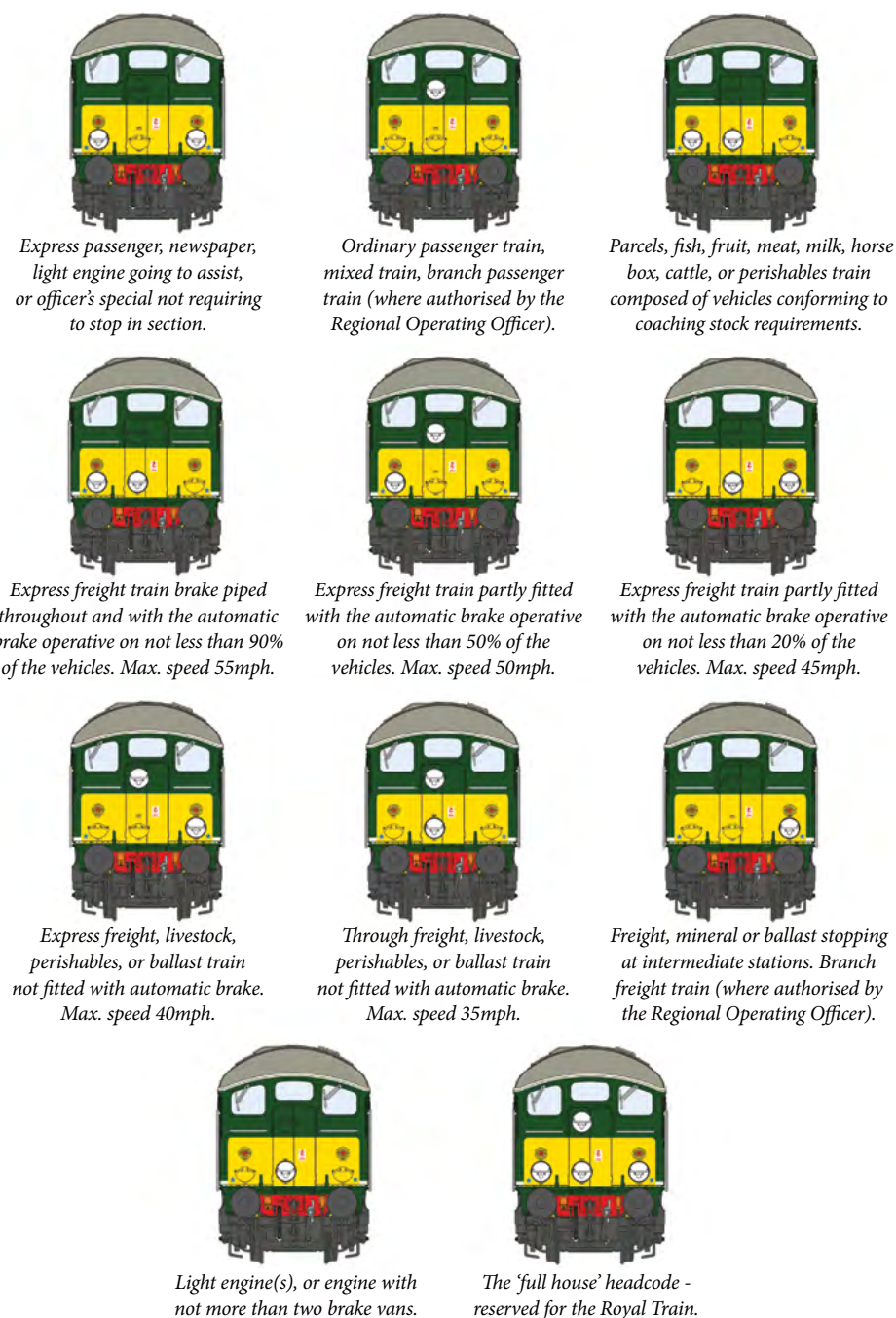
6. Additional detailing parts

For the benefit of modellers who wish to modify the look of their locomotives we have provided a number of optional fittings. These parts are included in bags found under the display case base. As well as the previously mentioned UK 'tension lock' couplings, in-line brake blocks for 'OO' gauge wheelsets are also included - please see Chapter 9 for more information. Cantrail boiler water filler point covers are also issued along with a vacuum timing reservoir and coupling bash plate (locates behind bufferbeam). Some spare lamp irons are provided in case of damage in use.

In addition, we have provided a selection of headcode discs in open, closed-down and closed-up arrangements. You can use these to change the headcodes displayed on your model. The legs need to be bent back 90 degrees and inserted in the location holes in the cab front.

See diagram, right, for a simplified explanation of the headcodes carried during the 1962 to 1968 period. A revision was made in 1968 following the elimination of steam and to reflect the increased use of air-braked stock and block trains.

If you are looking for an easy guide to what the different disc combinations indicate, then we recommend a visit to: www.2d53.co.uk/Headcode/headcodeC.htm



7. Running-in and maintenance

Even though every model has been tested extensively in our factory, performance characteristics will gradually improve with regular use. The locomotive should initially undergo a 'running-in' period to allow all moving components to seat properly. It is suggested that the model is left to run for at least 45 minutes in each direction at a selection of different speeds. Lubrication has been applied to the gear train and bearings during manufacture.

Occasional cleaning and light re-lubrication using non-hazardous plastic compatible oils and grease is suggested. Light oil should be used for axle and motor spindle bearings, with a more viscous grease (such as Molykote EM50L) for the worm and gear train. Good electrical continuity is essential for smooth and reliable operation. Inspect the model before use and carefully remove any deposits, debris or fluff that may have accumulated. As well as ensuring the rail head is clean, it is imperative that an uninterrupted supply to the motor is maintained by regular cleaning of the wheel treads and the wiper pick-ups acting on the back of the wheels. This can be achieved using a pipe cleaner soaked in lighter fuel or similar solvent. A touch of electrically conductive lubricant can be applied to the clean pick-up faces. Avoid using abrasive materials which will scratch the wheel surface and make cleaning more difficult.

To make this less of a chore, why not imagine you are running a real railway where locos need to visit the shed in order to be given booked maintenance after running for a set period. A regular 'A-exam' could comprise wheel cleaning, whilst a more occasional 'B-exam' might include inspection and cleaning of the wiper pick-ups, lubrication of moving parts, checking wheelset back-to-back measurements, etc.

8. Lighting and printed circuit board (PCB)

We know, through experience, that frustration has been encountered by many modellers in trying to adapt or modify lighting circuits and printed circuit boards to suit their specific needs. To this end, a simple but advanced design is utilised, capable of handling both DC (analogue) and DCC (digital) control. It additionally incorporates provision for sound by providing direct connections and space for a twin-speaker system. For smooth and reliable operation, electrical continuity is paramount so you will not find any unsoldered or 'wiper' connections here. All links with the main board are made using industry-proven JST miniature plugs and sockets, which have the added advantage of making swap-outs much quicker and simpler.

For DC users we've stuck to our 'keep it simple' philosophy and have avoided over-complication and retained robustness by avoiding constant brightness circuits for the light emitting diode (LED) lighting. The lights are designed to be prototypically dim (*marker and tail lights on the actual locomotive are only 25W bulbs*). However, some anti-flicker capability has been built in. As delivered, the DC model will also illuminate the cab interior in direction of travel. This can be disabled, if required, by unplugging the relevant LED connections wires on the main PCB.

The special DCC blanking plug incorporates a simple system for those wishing to slightly reduce the top speed of the locomotive. By removing the '000' SMD resistor 'bridges', the motor supply will travel via series diodes which reduces the maximum voltage available by 0.7V (one) & 1.5V (both) without affecting the lighting.

For DCC users, the PCB comes in to its own, having been specifically designed to take advantage of the latest developments in this field. The newest PluX22 (NEM658) decoder connection is utilised to take maximum advantage of the 10 function outputs provided by ZIMO's advanced sound decoders. The decoders provided for this model, manufactured specifically for us, have the PluX22 index pin (pin 11) in place as an active output (FO8) and we have described these decoders as PluX22e (enhanced).

Each group of lighting, at each end of the model, is allocated to an individual Function Output, always with a Common (+) line nearby, so that operation can be made completely independent of each other, a feature that we have taken advantage of in our DCC-fitted models. This also allows you to re-programme configurations if so required. Our DCC-equipped models feature optional lighting modes with a default of forward markers only (as if hauling a train). At the touch of a button, the tail lights can be switched on for a 'light engine' movement. Similarly, the cab interior light can be activated in one movement. Illumination throughout the model is provided by miniature surface mount warm-white or red LEDs with in-line protective current limiting resistors. Using ZIMO software, the lighting has been programmed with 'soft' on/off to mimic tungsten filament bulbs 'brightening up' and 'dimming down'.

As well as the previously described twin loudspeaker connections, the main PCB incorporates three other features new to British market. The first of these is the provision of two energy storage capacitors wired in parallel. Giving a total value of 1360µf, they are linked to the ZIMO decoder's dedicated circuitry connections providing full 'stay-alive' and 'smart-stop' capability. See the Chapter on DCC Sound for a more detailed explanation of these special features.

A further three-pin connector also provides for a direct link to the decoder's Switch Input, Common and Ground, allowing an input device, such as reed switch to be attached. The most obvious use of this is to attach a Hall Sensor allowing automatic magnetic triggering of a sound function, and in fact, a warning horn has been set as the sound default in our programming for just this occasion. (See Chapter 11 for further details and add-on kit). Wire routing holes have been provided in the chassis, below the motor, for those who wish to undertake this advanced modification.

Additionally, four solder pads are provided for DCC specialists who wish to make a direct connection to the decoder's serial user standard interface (SUSI) for control of further devices such as servos.

For reference, the Function Outputs are wired to the following lighting circuits on DCC equipped models:

Output	Lighting circuit	PluX22e pin
FOf	No. 1 end: Marker lights (white)	7
FO1	No. 1 end: Tail lights (red)	16
FO3	No. 1 end: Headcode box	2
FO5	No. 1 end: Headlights	20
FO7	No. 1 end: Cab interior/engine room	22
FOr	No. 2 end: Marker lights (white)	13
FO2	No. 2 end: Tail lights (red)	18
FO4	No. 2 end: Headcode box	19
FO6	No. 2 end: Headlights	21
FO8	No. 2 end: Cab interior/engine room	11

Note: Not all function outputs/lighting circuits may be used on every model version. For instance, a pilot scheme Class 24 will obviously not have alpha-numeric headcode box or twin headlight illumination circuits fitted. Redundant outputs may, of course, be reprogrammed and utilised for other features such as electromagnetic couplings, smoke generators, etc. if so wished (and if space can be found).

9. Wheels and bogies

In another first for a British model, and in response to the demands of those using employing more accurate track gauges, we have supplied factory-fitted 'finescale' wheelsets in one of three different gauges. The wheels incorporating the distinctive stress-relieving holes around their circumference. In best practice, turned wheels are mounted on steel axles with insulating collars that also act to limit lateral movement. Different size collars and axle lengths are used dependant on the gauge. Brass bearings lock into the machined cast metal gearbox to minimise wear and maintain tight tolerances.

In an effort to keep the wheels looking as accurate as possible within the compromises dictated by 'OO' (16.5mm) and 'EM' (18.2mm) gauge, the widely-used NMRA RP-25/110 wheel contour standard has been adopted, avoiding unnecessary deep flanges. These wheelsets have been extensively tested on numerous commercially available Code 75, 83 & 100 track systems.

For exact-scale 'P4' (18.83mm gauge), a much finer wheel profile is adopted that complies with published standards from groups working in this gauge.

The brake rigging and blocks align with 'P4' wheelsets by default. Optional 'OO' versions of the brake blocks are provided separately and can be fitted, if required, to give a better look when using 16.5mm gauge wheelsets. This will require disassembly of the bogie and is only recommended for the experienced.

Back-to-back dimensions are set at 14.50mm ('OO'), 16.50mm ('EM') & 17.75mm ('P4') at our factory but should be checked before and regularly during use, and adjusted if necessary to obtain optimum running characteristics. Some experienced users will wish to make small changes to these measurement to suit their own trackwork requirements.

Should you wish to change to a different gauge after purchase, this is possible by removing the keeper-plate on the underside of each bogie's gearbox and simply replacing each wheelset. The plastic keeper-plate is held in place by a large clip at each end and two smaller clips each side inboard of the axles. Gently lever them over their retaining lugs. The wheelsets can be extracted and replaced by hand. Make sure the gear wheels are in alignment and that the bushed brass bearings are firmly seated down in the axle recesses. Wipe pick-ups can be adjusted to apply light pressure to the rear faces of the wheels. Replacement wheelsets to suit all three track gauges are available from us for an additional charge.



10. Digital sound operation

Introduction

Installing sound into a model locomotive significantly increases its cost. We believe it should, correspondingly, increase its value. In our experience, too many sound-fitted models fall well short of this expectation. We understand the frustration many experience using restricted operational features usually provided with sound-fitted models so we were determined to give you the freedom and the tools to decide how your model's movement and sounds interact.

We set ourselves the challenge of providing the 'best ever' sounding Class 24 model, incorporating as much user-control as possible. In both these regards we believed our aim has been achieved, thanks to cutting-edge technology and the most up-to-date recording methods and equipment. This model is notable for being the first ready-to-run diesel to be factory-fitted with Austrian-made, high-performance, DCC decoders from ZIMO Elektronik.

Close co-operation with ZIMO's development team in Vienna has provided new or enhanced control features ideally suited to British diesel operations. Our understanding of the prototype and the software has enabled us to provide you with a sound project able to simulate all normal operational sound and movement combinations. This installation allows more realistic sounds to be deployed across a wider range of operating conditions. The sounds have been programmed in such a way that you, the user, may change the way that the sounds respond to your driving style or needs. This avoids the need for reprogramming and additional costs that would imply.

The sound output of this model was judged to be the most authentic in an audio test, which included a number of enthusiasts and professional railwaymen. Credit for this must go to Paul Chetter, who is widely regarded as the leading authority on ZIMO programming. Thanks to unprecedented recording access, his skill, enthusiasm and attention to detail have created an exclusive sound project that will satisfy the most ardent 'Baby Sulzer' fanatic. The distinctive 'spluttering' exhaust notes of the Sulzer power unit have been faithfully recreated and will be instantly recognisable.

A truly successful project is one that captures the essential characteristics of the locomotive. This includes how the model responds to control inputs, the relationship between track speed and engine sounds, the balance of individual sounds within the mix and how the installation affects the final results.

Please spend a few moments to read these notes which have been produced so that you may obtain the maximum satisfaction from this revolutionary ZIMO sound scheme. Some of the new features will not operate to their full potential if you use 14/28 speed steps. If at all possible, please ensure you use 128 speed steps to take maximum advantage of these controls. Individual locos may require some fine tuning that you can achieve with your DCC controller.

Sound specification

The model is fitted with a ZIMO MX645 PluX22e DCC sound decoder, tuned to a pair of high-end miniature 8Ω loudspeakers housed in custom-designed plastic enclosures mounted within the die-cast chassis. This arrangement was devised to provide the best possible audio experience from the restricted space inside the model. The decoder is also connected to a pair of energy storage capacitors.

The MX645 is a technologically-advanced chip, which is highly regarded because of its impressive specification that includes a 40kHz 'silent' drive with back-EMF sampling. Despite its relatively small size, it packs an incredibly powerful 3W audio amplifier and an accommodating 1.2A continuous (2.5A peak) current rating. All features, including up to ten function outputs, switch input and SUSI connections are available for customisation. This model is configured to run 'straight from the box' with ZIMO's legendary silky-smooth motor control.

Our loudspeakers were originally designed for portable consumer devices, such as smartphones and tablet computers where high quality sound is required but physical space is constrained. It is the world's first miniature speaker featuring advanced silicon membrane technology optimised for extended low frequencies. The result is superior bass performance over that expected from such a small device.

Premium ZIMO decoders have special on-board circuitry, described as an 'electronic flywheel', to manage capacitors used as external power supplies. These are the stay alive energy storage capacitors already included on the model's PCB (or the replacement SC68 supercapacitor upgrade). Once the decoder is attached, via the PluX connection, it does all the charging and monitoring automatically.

ZIMO's 'Smart Stop' system is unique and highly sophisticated. It is designed to avoid stopping on an electrically 'dead' spot. As the loco is slowing down, just before it stops completely, the decoder monitors the availability of power from the track. If it detects poor supply - a speck of dirt for example - it prevents a final stop. Instead it keeps the loco moving at minimal speed, using power from the connected capacitors if necessary. The track conditions are continuously assessed and as soon as favourable power conditions return, the decoder will stop the loco. The capacitors will be recharged during the dormant period ready to supply power again when required. These movements are very small and the monitoring so frequent that under normal operation it is almost impossible to see it happening. However, it has the potential to transform running characteristics and provide reliable starting in less than perfect conditions.

The system should not be regarded as an alternative to good permanent way cleaning and maintenance, but it can be a real help if the wheels are not entirely clean or the trackwork is uneven. The circuit assists in preventing unscheduled stops, sound interruption and flickering lights. It can make the difference between successfully crossing a dead frog or stalling on the points.

METCALFE-OERLIKON

MODERN BRAKE EQUIPMENT

1160 H.P. Type '2' Diesel-Electric Locomotives.

Built by the Derby, Crewe and Darlington works of the B.T.C.

More than 100 of these locomotives are to be supplied with Sulzer Engines and B.T.H. Power Equipment.

Metcalfe-Oerlikon brakes are also fitted



1160 H.P. Type '2' Diesel-Electric Locomotives.

Built by the Birmingham Railway Carriage & Wagon Co. Limited.

47 of these locomotives have Sulzer Engines and Crompton Parkinson Power Equipment. Metcalfe-Oerlikon brakes are also fitted.

1100 H.P. Type '2' Diesel-Electric Locomotives.

Built by the North British Locomotive Company Ltd.

They have N.B.L. / M.A.N. Diesel Engines and General Electric Company Power Equipment.

Metcalfe-Oerlikon brakes are also fitted to 38 of these.



The above are just three of the many types of Main Line Diesel-Electric Locomotives now in service with British Railways and all are equipped with 'Metcalfe-Oerlikon' patent Vacuum Controlled Air Brake Equipment.

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How a real locomotive operates

To simulate the sounds of a diesel-electric locomotive successfully, you will need some idea of how and why they sound as they do. The most important aspect to know is that the diesel engine itself does not propel the loco directly. The engine drives a generator, which provides the electrical power for the traction motors. It is these electric motors that actually turn the wheels via gears. This means there is no linear correlation between diesel engine speed (or sound) and track speed, and explains why some models sound so unrealistic.

For example, with engine idling, there is sufficient power to move a light locomotive (without train). Releasing the brakes is often all that would be needed to move off. Put a few hundred tons on the hook, and the loco will need a lot more power to get its train moving, even slowly. That's two different 'power' sounds needed for the same speed. Now imagine a heavy train on an upward incline. It may be going slowly, even decelerating, but the engine will be providing maximum power. On the descending gradient, the engine may well be at idle, with the loco travelling at speed or even accelerating, effectively being pushed downhill by the weight of the train behind it.

In the real world, these effects are created by gravity, mass and inertia. In the 'model world', sound projects have to simulate them. We have gone to great lengths to bring you the correct sounds and necessary controls to get as close as possible. It's now down to your skill and knowledge to simulate any eventuality!

Prototypical brake application

On a real locomotive, acceleration, speed and deceleration are under control of the driver. He will use his experience of the locomotive type, the train weight and knowledge of the route to anticipate the control movements required to achieve the required performance and safety. Deceleration is often achieved by reducing power only, allowing the locomotive to 'coast' down to lower speeds. Typically, the brakes are only used to fine tune this rate of deceleration or make a halt at a specific point. At other times, strong braking will be required, even at high speed, such as in an emergency brake application.

A feature notably lacking in all other programmable decoder brands with British sounds, is the ability to apply a variable braking force to increase the rate of deceleration when desired. This makes stopping a heavy train at a signal or station platform more difficult than it is on a real loco. Without brake force, the locomotive's dynamics are only partially modelled. There is no point in having the sound of brakes being applied if the rate of deceleration is unaffected!

Working closely with the decoder manufacturer's software engineers, we have designed and incorporated a revolutionary new 'Brake Force' feature. The objective is to simulate the real driving experience as closely as possible. It will require you to

change your DCC driving technique but has the feeling of 'putting you straight in the driver's seat'! Here's how it works:

For optimum control and convenience, the feature needs to be assigned to a non-latching (or momentary) F-button. On many non-European designed DCC controllers, the only momentary button is **F2**. Some, like NCE PowerCab have a designated separate key which operates **F2** from a dedicated Horn/Whistle button. The sound project has been constructed to take these limitations into account, so the Horn/Whistle button becomes the Brake Key. (Don't worry, the horn will not blow when you brake!). Other brands, such as Lenz, allow you select the type of operation - latching or momentary - for each F-button, for each locomotive.

With the locomotive running at mid-speed, reduce the throttle (speed step) setting to zero. The loco will slowly begin to decelerate and the engine sounds will spool down directly to idle. Next, make a brake application with **F2**. A short 'dab' will produce a short air release sound and a modest increase in deceleration. You can think of this as 'speed trimming'. This can be repeated if required, and is entirely prototypical in operation. A longer application will produce a longer air release sound and a slightly greater rate of deceleration.

Holding the **F2** button down will produce a long air release sound and the loco will perform an emergency stop. In other words, brake force increases with time and maximum deceleration rate is achieved immediately prior to coming to a halt. Automatic brake squeal will accompany the final moments before halting. The button can also be used to simulate 'brake dump' testing when at a stand.

The brake may also be operated during deceleration between different speeds, for example approaching a speed restriction. In this case, reduce the throttle to required lower setting. The engine sound will change according to the features described earlier, so may result in a different power sound rather than engine idle (but you may wish to force coast using **F6**). To increase the rate of deceleration, use the **F2** brake as before, and the speed of the loco will be 'trimmed' to exactly the selected speed and not below. So there are now no excuses for a signal passed at danger or exceeding a speed restriction! Remember also that prior to first use of the day, and at anytime deemed necessary for safety, the effectiveness of a locomotive's brakes would be tested.

If **F2** is left on a 'latched' button, and left on by mistake, the engine sounds will respond to the use of the throttle, but the brake release sound will not play (as brakes have not been released) and the loco will not move since it is being 'held' by the brakes. This is a bit like trying to drive off in your car with the hand brake still applied!

Please note that real locomotives do not 'stop dead' even during an emergency stop. To reflect this, an emergency stop will be reasonably abrupt but not sudden. If your DCC controller is equipped with a 'panic button' to avert imminent catastrophe, this will still operate as usual, and will have more immediate effect than the brake button.

Special control features

We have included several special control features which you may use to modify the way the sound samples play. These may be used individually or in combination to provide greater realism and thus enhanced pleasure. You do not *need* to employ them as your model (as supplied) will simulate normal driving completely automatically, but we strongly recommend you at least try them. These features effectively render the old, cumbersome, 'manual notching' techniques obsolete.

MULTIPLE STARTING OPTIONS: The sound is switched on/off and the engine started and stopped with the **F1** button. Starting a real Class 24 from cold first requires the lubricating oil to be pressurised and the coolant circulated. An electric pump, called a 'combined pump set', performs these functions. Your decoder has the combined pump set sounds assigned to the **F14** button, which will operate prototypically with the engine sounds off. This allows you to choose when to use it and the required duration. You can then choose a 'cold' start, where the engine fires after a bit of cranking, or a quicker, 'warm' start where the engine fires immediately.

Cold start: Engage **F5** button before using **F1** to start the engine.

Warm start: Disengage **F5** before using **F1** to start the engine.

In both cases, after the engine has started engage or disengage **F5** depending on the driving style you wish to use (see 'light engine mode', overleaf). To simulate a failed start in either case above, operate **F1** then disengage it immediately.

THROTTLE RESPONSE: As supplied, the decoder will output the sounds of a Class 24 with a loaded train. After running the combined pump set and starting up, the loco will stand with the diesel engine ticking over at idle. The sounds will respond to the throttle control in the following way:

From standstill, increase to Speed Step 1 and the brakes will release, before the engine will power-up slightly to get the loco moving. With increasing Speed Steps, further ramp-ups in engine power will be initiated until the final high-speed running sounds begin. The transition points between power bands will depend upon your actual model. The sounds will spool-down at similar points on deceleration.

THROTTLE 'PLUS': A new feature, unique to ZIMO, has been incorporated.

Open the throttle gently... the engine note will rise and fall appropriately and the acceleration will simulate that of a heavy train.

Open the throttle more quickly... The engine will ramp-up to full power and the rate of acceleration will be increased accordingly.

With the throttle fully opened... (then reduced if required) the loco will accelerate three times more quickly than normal.

Never before has a sound project simulated the variety of driving styles so accurately.

COASTING TECHNIQUES: We've allocated **F6** as the 'Coast' button. With this single action you can dramatically affect the engine sounds being played. It will produce different effects depending upon the speed of the loco, including when it is stationary. When in motion, it will spool the engine sounds down to 'idle on' without affecting the track speed. Use this to simulate 'shutting-off' prior to slowing to a halt or for many other 'coasting' scenarios (for example, a heavy train on a downward grade). Release the button and sounds will increase in power, according to the speed currently selected.

Try leaving the **F6** button 'on' after the loco has halted, and keep it on even when driving off. The loco can now creep around with just an idling engine sound, great for pottering around the shed or yard. Release it after speed has built up, however, and the engine will instantly burst into higher power, the precise sound depending upon the track speed and the status of **F5** & **F7** buttons.

*Note: **F6** takes precedence in its influence over sounds; if engaged, it will always cause the engine sounds to remain at or spool down to 'idle'. However, it has no impact on inertia.*

There is also another way of 'coasting' without the need for any button presses. No matter what actual speed your model is travelling at, or which engine power sound is playing, reducing the throttle by 10 Speed Steps (of 128) will spool-down the engine to idle, whilst the loco will continue travelling with a gradually reducing speed. This coasting sound will continue until you accelerate; at which point the sounds will change to those relevant to the current speed.

NOTCHING-BACK POWER (STEP DOWN): In most circumstances, the driver of a locomotive will maintain the correct track speed by varying the engine power to match the load, gradient and signal indications. Sometimes this will be by 'coasting' with the engine at idle and at other times by just reducing the power to a lower level. Following the instructions outlined above will reliably simulate the former.

However, if instead of engine idling you would rather hear a slightly more powerful note, you can do so at any time by *decreasing* the current speed by just one step on your controller. The automatic ZIMO 'notch back' feature (sometimes known as step-down) will instantly transition the sound playing to the next lower power band. For example, if the loco is playing $\frac{3}{4}$ power sounds, reducing speed with your throttle by one Speed Step will cause the sound to immediately spool-down to the sound of $\frac{1}{2}$ power. If in $\frac{1}{4}$ power, it will spool down to idle. If you operate with 128 Speed Steps selected, this will be achieved *without any appreciable change in track speed*. (Continued deceleration will not give further changes in sound until the speed settings reaches the normal threshold which has been set in the project).

An *increase* of one Speed Step, or more, will immediately ramp the sound back up to the higher power. So, at any given speed, it is possible, to toggle between two power bands without perceptibly changing the speed. Talk about fine control!

LIGHT ENGINE MODE: Characteristics of an uncoupled or 'light' locomotive will be quite different from when it has a heavy train in tow. It will be capable of accelerating and decelerating much more quickly whilst the power required to accelerate and maintain speed will be significantly reduced. These changes cannot be successfully simulated simply by changing inertia settings which, in any case, would have to be adjusted when the loco is halted every time it deposited a train.

With a single press of **F5**, you can now alter the driving characteristics to that of 'light loco'. Inertia is automatically, reduced, the thresholds at which the sounds change are adjusted and the samples playing are amended. With small throttle increments the idle sound will be held for the first portion of driving, enabling slow yard movements (or similar) to be made without engine 'revs' increasing. Alternatively, large throttle movements will produce a ramp-up for a few seconds initially, after which the engine sounds will return to the level appropriate to the new speed.

This feature reduces inertia and momentum, as well as delaying automatic engine power increases until higher track speeds are reached. **F5** can be operated at any speed to give another way in which the engine sounds may be instantly modified.

*Note: This feature works best if you switch **F5** 'on' or 'off' whilst the engine sounds are playing in idle. Once switched, you can leave it that way, but any further change should also be made with the engine sound again playing the idle sound. Just to be clear, the actual speed is unimportant, but the engine sound must be idling. You can achieve this in several ways as discussed earlier.*

POWER HANDLE POSITIONS: In common with most British designs of locomotive, the Class 24 power handle does not have fixed power level positions or 'notches', but is continuously variable. There is, however, a tactile 'notch' to indicate selection of an 'on' position. There are also markings to show approximate power levels as follows:

OFF: In this position, the engine is idling only (and powering ancillaries etc.).

ON: Engaged prior to movement, this position connects the main generator to the traction motors. This additional load causes the idling engine note to speed-up very slightly to compensate. In layman's terms, the loco is now ready to move. Indeed, on level track, if the brakes were released, the loco could move slowly without additional power needing to be applied.

QUARTER: Approximately a quarter of the power available. This is typically enough to lift a light train on level track or for low-speed yard movements and shunting.

HALF: Approximately a half of total power. This is typically used for light trains on slightly adverse gradients, or to provide an acceleration surge

THREE-QUARTERS: Approximately three-quarters of total power available. This is enough to lift a heavy train on level track and the maximum normally required when running 'light engine'.

FULL: Everything available! Used to lift heavy trains and for brisk acceleration. May be required in any load condition on steep gradients to start off or maintain speed. The driver will use anticipation, his knowledge of the road and his driving experience to vary the position of the control lever to maintain the correct speed.

Despite what many enthusiasts believe, good driving practice requires relatively gentle movement of the power handle until FULL is reached. With a heavy train 'on the hook', a driver will always have one eye on the ammeter to prevent overloading.

To the outside observer, little of this is visible, but the engine sounds and exhaust note can be heard to vary greatly, irrespective of track speed. The power required (and therefore the engine note at any given speed) will vary depending upon gradient, loading, environmental factors, track conditions, signals and speed limits.

The **THROTTLE RESPONSE**, **THROTTLE 'PLUS'**, **COASTING** and **NOTCHING-BACK** features of this ZIMO decoder will enable you to simulate this behaviour in most circumstances simply by use of the throttle on your chosen DCC controller.

Since our aim is to provide you with the facility to simulate every eventuality, and to satisfy the needs of those who prefer full manual control, you will find that the power handle positions are replicated on a series of F-buttons. Please note that the use of these buttons is entirely at your discretion; the project will work correctly without their use at all, though the 'ON' position (**F7**) will add to the prototypical experience before moving off.

These are the F-buttons used. For correct operation, they each must be 'latched':

F7 = 'ON' **F23** = ¼ Power **F24** = ½ Power **F25** = ¾ Power **F26** = Full Power

Each button can be used in isolation. That is to say pressing **F24** will cause the engine sound to accelerate up to ½ Power in a single sweep and remain there. Disengaging it will cause the engine sound to spool down, in a single sweep, to idle. They can also be used progressively - activate **F23** to ramp-up to ¼ Power, followed by **F25** will transition engine sounds directly to ¾ Power and so on.

Because these actions are fully integrated into the driving scheme, it is possible to mix throttle and F-button controlled sounds if you wish. For example, you want the engine sound to ramp up to ½ Power and maintain that sound until the actual track speed of the loco requires a transition to ¾ Power. Engage **F24** and sound will transition to ½ Power. Drive the loco with your controller. When speed exceeds the internal threshold to trigger ¾ Power, the sound will automatically ramp-up.

Deceleration will cause the engine sound to spool down, but will hold steady at ½ Power unless **F24** is disengaged. Remember that 'Notch down' and 'Coasting' by use of the throttle remains active throughout, but any 'power handle' button will act as a floor beyond which the engine sounds will not drop.

TRAIN HEATING: Ever wondered what that diesel loco is doing on the end of a steam-hauled special? Or marshalled inside, behind another leading locomotive? A common reason was and is to provide train heating of the type required by the stock being hauled if the lead loco did not possess the correct equipment. In fact, this was a common occurrence when Class 24s were loaned to the Southern Region in the early 1960s, when they were employed as the only way to steam-heat coaching stock that was to be hauled by new Class 33s (equipped with electric train heat only).

You can simulate the use of your Class 24 in this way quite easily. You will need to speed match the loco with any other loco in the train, and use your preferred method of 'consisting' to operate them together. Your Class 24 will be providing motive power, of course, but it is possible to lock the engine sound in 'idle' to prevent it changing with speed or load. Before driving off, engage **F6**. By default, F6 plays the engine 'on' sound. If you wish to 'hold' a higher engine sound specifically for this role, change the value CV375 to 2, 3, 4, 5. For normal use, remember to revert back to the default setting, CV375 = 1. This method could be used to simulate the operation of the later Class 25 'ETHEL' units.

Two redundant Class 24s were actually converted to static carriage pre-heating units in 1976. The conversions saw the generator output used to provide an electric train heat supply via jumpers and cables. These departmental locos had their traction motors isolated, but obviously the engine needs be running to provide power. This method of static operation can be replicated using the manual power handle positions described on the previous page.

Global commands

LIGHTING: The main lighting switch (**F0**) has been programmed by default to reflect the most common working arrangement, i.e. when the locomotive is at the head of a train. This will show illuminated marker lights (white) behind the headcode discs in the direction of travel only. Tail lights (red) are switched off, since the rule book states there should always be an illuminated red lamp at the rear of the train. In contrast, light engine movements should show white markers to the front and red tail lights to the rear, and this arrangement is possible by selecting special lighting function **F21**. A third lighting function (**F22**) additionally allows the interior lighting to be operated in the cab facing in the forward direction.

SHUNTING MODE: Pressing **F20** will temporarily remove all inertia settings and reduce speed by up to one half and is great for precise control during shunting. Release the button to immediately restore normal operation.

LIVE VOLUME CONTROL: This new feature replaces the mute button and gives you the ability to adjust the sound level coming from your model without the requirement to go into programming mode and adjust CVs. The live volume control should only be

used when the main engine sounds (**F1**) are running. **F27** & **F28** are the Down and Up buttons. Hold the relevant button until you are satisfied with the sound output. They can also be used to reduced levels in fiddle yards, or if your telephone rings! It's best not to have the sound cranked up at maximum, and always remember when you have reduced the sound to zero and cannot think why your model is silent.

Practical applications

We've given you a lot to think about, so here's some scenarios and guidance for you to practice using these features...

Scenario 1: Driver's checks and start-up

Imagine your driver has 'signed on' for work, read his notices and has been allocated his locomotive for the day. At the shed or stabling point, after finding his loco, he must first conduct 'preparation duties' before it can be started-up. These include making a visual inspection, connecting the starting batteries and then undertaking a series of specified checks. Sounds for these are included so you can enjoy the 'full experience' but are manually controlled and therefore optional. The sequences are accurate, but time has been compressed to reduce their duration.

Operating **F10** will provide the sound of the exterior BIS (battery isolating switch) panel being accessed, a distant bell ding as the batteries and a click as the lighting circuits are switched in. The clatter of the cabinet door being swung closed and locked completes the effect. After opening the cab door (**F11 on**), then slamming it shut (**F11 off**), begin the start-up sequence with **F12 on**. The driver can be heard inserting his key into and unlocking the master controller and opening the cabside window. After the 'clunk' indicating the movement of master handle to the 'engine only' position, the combined pump set would start and run (**F13 on**) until the lubricating oil pressure was sufficient, usually about one minute. The AWS system is also activated before cancellation of its warning horn. Switch **F13 off** and activate **F5** before starting the engine with **F1**. (In reality, the pump set would continue to run but this sound would not be heard over the exhaust, and it uses up a valuable sound channel). Using **F5** before **F1** will initiate a cold, prolonged, start and put the loco into 'light engine' mode.

When the engine has fired and reached a steady idle, further procedures would be undertaken. **F12 off** will play a fire alarm bell test and **F14** gives the hand brake wheel being released. Because these sounds can be difficult to hear over the engine, you may wish (for play value) to press **F12 on** and **off** and wait for the sequence to complete, and release the hand brake (**F14**) before running the pump (**F13**) and starting (**F1**).

As you will notice, some function buttons will produce one sound when switched on, and a different, but complementary, sound when switched off. For example **F11** 'on' will play the sound of the cab door being opened. Switch it 'off' and you will hear the door being shut. You can, therefore, vary the time during which the door is 'open'.

Scenario 2: Light engine movements and a heavy loose-coupled freight train

Imagine a locomotive having been checked over and started-up 'on shed' ready to leave for the day's duties. The first action is to manoeuvre quietly 'light engine' from the depot over to the sidings to pick up its train (you decide the constituents, but make it heavy). It then struggles away with its heavy train, engine roaring. It traverses your layout, the engine note rising and falling as it adapts to the environment until it reaches its destination, uncouples and returns to shed alone.

This is how you can achieve realistic movement and sounds, assuming sound is on and the loco is ready to move: Engage **F5** (light engine mode), drive away slowly, adding one speed step at a time to move up to the train without the engine ramping-up. Perhaps using **F9** (flange squeal) as you drift over the depot throat pointwork. Perform your normal functions to couple up, using **F8** (buffering-up and coupling) to provide the sounds if you wish. Disengage **F5**. When you drive away now, inertia will increase and the engine will ramp up more quickly, then on to full power. Just as you pull away, initiate **F18** (coupling snatching). Use a combination of throttle movements, and **F6** (coast) to adjust track speed and power sounds. You could try **F27** (reduce volume) as the train enters a tunnel, pressing **F28** (increase volume) just as it emerges. Once the destination is reached, uncouple and engage **F5** again for the solo trip back home. On the return, open the throttle more quickly and the engine will ramp-up to accelerate the loco to main line speeds then automatically reduce to an appropriate level. Back at base, small throttle openings will allow you to negotiate the crossover from the main line into the depot at typically low speed with the engine just ticking over.

Scenario 3: Coming to a halt at a terminus station

Your train is coming to the end of its journey - a terminus station. The challenge is make the arrival and braking as comfortable as possible for the passengers. The requirement is to slow down for the speed limit on the approach pointwork and then come to a smooth, but controlled stop in front of the buffer stops without touching them (leaving enough room for uncoupling).

We have all heard (and seen) models brought to a halt hard up against the stops with their engines still running at full thrash. To avoid this unrealistic behaviour, do as a real driver would, and anticipating coming to a halt. On the approach, depress the **F6** (coast) button to reduce engine sounds to idle to simulate the driver shutting off power under caution signals. At the same time, reduce the speed step setting, and (manually) dab the brakes (**F2**) to the match the speed limit on the run-in. If crossing over complex pointwork, a little flange squeal (**F9**) would not go amiss, perhaps with a warning 'pip' on the horn (**F3**) to notify any permanent-way staff of your presence. With the platform and buffer-stops coming into view, take the speed control quickly down to zero and mix normal deceleration with further brake applications (**F2**), judging carefully how long the brake needs to be applied without spilling the coffee! Come to a stand with the engine ticking over. Once the passengers have departed,

uncouple (**F8**) from the stock, press **F6 off** to simulate the power handle being moved to off, and then shutdown the engine (**F1 off**). The combined pump **F13** should be allowed to run for a short while whilst the hand brake is applied **F14**. Then its home for tea, with the cab door **F11** being opened and closed.

Scenario 4: Pulling away from a signal check (on a basic 28 speed step setting).

You are on a train, held at a caution signal. The signal clears and you need to apply power to get the train moving again. Not knowing what the next aspect will be, you want just to overcome the rolling resistance of the train and ease back on power ready to make your next driving decision.

This action demonstrates the ease and simplicity of using our sound project, reflecting the fact that it is not essential to employ 128 Speed Steps (although recommended) and you don't have to get into intricacies if you don't want to. With your train stopped at the signal, simply and quickly apply 7 Speed Steps on the throttle, as soon as the signal changes, and leave the speed there. The loco will power up, the train will begin to move, and once rolling along steadily, the engine power will automatically spool down. All this is accomplished 'automatically' with just one input to the handset.

We love these features, especially in combination, and we're confident that you will enjoy the realism they can provide. Of course, you can learn a lot by experimentation, and develop your own techniques. If you find a new way to utilise the buttons, we would very much like to hear about it.

Some useful suggestions

User choice and variety is why we made the sounds so versatile in the first place so we don't want to dictate how you use your model. However, because this project is such a radical departure from anything previously offered, a few suggestions and recommendations are offered here.

We strongly suggest that you only consider changing CV1 & CV29 until you become familiar with all the nuances and features of your new model. More importantly, do not assume that any given CV will have the same effect as with other decoder brands – many are ZIMO specific.

The model is delivered with its locomotive identity/decoder address (CV1) set to 3. Typically, your DCC controller will allow you to change this to something more suited (For example, the last three or four digits of the running number).

CV29 is set to 6 to allow for both digital and analogue operation. If you will not be using conventional control at all, we recommend changing the value of CV29 to 2. This can enhance integrity of the DCC signal and avoid possible 'runaway trains'.

DCC systems and handsets vary in specification, some allowing function buttons to be allocated as 'momentary' actions as an alternative to 'latching' switches. If this

feature is available it is worth changing some functions to momentary for extra play value and thus giving much finer control over things like horn sounding duration and buffering-up/coupling noises.

Careful consideration has gone into planning the function button assignments in this highly specified sound project. Whilst the main sounds and actions have been kept to lower numbered functions, it has been designed to use *all* available buttons (F0 to F28) as per NMRA standards. Systems with access to all buttons include ZIMO, NCE PowerCab, Lenz v3.6, Hornby Elite, Gaugemaster Prodigy, later ESU ECoS)

If your DCC command station is lesser specified and is unable to access buttons above **F20**, then you will not be able to operate the tail lights or cab interior lighting. Here are some work-arounds if you require these lamps illuminated. CV436 = 29 will put the front markers and tail lamps on together (at opposite ends and directionally controlled). To switch them all on or off use **F0**. To revert to front markers only, set CV436 = 21. For cab lighting, make CV159 = 60, CV160 = 60 & CV454 = 29. This will set the cab lights to come on whenever the marker lights are switched on, and will change ends when the direction change button is activated. To compensate for the fact that you do not have full control of the cab lights, they will only illuminate when the loco is stationary. As soon as the throttle (speed step) is greater than zero, they will extinguish. If the marker lights are 'on' when the locomotive comes to a halt, the cab lights will illuminate automatically.

Analogue sound operation (running on DC)

It is a shame to start with a warning, but it is vitally important. Out of the box, your ZIMO sound-fitted model is configured to run on 12V direct current if required. ***All DCC decoders are susceptible to damage if exposed to high frequency track cleaners (e.g. Relco).*** Operation may also be erratic if PWM or Feedback type controllers are in use. For the safety of your decoder, ensure that the track is fed only with a pure DC supply.

The sound will commence or be maintained at around 5V, whilst the motor will require a little more to start. By subtle use of the controller, you may, therefore, have sound playing (and lights) without any movement. Increasing voltage will increase engine power sounds and vice versa. Automatic and random sounds will play, but you will not be able to initiate any sound that requires the use of a function button. The decoder is also set to operate on DC using inertia and back-EMF speed regulation.

11. Function button list

To make DCC sound operation as simple as possible, we've divided the DCC functions up into three distinct groups, and kept them in a natural sequence of events, which also avoids too much jumping around when using controllers that can access a limited number of keys at any one time.

Essential driving controls and common sounds

Function Button	Function or Sound	Button Type*	Volume CV	Sound CV	Sound ID
F0	Master lighting switch	L	571	570	42
F1 ON	Engine start-up	L	-	-	-
F1 OFF	Engine shut-down (or failed start)				
F2	Active brake application	M	517	516	28
F3	Low tone warning horn (playable duration)	M	520	519	25
F4	Two-tone warning horn	M	523	522	22
F5	Light engine mode (and cold start option)	L	-	-	-
F6	Coast	L	-	-	-
F7	Power handle to 'on' (manual power band)	L	-	-	-
F8 ON	Buffering-up	L	535	534	31
F8 OFF	Coupling thrown over hook				
F9	Flange squeal (playable duration)	M	538	537	35

Ancillary locomotive and environmental sounds

F10 ON	Battery isolating switch cabinet opened	L	541	540	27
F10 OFF	Battery isolating switch cabinet closed				
F11 ON	Cab door being opened	L	544	543	40
F11 OFF	Cab door slammed close				
F12 ON	Driver's pre-starting checks	L	547	546	30
F12 OFF	Driver's post-starting checks (inc. fire bell test)				
F13	Combined-pump set running	L	550	549	44
F14	Handbrake wheel winding on (or off)	M	553	552	36

F15 ON	Steam heat boiler effect (leaking steam pipes)	L	556	555	39
F15 OFF	Steam heat boiler effect (safety valve release)				
F16	Guard to driver instructions <i>The default instructions are for a passenger train. For freight train instructions, set CV558 = 45</i>	M	559	558	20
F17	Platform staff/guard despatch whistle	M	561	562	33
F18	Loose-coupled wagons snatching	M	565	564	41
F19	Detonators exploding (under deceleration)	M	568	567	32

Lighting options, manual power bands and volume control

F20	Shunt mode (half speed, no inertia)	L	-	-	-
F21	Tail lights (directional for light engine)	L	677	676	42
F22	Cab interior/engine room lights (directional)	L	680	679	42
F23	Power handle to ¼	L	-	-	-
F24	Power handle to ½	L	-	-	-
F25	Power handle to ¾	L	-	-	-
F26	Power handle to 'full'	L	-	-	-
F27	Live volume control - Decrease	M	-	-	-
F28	Live volume control - Increase	M	-	-	-

Input 1 Flange squeal (if triggered by decoder switch input)

The following random/timed sounds will play whilst the locomotive is in motion: Compressor and Exhauster noise; Radiator scavenger fan; AWS bell

* *Button Type: Preferred form of function button operation (can be set individually for each locomotive address by major DCC command stations) L = Latched, M = Momentary.*

12. Troubleshooting for digital operation

The ZIMO sound decoder used in this locomotive is extremely robust and includes thermal cut-outs and overload protection on all outputs. However they are not immune to damage, so please avoid making changes or re-wiring unless you are confident or experienced. For the novice, there are some things which may appear to be a fault but which can be remedied after a few checks. Please refer, in the first instance, to the table on the next page.

Resetting the decoder

With so many CVs, which may be changed to customise your model, it is possible that undesired results might inadvertently occur, or the sounds behave oddly. It is normally simple to undo these programming errors but sometimes, especially if you have made multiple CV changes, it is more difficult. Use CV8 = 8 to reset the entire project back to how it was supplied by us. This will preserve all the sounds held onboard. Any CV changes you have subsequently made will be lost. This includes loco address or ID, which will be reset to 3, and any changes to global or individual sound levels.

Changing CVs

The precise sequence of keystrokes will depend upon your DCC controller, but there are two types of what is commonly called 'CV programming'.

SERVICE MODE programming requires the use of a dedicated section of track occupied by one loco at a time. As this does not require the loco ID to be entered, it is the usual method used to set the address. Switching to this mode usually 'cycles' the power to the loco automatically.

PROGRAMMING ON THE MAIN or POM is exactly as the name suggests. It requires entry of the locomotive address to avoid accidentally reprogramming all the locos on the layout. It does not interfere with normal running of the layout so can be used to make changes 'in real time'. However, it does not cut or 'cycle' power to the reprogrammed loco.

Both of these methods have their advantages, but some CV changes are only 'saved' or put into action when the decoder 'reboots'. This requires the power to be cycled (switched off and on). If you use POM exclusively, please be aware that for some DCC controllers and some CV changes to be effected, you will need to cut the power to the decoder. Usually tilting the loco to one side, so it breaks contact with the rails for a few seconds, will suffice.

For more information on common CVs, please download the 'Small Decoder Manual' from here: http://www.zimo.at/web2010/documents/MX-KleineDecoder_E.pdf

Symptom	Possible reason	Solution
Movement but no sound	Sound switched off	Press <u>F1</u>
	Live volume too low	Press <u>F28</u>
	Volume at zero	CV266 = 120
	Speaker faulty	Contact RAIL EXCLUSIVE
	Decoder faulty	Contact RAIL EXCLUSIVE
Sound but no movement	Zero speed steps selected	Increase throttle
	Motor/Transmission retarded	Inspect for obstructions and clear as appropriate
	Motor/Transmission faulty	Contact RAIL EXCLUSIVE
No sound or movement	Incorrect Loco ID in use (especially common after a reset, CV8 = 8)	Select the correct loco ID (Ships from factory as ID 3, Defaults to 3 after a reset)
	Dirty track, wheels or electrical pick-ups	Inspect and clean all contact points as required
	Electrically dead portion of track including deliberately isolated sections and 'insulfrog' type points	Check for electrical continuity and reinstate as required
	Power supply disconnected	Connect power supply
	DCC controller not switched on	Switch on DCC controller
	Track power disconnected	Check for breaks or damage to track wiring and repair as required
CV change not effected	Decoder or loco faulty	Contact RAIL EXCLUSIVE
	Incorrect or 'out of range' value selected	Retry using correct value within acceptable range. Refer to the ZIMO 'Small Decoder Manual'
	Some changes require the loco power to be 'cycled' before they become active	Lift all power-collecting wheels on one side clear of the track, then replace. Tilting the body is usually all that is required or Cut power to the track or Turn off power at socket

13. Spare parts and enhancements

We hold a stock of spares to cover for possible breakages, loss or worn-out parts. Requests for spares should be directed to: slw@railexclusive.com. Alternatively, call us on 01780 470086, or write to the address given opposite.

Where damage has been incurred, we will supply the new replacement part free of charge on receipt of the original part. Other parts will be made available for a small charge including postage. With over 350 components in each model it is not practical to list each and every item. If you need help identifying parts or having trouble with disassembly please do not hesitate to contact us.

The following enhancement packs are made available for sale separately:

SOUND UPGRADE KIT: To convert the standard DC (analogue) model to full DCC sound specification. Comprises a MX645 PluX22e sound decoder pre-loaded with our bespoke Class 24 sound project and two SLW 'Dumbo' smartphone speakers with wired 2-way JST sockets (for direct connection to the PCB mounted plugs). Note: This kit is not compatible with any other model. £100 + free (tracked delivery) P&P to existing customers of analogue Class 24s only.

SUPER-CAPACITOR UPGRADE KIT: To upgrade the DCC sound model to enhanced stay-alive capability of approximately 1.5 seconds to avoid sound drop-outs, light flicker and stalling on less than perfect trackwork. Comprises SC68 6800µf compact super-capacitor. Pre-wired for installation. Requires soldering. £30 + free P&P.

HALL DEVICE KIT: To magnetically trigger further sound function via the decoder's switch input connections. Comprises a Hall device, two 6mm diameter neodymium magnets and a 200mm length of colour-coded wiring terminating in a 3-way JST socket (for direct connection to PCB mounted plug). Requires soldering. £10 + free P&P to existing customers only.

REPLACEMENT WHEELSETS: A pack of four drop-in wheelsets for 'OO', 'EM' or 'P4' gauge (please specify at time of ordering). Steel 2mm diameter axles fitted with RP25-110 or 'P4' profile insulated wheels, brass bushed bearings and toothed gear wheel for SLW gearbox. £20 + free P&P.

TYNE DOCK DETAIL KIT: Plastic parts to convert water tank (boiler)-fitted standard release model to Tyne Dock specification. Comprises a pair of high and low level air pipes for each end, two battery boxes without location pins and battery box support moulding. £7.50 + free P&P.

ETCHED WORKSPATES: A pair of painted and polished photo-etched stainless steel workspates (and shedplates where appropriate) for placing over printed detail. £1.00 + free P&P or, FOC to existing customers of Class 24 models, on receipt of SSAE.

14. Warranty and statutory information

SLW/RAIL EXCLUSIVE guarantees (to the original purchaser) this model locomotive to be free from defective materials or workmanship during a six month period from date of purchase. Under these terms, the product will be repaired or replaced, at our discretion, without charge for parts or labour, when returned. This guarantee does not cover defects caused by damage or misuse, abnormal service or handling, including incorrect maintenance, nor any product whose exterior has been damaged or defaced, nor to any product altered or repaired by other than SLW/RE.

This guarantee does not affect your statutory rights as a purchaser under the 'Sale of Goods Act'. SLW/RE cannot be held responsible for any consequential damages arising from this product. This shall be the exclusive written guarantee to the original purchaser and neither this guarantee nor any other guarantee, expressed or implied, shall extend beyond the period of time given above.

We will endeavour to provide customer support and goodwill for as long as possible beyond the initial period, and do everything within our power to resolve any issues and ensure this model provides you with years of reliable service.

CONTACT ADDRESS:

Sutton's Locomotive Workshop, RAIL EXCLUSIVE,
20 Park Street, King's Cliffe, Northamptonshire, PE8 6XN
Great Britain.

TELEPHONE, WEBSITE & E-MAIL ADDRESS:

Tel: 01780 470086 Web: www.sulzertype2.com
E-mail: slw@railexclusive.com

SAFETY:

This model is not a toy. It is not for use by children (under 14 years of age) as small parts may become detached and present a choking hazard. Metal parts may have sharp edges and should be handled with care. Retain packaging for future reference.

RECYCLING:

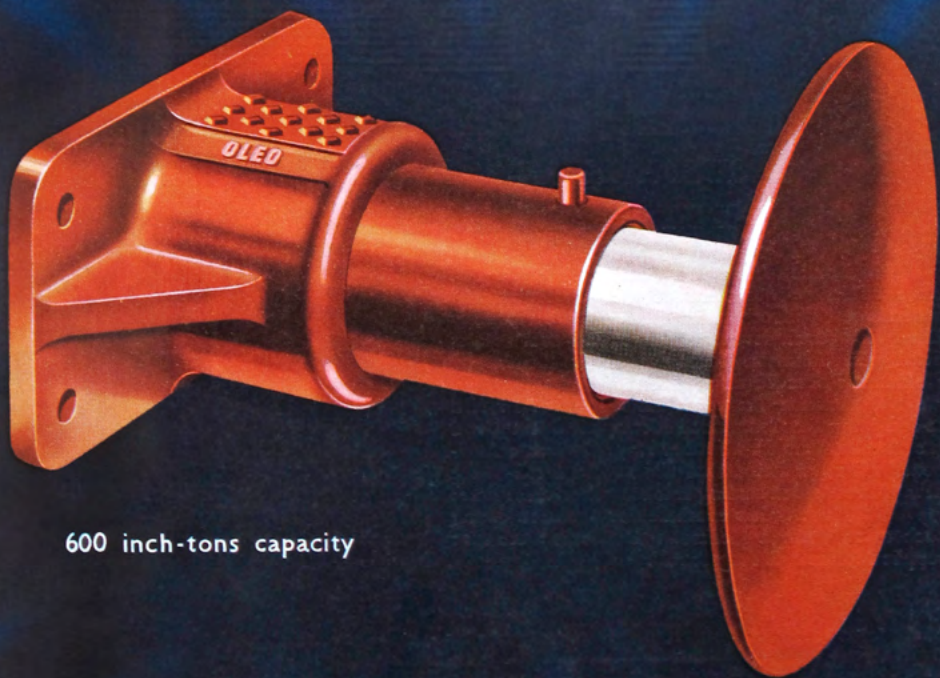
Metal box is widely recycled. Model contains electronic components that should be disposed of outside of normal waste arrangements (WEEE directive).

RESEARCHED & DESIGNED in Great Britain.

MANUFACTURED & ASSEMBLED in China.



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