SMOKE WITHOUT FIRE

THE OLD PROVERB says there's no smoke without fire – but if that's true, how do we get smoke from model railway smoke generators? Well, actually of course, we don't. Like all smoke and mirrors, it's an illusion.

First a word of caution. By their very nature, smoke generators produce localised high temperatures. Incorrectly fitted or operated units can easily melt plastic locomotive bodies. Follow the manufacturer's instructions on fitting and safety to the letter and you won't have any problems.

The basic principle employed is fairly low-tech. In its simplest form, an electric element is contained within a vessel that has an opening at the end of a tube. The lower body of the vessel may be widened to increase capacity in this reservoir. When a current is passed through this element it gets very hot, and the special proprietary liquid around the element evaporates into a gas which looks like smoke. This doesn't come free: it takes a great deal of power (in model railway terms) to produce this temperature rise, and the heat generated will dissipate by the easiest route.

Before any current is applied, the 'smoke' fluid must be loaded into the reservoir to ensure the element doesn't overheat.

When power is supplied, the heat from the element will be transferred to the fluid. When its boiling point is reached it will produce a gas that expands out of the opening. The volume of gas will depend on the design of the unit, the amount of current supplied and the fluid used. This is manufactured with a blend of ingredients designed to produce minute droplets which are carried out as a 'cloudy' emulsion which gives the characteristic grey/white 'smoke'.

As this expands and escapes it takes away a lot of the heat that may otherwise melt your locomotive.

Which control system?

The heating element is essentially a bit of coiled resistance wire. Any AC or DC current of the required value will make it work correctly. The problems arise when the fluid is used up. Without the cooling effect, there will be a rapid build up of heat. This will eventually either burn out the element, melt your plastic locomotive body, or both!

At an exhibition one DC layout operator told me that replacing melted chimneys is the price you pay for running smoke. Interestingly, the same chap emphatically said that DCC and smoke generators do not mix because you can't turn them off.

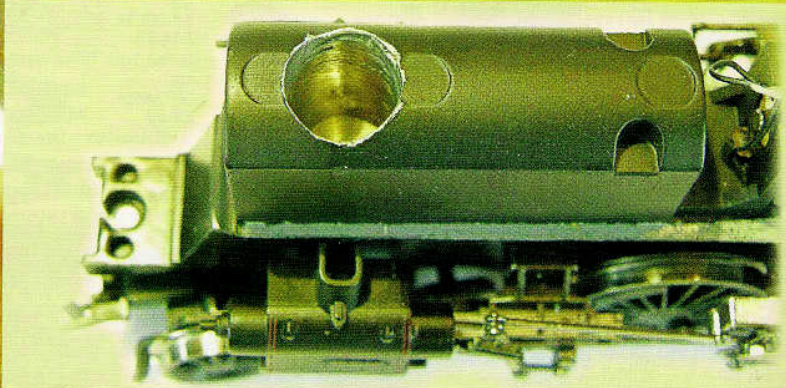
In my experience, neither of those statements is true. Provided all precautions are taken and the decoder you employ is up to the job, DCC is ideal for smoke. The Zimo MX640 decoder used in this project can supply up to 800mA to any function output; more than enough for the usual requirements (in the order of 120mA). However, note that some decoders have an upper limit of just 100mA.

The unit can be switched on and off manually whilst in motion. The MX640 allows you to specify a set period of operation, after which it will automatically shut the generator off. This is ideal when you are operating several locomotives concurrently as it protects your equipment if you forget.

The MX640's functionality doesn't stop there. You can specify, by CVs, the amount of smoke generated at idle, steady speed and during acceleration. If you are fortunate enough to have a fan assisted smoke generator and the space available to fit it, this remarkable Zimo decoder will also allow you to synchronise the 'puffs' with the 'chuffs'!

STEP BY STEP INSTALLING A SEUTHE SMOKE GENERATOR

1 The first stage with this part of the project is to separate the body from the chassis as detailed in the manufacturer's instructions. With this done the moulded chimney needs to be opened out to accept the smoke generator. Do this slowly and carefully removing only a small amount of material at a time. Constantly test fit the smoke generator until it is a snug fit inside.



2 Next a 9.5mm hole needs to be created in the cast metal weight at the front of the chassis. This is best done in stages, but handily there is a pre-drilled hole for a screw head exactly where you need to drill down through the casting on this model. Work in stages, starting with a 4mm drill, then 6mm drill, then 8mm drill to open out the hole for the generator to sit in.

PLEASE TURN FOR STEPS 3-

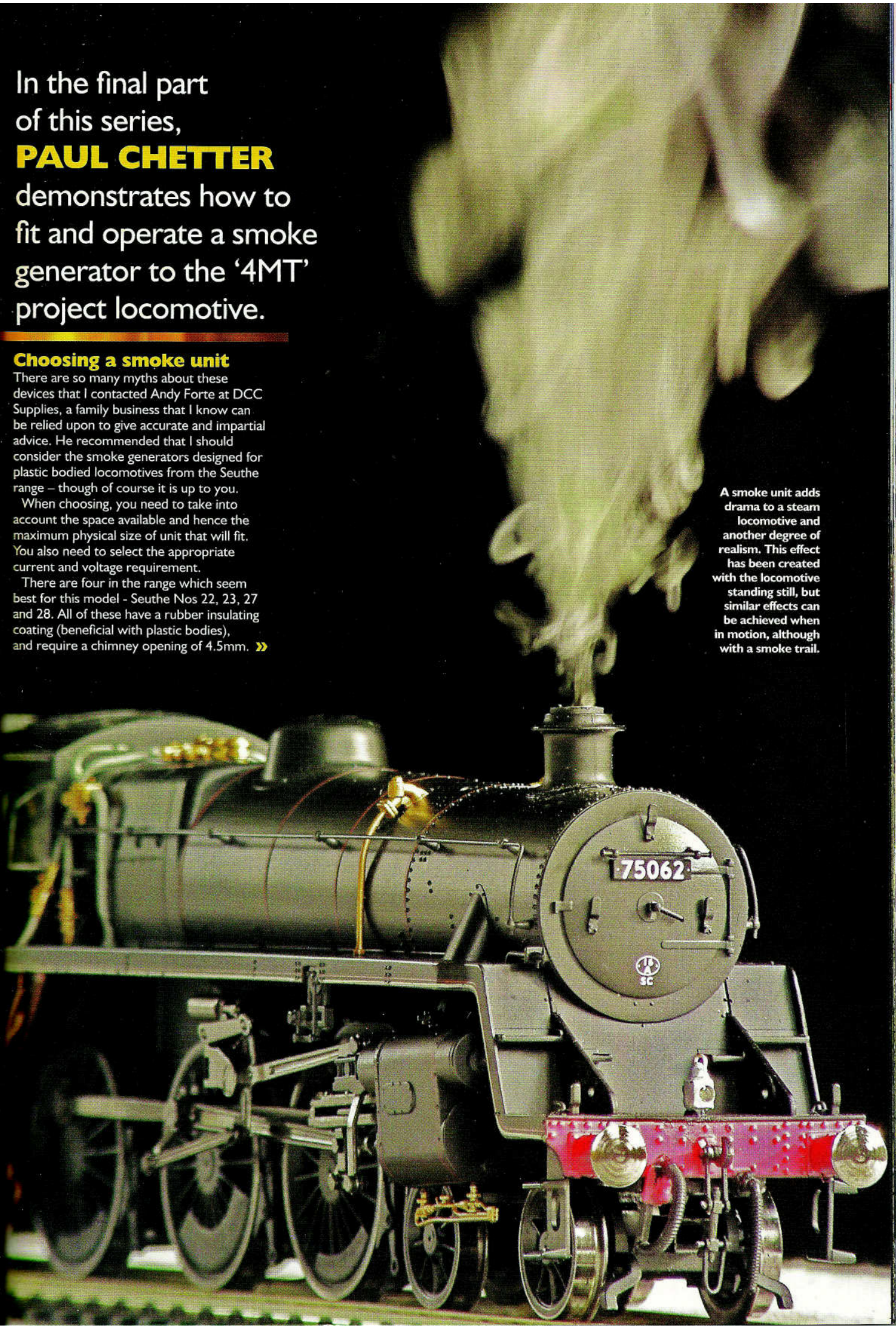
In the final part of this series, **PAUL CHETTER** demonstrates how to fit and operate a smoke generator to the '4MT' project locomotive.

Choosing a smoke unit

There are so many myths about these devices that I contacted Andy Forte at DCC Supplies, a family business that I know can be relied upon to give accurate and impartial advice. He recommended that I should consider the smoke generators designed for plastic bodied locomotives from the Seuthe range – though of course it is up to you.

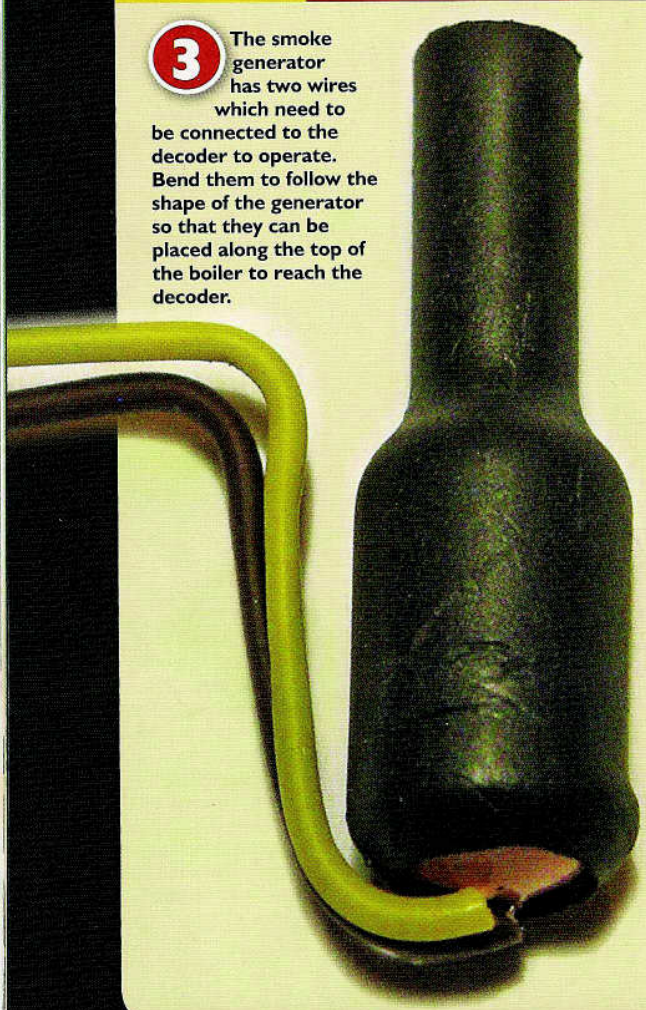
When choosing, you need to take into account the space available and hence the maximum physical size of unit that will fit. You also need to select the appropriate current and voltage requirement.

There are four in the range which seem best for this model - Seuthe Nos 22, 23, 27 and 28. All of these have a rubber insulating coating (beneficial with plastic bodies), and require a chimney opening of 4.5mm. »

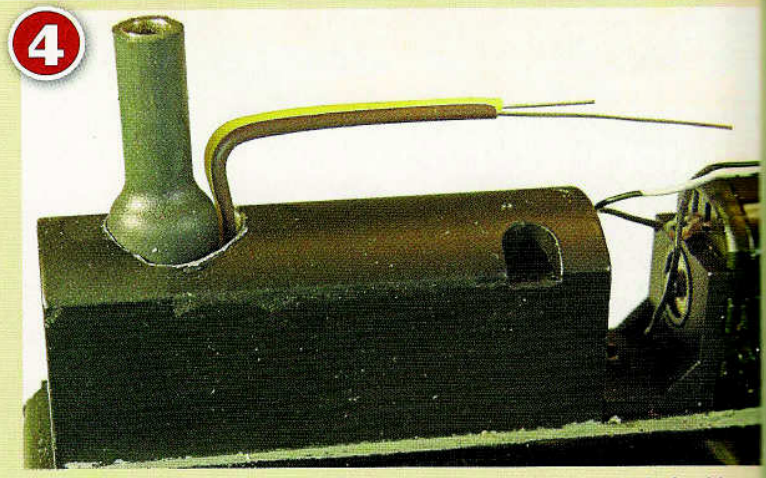


A smoke unit adds drama to a steam locomotive and another degree of realism. This effect has been created with the locomotive standing still, but similar effects can be achieved when in motion, although with a smoke trail.

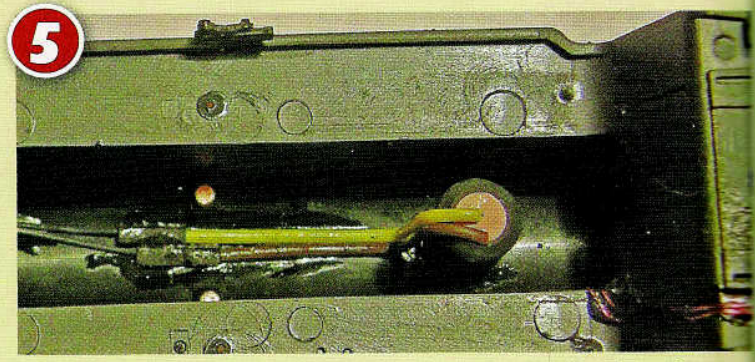
STEP BY STEP INSTALLING A SEUTHE SMOKE GENERATOR



3 The smoke generator has two wires which need to be connected to the decoder to operate. Bend them to follow the shape of the generator so that they can be placed along the top of the boiler to reach the decoder.



4 Test fitting the smoke generator is an important step and one which should not be missed out. This ensures that everything fits as it should before committing to the final installation.



5 Once you are satisfied that everything will fit back together glue the smoke generator into the chimney of the locomotive body with an epoxy resin and allow to harden. Glue the wires in place too and create the connections to the decoder.

Numbers 27 and 28 are short versions of 22 and 23 respectively, so they have smaller fluid reservoirs.

Numbers 22 and 27 operate on a voltage range of 10v to 16v, with a current of 120mA whilst numbers 23 and 28 require 16v to 22v and draw 70mA.

Numbers 23 and 28 are often recommended for DCC, but I don't entirely agree. It depends on your decoder and control equipment.

The lower current requirement of 70mA would suggest that it would be better suited to more modest decoders with limited function output values. However, a given amount of heat requires a given amount of power. If the current is lower, the voltage must increase to compensate. This is reflected in the higher quoted operating voltages.

Not all DCC systems are able to supply these higher voltages, so performance will be poor. It is not unusual for DCC systems to run at 14v-15v.

Since the MX640 can effortlessly output the 120mA we would need, I elected to fit one of the low voltage models so that it could be used with any DCC system.

Number 27 would fit with the least amount of work, and may suit your needs. I felt the smaller fluid charge would mean filling up would be too frequent, so, I arrived at Seuthe Number 22 as my preferred choice.

Fitment

I really don't like carving up my expensive models, but some modification is inevitable in order to fit this unit into the Hornby '4MT'.

The first, fairly minor, operation is to increase the size of the chimney opening by a small amount. A round needle file will work as there is not much material to be removed. Check regularly until the neck of the smoke unit just slips in.

You will now need to make a blind hole towards the front of the chassis which is wide and deep enough to accommodate the base of the smoke unit and allow the connecting wires to emerge.

There is an existing narrow hole with a screw at the bottom in exactly the correct location, so you just need to widen it out to 9.5mm. This is not a job you should tackle free-hand. The metal is relatively soft and easy to work with sharp drills, but if they bind you could lose the skin off your hand or worse.

The best way is to use a pillar drill and vice. This gets your hand out of danger and gives full control of the process. You can strip the chassis completely, but I found that I was able to mask off the area so that any swarf from the drilling was kept away from the wheels and motion.

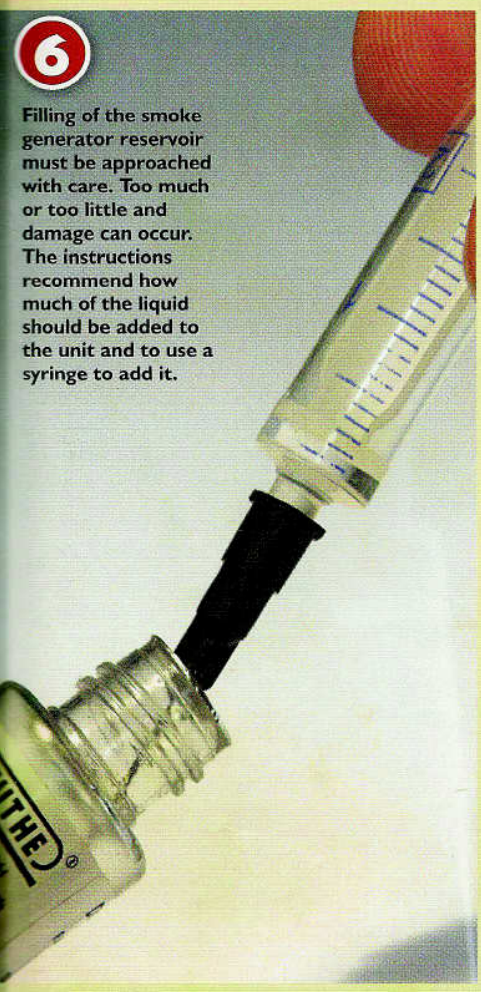
Centre the drill with the existing hole. Start with a drill bit just larger than this hole, and take out a thin layer all the way down to the bottom of the hole. You will feel the drill make contact with the screw head at the bottom. Stop drilling and use another bit, slightly larger than before. Repeat this until you have used a 9.5mm drill bit. The hole should now be wide enough for the smoke unit to fit with a little free play, with the wires running up from the bottom.

Connect the wires to your decoder

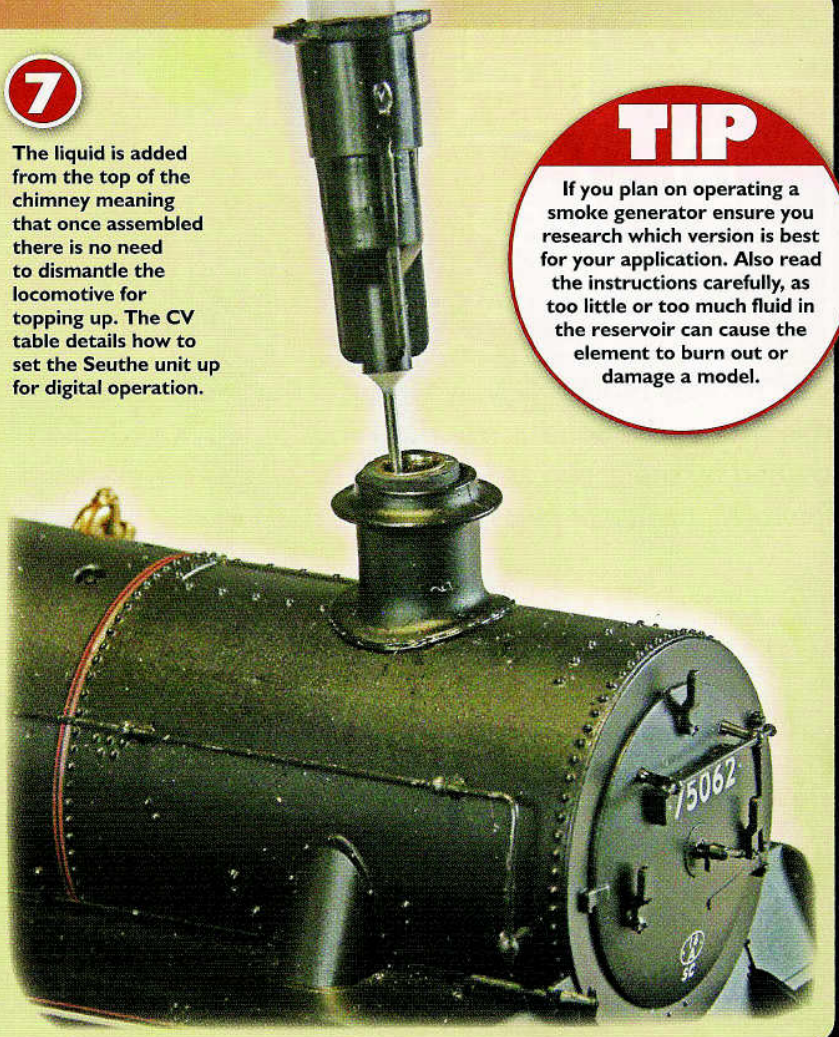
CV LIST

Set the following CVs to the value shown for the Zimo MX640D decoder. This will allow the smoke generator to switch on/off manually with function key 12 (F12). It will automatically shut down after 5 minutes if you leave it on by mistake.

CV Number	36	38	40	41	42	46	61	128
CV Value	0	0	4	0	0	8	97	64



6 Filling of the smoke generator reservoir must be approached with care. Too much or too little and damage can occur. The instructions recommend how much of the liquid should be added to the unit and to use a syringe to add it.



7 The liquid is added from the top of the chimney meaning that once assembled there is no need to dismantle the locomotive for topping up. The CV table details how to set the Seuthe unit up for digital operation.

TIP

If you plan on operating a smoke generator ensure you research which version is best for your application. Also read the instructions carefully, as too little or too much fluid in the reservoir can cause the element to burn out or damage a model.

according to the wiring diagram. In this instance I connected one wire to solder pad 15, common +ve (blue wire) and the other to pad 13, FO2 (brown wire).

Check that there will be no clearance problems during reassembly and once happy you can glue the smoke unit into the chimney using epoxy resin. Ensure that the top of the unit is flush with the top of the chimney. I found that the close fit meant I did not need to glue the unit in place in this case.

Reassemble the locomotive, making sure not to trap or damage any wiring, put it onto your track and set the CVs according to the list.

Operation

The smoke generator pack usually contains a small bottle of fluid and a syringe to 'fill' the reservoir. I use that term advisedly, because the last thing you want to do is literally fill it up.

If you put too much fluid in, the unit will not function correctly and you will most likely end up with a good proportion of it down your model or on the tracks.

Read the instructions carefully. Put the needle end into the fluid container and draw up 2ml into the syringe. Invert and squeeze out any air. Put the needle to the bottom of the reservoir, taking care not to damage the centrally located heating element. Express the fluid into the unit and retract the syringe.

The CVs listed will give a working setup with the Zimo MX640D, with a greater volume of smoke as speed increases, and automatic switch off after 10 minutes. Feel free to tweak to match your needs. All the information is available in the decoder manual. You are now ready to create smoke effects. Press function key 12 on your DCC controller to switch the function on and off. Function key 12 on most controllers will require a 'shift' action for access. I choose to put it here so that I do not start the smoke by unintentionally pressing any single keys. If this is inconvenient for you, simply remap using the decoder manual instructions.

These simple bulb type smoke units take a few seconds to warm up from cold. They also tend to produce a gentle 'pop' as the first gasses emerge. Do not be alarmed, this is normal operation.

The recommended smoke fluid is non-toxic. However, the smoke effect can linger for some time if there is no 'wind' to dissipate it. For this reason, and to reduce consumption of the fluid, I prefer to operate smoke only when the locomotive is visible.

There is no point wasting fluid in tunnels, and drawing attention to your hidden fiddle yard with 'smoke signals' is counter-productive in exhibitions!

That said, a smoking locomotive emerging from a tunnel can make for a dramatic entrance. If you can get your timing right, you can press F12 so that smoke is generated just before the locomotive bursts from the portal – spectacular!

There are a number of ways you could automate this operation to get the effect just right each time, but there is real satisfaction from getting it right manually.

If you've followed this series from the start you should have all the information you need to fit a locomotive with digital sound, working lights and smoke – and after editor Mike Wild has weathered and detailed our project '4MT' you can enter our competition to win it. See the next issue of *Hornby Magazine*, on sale on January 14 2011 for more details.

WHAT WE USED

Product	Cat No	Manufacturer	Price
BR Standard '4MT' 4-6-0	R2715X	*www.hornby.com*	£127.19
Sound Decoder	MX640D	*www.zimo.at*	£84.00
Seuthe Smoke Generator	Seuthe No 22	*www.dccsupplies.co.uk*	£17.61