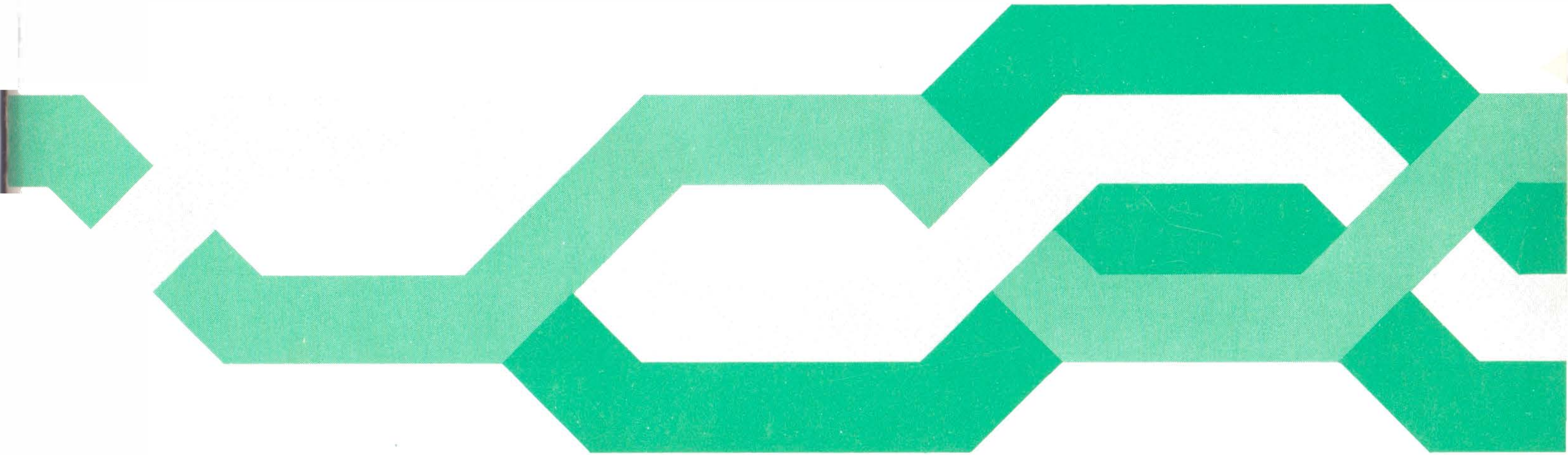
Maintenance News

16

Spring
1980



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Contents

Editorial

THQ has been reorganised – and the titles Service Department (SvD) and Maintenance Division have disappeared. This may have puzzled some of you, especially as 'Customer Service' is a hallmark of our business. But, though the names may have gone, the functions remain. In fact, by reshaping the THQ departments they will be able to respond more quickly to change. And our Business – *Telecommunications* – will achieve service improvements more swiftly than in the past.

Broadly speaking, the Sv5, Sv6 and Sv7 groups have become part of the Network Executive (NE) – for exchange system maintenance, or the Marketing Executive (ME) – for the duties concerned with customer apparatus maintenance. New codes have been used in this issue of *MN*.

Despite the changes in THQ I can assure you all that *Maintenance News* will continue.

Ron Quinney – Editor

Better joints for local lines

by **Dennis Ansell** NE/T8.2.5

The basic difficulty of providing satisfactory, lasting, seals at joints on obsolete and new cables has involved much development work in recent years. Here we look at new and modified joint closure practices either under review or in process of introduction. The chief purpose of this work is to improve the overall reliability of local underground plant.

Cable joints are a major source of faults in the local network. Many of these are due directly to failure of the joint closure. When a joint fails water can enter causing low insulation, battery contact and, later, disconnexion faults from the resulting corrosive action. The UK network is mainly polyethylene sheathed and it is on this plant that most problems arise. They are accentuated by the variety of obsolete cables and joint practices that exist.

Local main cable joints

Main cables are those larger air-spaced types, normally greater than 100-pairs, that radiate from an exchange to primary cross-connexion points. Air pressure – which is monitored by alarm circuits – checks the soundness of the cable sheath and joint closures and provides a degree of security against ingress of water should they fail. The basic methods used for joint closure on existing or new plant are :

- lead plumbing – when only lead cables enter a joint
- epoxy putty (EP) – where polyethylene or a mixture of lead and polyethylene are present.

For various reasons EP is unsatisfactory as a joint closure, so two new practices have been developed. These apply equally to MU and CJ cables.

Injection welded joints are made with new equipment – resulting in a heat fusion sheath closure on all black or 'natural' polyethylene-sheathed cables containing a moisture barrier. Provision is made for split sleeve welding and, with other minor adaptions, can be applied to lead-sheathed cables incorporated in a joint. This method – which started in January 1980 – is for use on all new cable provision work and for replacing existing EP joints that are opened. Equipment will be phased-in by regions over a three-year period.

The new system consists of placing a steel-lined polyethylene sleeve over the joint with split discs fitted between the sleeve ends and cables. An electrically-heated mould is fitted around the sleeve and cables, then molten polyethylene is injected into the mould from an electrically-heated, pneumatically-controlled, gun. After injection, the mould is cooled by water pumped through passages in the mould body. The heating and cooling cycles are semi-automatically controlled from a master unit. A joint may be pressure tested immediately after it is completed.

Fig.1 shows a completed closure. At present a maximum of two cables can be accommodated at each end of a joint, but 3- or 4-entry joints are being considered.

Heat shrinkdown repair joint – shown in Fig. 2 is a new maintenance repair method for leaking EP joints. Subject to successful trials, it should be available during 1980. EP joints have always been difficult to repair – needing a hammer and knife to remove a faulty wipe and extensive preparation work before applying the new plumb. The associated plumb often requires renewal because of joint disturbance and another disadvantage is that new EP plumbs cannot be pressure tested until 24-hours later.

The new split heat-shrinkdown sleeve technique is similar to that already used for sheath repairs (*TI E3 A3044* refers). For single-entry plumbs the cable sheath is built up using self-amalgamating tape so that the change in diameter from plumb to cable sheath is made more gradual. A suitably sized repair sleeve – cut to length so that it overlaps the joint sleeve and cable sheath – is wrapped around the plumb and secured using a brass flexible rail. The rail is locally shaped to match the contours of the sheath, plumb and joint sleeve. Heat is applied from a propane torch and, by working outwards from the centre of the repair sleeve in a circular motion, the sleeve shrinks down fully onto the sheath and jointing sleeve. The repair can be pressure tested after about 45 minutes.

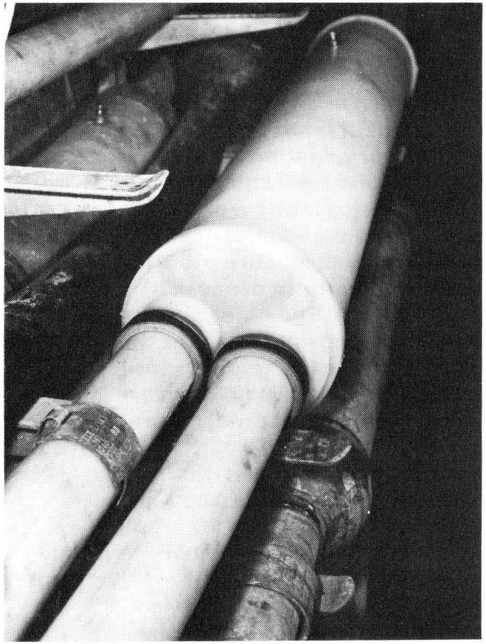
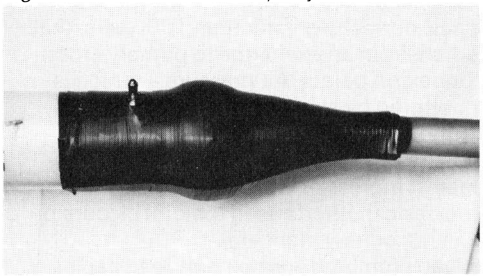


Fig. 1 Injection welded joint closure showing a 2 cable entry.

Fig. 2 A Heat shrinkdown repair joint.



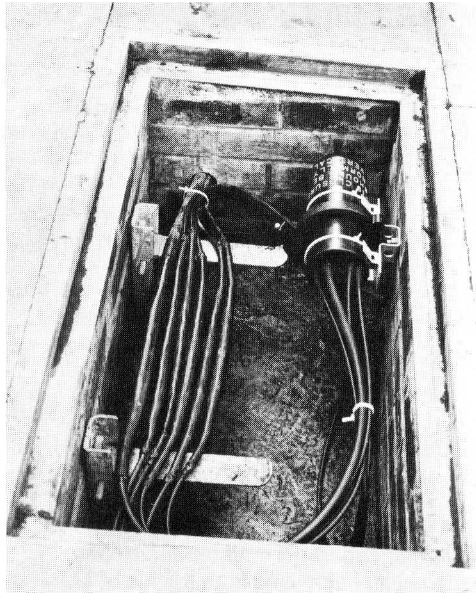
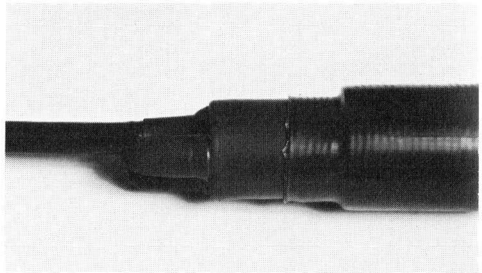


Fig. 3 An expanding plug joint has been replaced by a sleeve 31A. All the shrinkdown closures are contained within the jointing structure. The technique should be available by mid-1980.

Fig. 4 Multi-entry shrinkdown collar joint.



This method can also be used for multi-entry EP joints. Using a resin pack 8A, a resin block is cast onto the cables adjacent to the defective plumb, completely enclosing them. The joint sleeve, the plumb and the resin block are then sealed with a heat shrinkdown sleeve as previously described.

Distribution cable joints

Distribution cables – normally 2 to 100-pair – are used for distributing the main cable pairs to customer's premises. Some 90 per cent of the network is polyethylene sheathed and a large amount is directly buried and jointed. Since the 1950s, when it was introduced, various cable designs have been used – unfilled, water blocked (containing blocks of compound at discrete intervals in the cable), and the present type fully-filled with petroleum jelly compound (grease). Also, many types of joint closures have been used over the years – expanding plugs, couplings tee, the all-tape joint and so forth. Current methods use tape and collar joints, sleeves 31A and jointing posts. The 1978 report on underground maintenance strategy identified troublesome plant and recommended that new methods of joint closure be developed. These are now described.

The heat shrinkdown joint is suitable for one-to-one cable joints for maintenance when:

- repairing damaged or cut cables, buried or otherwise
- changing over a cable
- replacing existing multi-entry joints (for example the expanding plug type) with a sleeve 31A or jointing post
- replacing other faulty single-entry joints – resin filled, for example.

The main jointing components will be supplied in kit form in three sizes (Kits, Closure 1A, B, C) covering the full range of cables from 2/0.5 to 100/0.9. Kits contain polyethylene coated aluminium foil, galvanised mild steel tubular mesh, heat-shrinkable sleeve and brief instructions. The tubular mesh and shrinkdown sleeve are first fitted over the cable to one side of the joint. The aluminium foil is then cut to size and wrapped around the joint and secured with tape to the cable butts. The mesh is slid over the joint and secured at one end to the cable sheath. The mesh is then smoothed down and fully overtaped and secured to the opposite cable sheath. After applying the shrinkdown sleeve over the joint with equal overlaps at each end, it is shrunkdown using heat from a propane torch. Fig. 3 shows a typical maintenance application.

The multi-entry shrinkdown collar joint – still on field trial – is mainly for use on new work. A pre-formed collar with three outlets is used (Fig. 4) fitting inside a sleeve PE 3 or 3A. The outlets are made from shrinkdown material and marked A, B or C appropriate to the cable size. Outlet A is for 2- to 50-pair and B for 20- to 100-pair. The C outlet – for 2- to 100-pair cables – is intended to be left spare for cable renewal, should the need arise.

For jointing, the collars, shrinkdown sleeving and PE sleeve are fitted over the cables as required. The collars are placed at predetermined positions and the outlets used are shrunk onto the cable sheaths prior to jointing. A special tool protects the spare outlet from the applied heat. After jointing, the sleeve is slid into position on the collar and the closure completed with the shrinkdown tubular sleeving.

So far, as an alternative to the present taped sleeve and collar method, the trial results are encouraging.

Shrinkdown sleeve 43 is still under consideration for national use. Intended primarily for maintenance use, it comprises a split heat-shrinkable sleeve with a spur outlet opposite the split. It should replace existing faulty frontage tee joints. The spur cable is fed through the outlet port and jointed to the frontage cable. A heat shield consisting of three layers of 25 mm polyethylene coated foil is applied over the cable core. The shrinkdown sleeve is fitted over the joint, the split secured with a metal rail and the sleeve shrunk onto the cables.

Cable butt injection is a simple process of sealing unfilled cable cores with grease to a distance of about 225 mm from the butt. The idea is to prevent water entering a joint through the cable butts because of sheath imperfections or an adjacent faulty joint closure that is laying in water. It is suitable for polyethylene sheathed and insulated cables of 10-pair and over. A nozzle dispenser 7A is eased fully into the butt in the centre of the cable between the conductors. A dispenser 7A is filled with a sachet of compound 23 and attached to the nozzle by a flexible hose. Grease is injected into the cable by slow operations of the side lever on the dispenser, avoiding build-up of back pressure. The seal is satisfactory when grease exudes between all conductors and the outside layer of the cable core.

A timely reminder

This article has not described other subsidiary jointing operations such as sheath preparation and degreasing. But all are essential for successful joint closures.

So, as a timely reminder, follow the correct procedures laid down in instructions and do not take short cuts. All too often plant and practices are given bad names – and fall into disrepute – because of malpractices. (01-432 1373)

Future of Strowger

by **Bob Felgate** NE/ES9.3.3

At present Strowger equipment provides the majority of the telephone switching network throughout the world. Most telephone administrations are changing from Strowger to more modern systems. But large quantities of Strowger equipment still remain, particularly in our own system where it earns about 90 per cent of the switching income.

Since the start of automatic telephony, Strowger equipment has been the main switching system in the UK and still connects some 80 per cent of our customers. Possibly as much as 90 per cent of the main network (trunk) equipment is also Strowger. It is interesting to note that, in spite of a number of old exchanges in operation with equipment more than 40 years old, the average age of Strowger equipment is about 15 years. This gives some measure of the growth in the switching system in recent years, trebling in size in the past 15 years.

However, the days of Strowger are numbered. Although changes have been made in maintenance philosophy and techniques in recent years – including the adoption of many maintenance aids – maintaining Strowger equipment for a reasonable quality of service is costly. Also to provide the new facilities that customers now require entails much additional equipment and extra work.

The full implications of the modernisation plan have not yet affected switching systems, but increasingly this will now occur. The plan is for all large local Strowger exchanges to be replaced by 1992. This covers most of the Strowger director and non-director exchanges including the local multiple of the GSCs – but excluding UAX13s.

To achieve this goal the last order for Strowger local equipment has been placed although it could be some two years before we see the delivery completed. The last orders for the main network equipment are still to be placed, but orders for most 2-motion selectors have already ceased.

What of the future?

It is not possible to modernise every exchange overnight, due to the immensity of the job and the manpower and capital expenditure involved; so a strategy for the next few years has been developed. As local exchanges are changed to other systems, Strowger equipment 'made spare' – of 1960 or later vintage, meeting certain criteria of condition – will be recovered for re-use. Most of this equipment will be re-used for extensions to existing Strowger exchanges primarily in its own GM's area and, to a lesser degree, in its region. Only about 25 per cent will be transferred to other regions. It may be necessary in the early years of the programme to re-use equipment manufactured before 1960 provided it meets certain other requirements. Equipment that has been identified for scrapping will be marked with a blue spot by area staff in a position which is easily visible alongside the rack destination or the pillar of the selector. At a closing exchange it is essential that equipment ear-marked for re-use must not be kept as all of it is required for planned extensions.

If you have some poor equipment in your working Strowger exchange that you would like replacing to improve service, report the facts to your area/region planning group. They will make equipment available as soon as possible. On no account must staff swap equipment on their own initiative.

In the interest of customer service, it is important that all equipment – including that marked for scrapping – is maintained in good order while the exchange remains in use. 4000-type selectors will only be used to extend existing 4000-type or mixed 2000/4000-type exchanges. The intention is to end up with only one type of switch – the 2000-type selector. In the early years of the programme, however, insufficient equipment will be available to achieve this. THQ will issue instructions when 4000-type selectors can be scrapped.

Equipment recovery

To reduce damage to equipment destined for re-use, methods of recovery – packing, transportation and storage – are set out in Planning Instructions. Each rack of equipment will be recovered with 3-metre cable lenths for jointing to new cable at the receiving exchange.

Equipment installation

At the receiving exchange the old cable lengths will be joined to new lengths by means of '3 Ms' connectors – a solderless method of jointing – which should be trouble-free for the remaining life of the equipment. To indicate these joints such cables will be marked with 12 mm green plastic tape near the butt ends. At the joint itself either the sealing tape or a special tape will be labelled, to indicate that the racks have been joined together.

It is important at the installation stage to make sure that the various straps are wired-in correctly. Straps required on selectors, and relay sets in particular, could be different from the exchange they were removed from – for example forward or backward holding.

If sufficient equipment of the type required is not available one type can be converted to another. A series of TE Works Specifications have been prepared to indicate how this can be done. An example is converting subscriber's line circuits from negative to positive battery metering.

Equipment testing

As re-used equipment was working previously, it is not necessary to give full acceptance testing as is usual for new equipment. However, some items will require complete testing – cables for example, will be tested for continuity as normal. If full testing has not been done, once installed the equipment will be given a full block routine overhaul. Then it will have to pass three full routine cycles on an automatic routiner, if available. If not, a manual box tester, may be used.

Piece parts

Sufficient piece parts and spares have been ordered to last the lifetime of Strowger – although at present no complete strategy has been prepared for the main network switching centre modernisation. So, to reduce the possibility of shortages in the early years of the programme, from now on such spares and piece parts must only be used for the provision and maintenance of Strowger equipment. Their use for the construction of locally-made equipment must be avoided.

Final reminders

- To enable maximum use from the transferred Strowger equipment, and to give a good quality of service to subscribers on the new exchange, its scheduled maintenance at the old exchange must continue up to the time of closure.
- Ensure that the various straps required are correctly connected to enable the equipment to function in the new position.
- Only use piece parts and spares to provide and maintain service for the subscriber – not for locally-built items.

(01-432 1341)

Introducing TXE4A

by **Ron Askew** NE/ES9.1.2

TXE4A is a cost-reduced version of the present generation of TXE4 equipment (known as TXE4(RD) – Rectory Design) of which some 50 are in service. Each of the major common-control areas has been redesigned using modern technology including TTL and MOS ICs, giving some 10 per cent space reduction. In *MN10* we introduced TXE4, giving details of the overall working of its different parts. Here, some of the basic differences between the two systems are outlined.

The block diagram shows the major functional areas of the TXE4A and we first look at those blocks in the 'control area' of the exchange. The switching area and peripheral relay sets have remained unchanged from the TXE4(RD) design.

Cyclic store

To recap, TXE4(RD)-type Cyclic Stores are arranged in groups called trisets and up to seven trisets can be provided in an installation. Each fully-equipped triset is made up of three sets of four racks of equipment. Each rack providing the scanning logic, threaded data storage and subs line circuits/A switches for the same number of subs, junctions and miscellaneous circuits. The complete 12-rack triset provides for 5760 subs, 1008 ICJ and 1512 OGJ and miscellaneous circuits, and forms the basic module which has been taken for the new design of Cyclic Store.

In TXE4A the basic functions of the Cyclic Store remain, but physically this area has been changed completely. There are now only two different types of rack – the subs A switch and the Cyclic Store – compared with the four different types used in TXE4(RD). The new subs A rack contains the line circuits and A switches together with the scanning logic for 720 subs. Hence there can be up to eight subs A racks in the basic triset module. All the remaining equipment (the junction scanning logic, state of line store and logic, and the equivalent of the threaded data storage for a complete triset) is now accommodated on a single rack – the new TXE4A Cyclic Store. Thus the TXE4(RD) triset of 12 racks has been replaced by eight subs A racks plus one Cyclic Store rack.

Using new technology, the TXE4(RD) Cyclic Store consisting of threaded-wire cores has been replaced in TXE4A by duplicated re-circulating shift-registers. With these, data is continuously moved, or shifted, along a series of IC storage elements. When it reaches the end, it becomes available for transmission to the Main Control Units (MCU). It is also fed back to the start of the shift-register, thus forming a circulating loop of data.

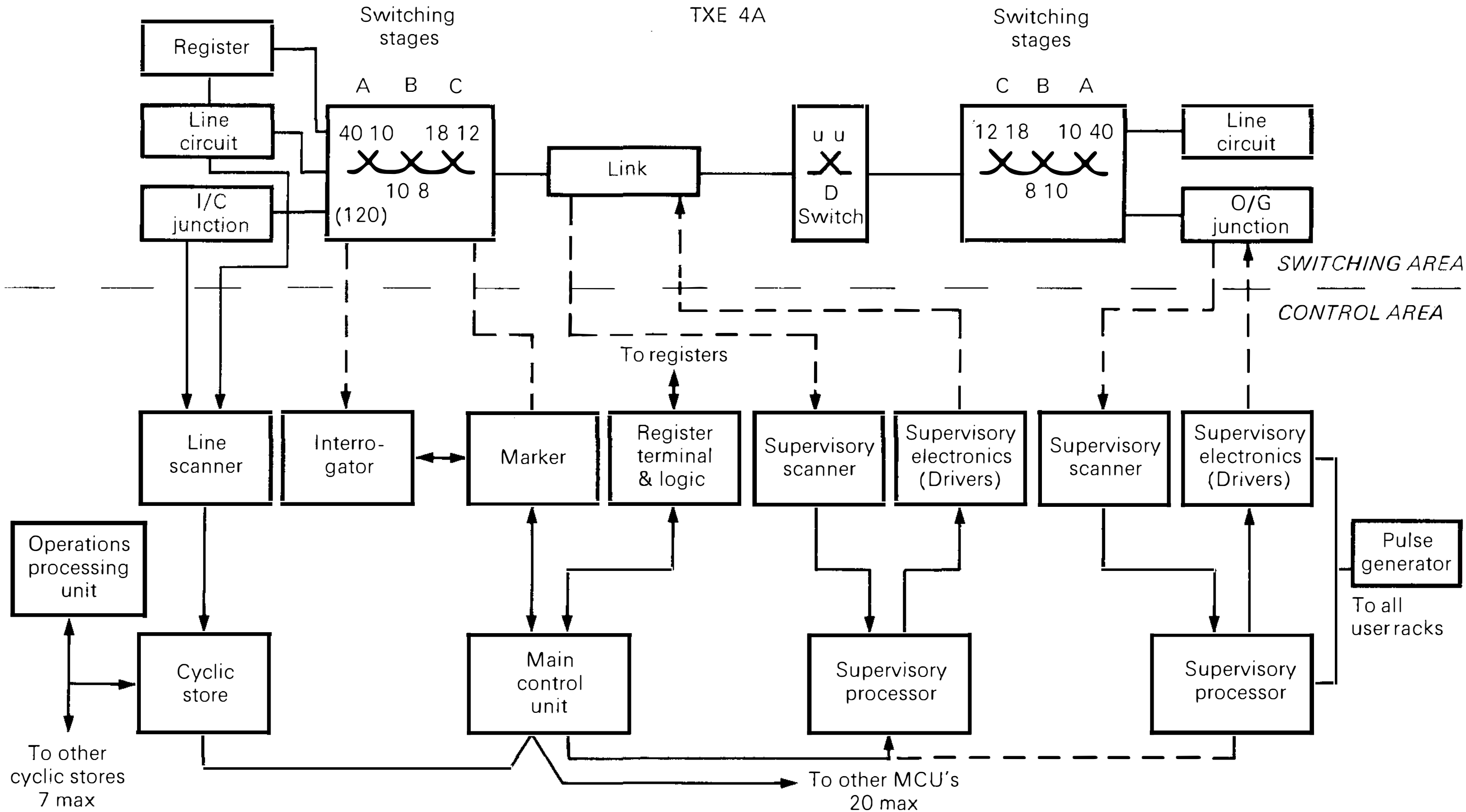
However, this technology brought its own problems in that interruptions to the power supply could have caused corruption to, or complete loss of, data. To overcome this a magnetic tape back-up store is used. This is unaffected by power supply interruptions, and automatically loads a copy of the exchange data into the shift-register stores when power is restored. The back-up tape itself is held on an open reel tape machine mounted on the TXE4A Pulse Generator Rack controlled from the new Operations Processing Unit (OPU) – described later.

Main control unit

Another major functional area redesigned is the Main Control Unit (MCU) which controls the setting up of calls through the exchange.

Although the TXE4A MCU architecture closely resembles that of the TXE4(RD) – which uses discrete components throughout – the TXE4A MCU makes extensive use of ICs, one of which is the EPROM (eraseable programmable read-only memory). EPROMs function very much like other read-only memories in that once information has been stored in them they are used only in the read out mode. With EPROMs the data is entered electrically after manufacture but can, if required, be erased by exposing the device to high-intensity ultra-violet light and then re-programmed. These devices are used to store the operating programs of the MCU and are also used in the Supervising Processing Unit (SPU) and Marker. They replace the TXE4(RD) MCU miniature threaded-wire stores and some hardwired logic boards of the SPU and Marker.

The change in technology has allowed


TXE 4A
Switching stages
A B C
40 10 18 12
10 8
(120)
Register
Line circuit
I/C junction
Link
u u
D Switch
Switching stages
C B A
12 18 10 40
8 10
Line circuit
O/G junction
SWITCHING AREA
CONTROL AREA
To registers
Line scanner
Interro-gator
Marker
Register terminal & logic
Supervisory scanner
Supervisory electronics (Drivers)
Supervisory scanner
Supervisory electronics (Drivers)
Pulse generator
To all user racks
Operations processing unit
Cyclic store
Main control unit
Supervisory processor
Supervisory processor
To other cyclic stores 7 max
To other MCU's 20 max

several important functional changes to be made, more than doubling the MCUs processing capability. First, a reduction from 12 to 2 microseconds in the time taken to execute program instructions speeds up its operation. But this does not represent a full six-times advantage, because the instructions themselves have been reorganised. Second, an additional comparator subsystem has been added to the MCU, removing a major bottleneck in call processing enabling it to handle much more traffic. Third, the registers themselves. Dialled pulses received in the register of a TXE4(RD), are detected and counted into digits using the MCU program, taking up processing time. In TXE4A the registers count the pulses and pass complete digits to the MCU.

The net effect of introducing these changes has been to increase the processing capacity of the TXE4A MCU to 96 registers compared with 36 for TXE4(RD). Obviously this has reduced the total quanity of MCU racks required; but it should be noted that, for security reasons, a minimum of 3 MCUs are still needed at TXE4A exchanges – as with TXE4(RD).

Supervisory processing

Several changes in design philosophy have also been applied to the Supervisory Processing area (SPU) – the part that monitors calls after they have been set up, applies metering, tones, or relases calls according to their current status.

With TXE4(RD), SPUs are provided per odd-plane marker, and bridge links are processed only by the SPU on their own associated plane. Junction relay sets and tone circuits are processed by 3 SPUs using majority decision. The area for storing the status of supervised circuits is provided in TXE4(RD) SPUs whether the associated circuits are equipped or not. Also, the processing electronics racks – which actually scan the circuits and send instructions – have to be provided on a fixed basis of one rack per switching unit. This leads to partially-equipped racks and substantial redundancy in rack equipment.

In TXE4A the SPU is not associated with the markers but exists as an exchange subsystem in its own right, and can process up to about three times as many switching units as the TXE4(RD) SPU. Each SPU is mounted on its own rack and comprises three identical security levels operating in parallel on a majority decision basis. This means that bridge links are now processed in the same manner as are junctions, consequently with greater security. The storage area is now much more flexible and can be packed with far greater efficiency than that of the TXE4(RD). This in turn has allowed more efficient use of processing electronics racks achieving large savings in floor space.

Pulse generator

All the pulses required by a TXE4(RD) system are generated by a pulse generator and fed out to the racks requiring them. TXE4A, however, generates about six basic system pulses only, adopting the principle of distributing them throughout the exchange to synchronise regenerator circuits on each user rack. The local regenerators then supply the required pulse patterns.

Operations processing unit

So far, we have looked at the changes to some of the existing exchange subsystems We now examine some of the facilities offered by a rack new to TXE4A – the Operations Processing Unit (OPU).

The main function of this new equipment is to control the reloading of data into the Cyclic Store – mentioned earlier. However, as well as dealing with store reloads, the OPU is also used to control data transfers between a teletype and the shift-register stores. Day-to-day changes to exchange data such as new customers, TOS and so on, are made at a teletype keyboard. After the OPU checks for correct format, they are entered into the shift-register stores.

The teletype also offers an extremely convenient method of obtaining Cyclic Store data and certain other facilities, for example Directory Number to Equipment Number interrogation which, in TXE4(RD), requires recourse to record cards. The 'search data' is typed in and the desired data returned automatically.

Other OPU functions

- Use with routiners – in TXE4(RD), the routiner hardware is located on the first three Register Racks and the operating program stored in the three associated MCUs. Thus each Register rack is wired differently, and the program stores are different for the MCUs. For TXE4A, the hardware and operating program have been moved to the OPU resulting in a standard register rack and a standard

MCU program. No change has been made to the setting-up operations – the control panel is still on the MEER rack.

- Use with new test set – the TXE4(RD) Marker and SPU Testers will be replaced by a combined function test set in TXE4A with enhanced facilities. In this case the OPU sends a sequence of information which tests every function of the Marker.

If successful, the test can then be used in its network testing mode – a function new for TXE4A. The OPU sends simulated path-setting information to the Markers, exercising the network, allowing the location of faults in the crosspoint scanning gates and some of the crosspoints themselves.

As an aside, the Marker/SPU Tester is the only change in exchange testers from those used on TXE4(RD) – apart from a revised DC/DC Converter Test Set, and the Maintenance Display Unit and Interrogate Gate Tester, which are not required for TXE4A. All other testers used on the peripheral relay sets and the switching network, are the same as used on TXE4(RD).

Interworking

If a TXE4A is used as an extension to a TXE4(RD) exchange additional equipment is needed to allow interworking between them.

TXE4(RD) uses a 2-out-of-5 coding method of transferring data around the exchange. It also uses discrete 12V logic for the highway drivers and receivers. TXE4A, on the other hand, uses 4-bit binary plus parity coding and uses 5V logic integrated circuit highway drivers and receivers. Therefore, additional equipment is needed whenever data is transferred between TXE4(RD)s and TXE4As. Additionally, conversion equipment is needed in the Cyclic Store-to-MCU highway area, because TXE4(RD) uses parallel form whereas TXE4A uses serial.

Some racks contain space for their own interworking equipment; however, much of it will be mounted on a new Interworking (I/W) Rack. One I/W rack will probably suffice for small-size extensions but others – particularly those concerned with the Cyclic Store or MCU area – may require multiple I/W racks.

TXE4A programme

The first public exchange, Belgrave (MTR), is expected to be in service early 1981. Ten others will be ordered by March 1980, the first of which at Clevedon (SWTR), Gipsy Hill (LTR) and Duntocher (STB) are due for completion late 1981/early 1982. The profile for the next two years is 23 orders in 1980/81 and 70 orders for 1981/82.

Ultimately a total of about 350 TXE4(RD)s and 350-400 TXE4As is expected. Although this programme refers to stand-alone exchanges, as mentioned earlier TXE4A has been designed to interwork with TXE4(RD), so some TXE4(RD) exchanges will be extended using TXE4A equipment.
(01-432 1304)

International leased circuits

by **Geoff Blaxall,** International Executive IE/IN4.2.3

□ What's special about International Leased Circuits (ILCs)?
□ Why do customers want them?
□ Why should they be given special treatment?
□ What's in it for us?

All these questions have been asked at some time by inland maintenance staff when chased by us or one of the International Maintenance Centres (IMCs).

□ ILCs are special

Many of us involved in maintenance are familiar with the headaches which Private Circuits (PCs) and Private Switched Networks can cause. Periodically, THQ and regional staff discuss mutual problems, pooling their expertise with a view to improving service to customers renting inland PCs. But the problems of maintaining a high standard of service on international leased circuits – the equivalent of PCs – are often more difficult for a number of reasons, including differences in:

- language
- standards of training
- national practices
- national rules and instructions
- fault escalation procedures – it is no good sending an A1053 abroad!

It might not be generally known that there are no international rules to which telecommunication administrations or operating agencies can be compelled to comply. Instead, the CCITT (International Telegraph and Telephone Consultative Committee) – through its Working Parties and Study Groups – publishes a series of *Recommendations*. These, though not binding on members, are intended to enable effective co-operation in the maintenance of service. Not all the *Recommendations* conform precisely to the UK PO methods of doing things. So, part of our job in the International Executive is to convert them into TIs published in the F (International and Maritime) series. Staff at international and national stations have access to a set of these working instructions through TI Basic Duty Code 954. The lack of international rules means that co-operation between countries at field level relies heavily on mutual trust and goodwill.

To maintain as high a reliability standard as possible on the UK national section of all ILCs – whether speechband or wideband – High Grade Precautions (HGPs – see *MN14*) and maintenance class 'E' are specified on the circuit provision advices (A886P). When called for, DC wetting should be applied as in *TI A8 K0601*. ILCs can be recognised by their designation which either includes the names of the two terminal towns involved, in alphabetical order (examples being Edinburgh-Frankfurt DP2 and Barcelona-Birmingham XP3) or comprises a six-figure number without a prefix (such as PW, PW/LR, RA normally found on inland private circuits).

□ Customers need ILCs

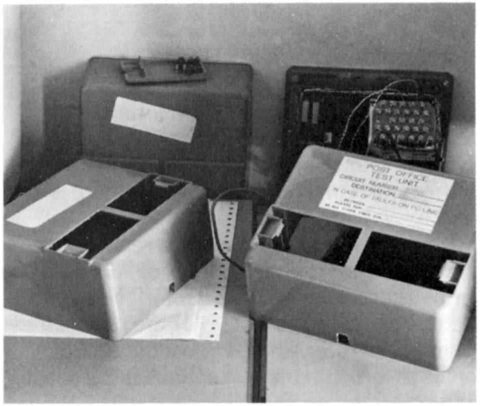
At one time the few ILCs terminating in the UK were mainly inter-PBX links. These allowed intercommunication between associated companies (usually) in Europe. But the use of PCs has expanded in the UK and in other countries, leading to proportional increase in demand for ILCs – not just to Europe but also to the rest of the world. Communications satellites have opened up greater possibilities for customers but, at the same time, have created more headaches. For example, some multi-national companies with private switched networks in various countries require them linked so that 'desk-to-desk dialling' is available to their staff. Others find it convenient to hold all their stock, staff and process records in a large computer in one country, and provide access from other countries via ILCs. Often these carry data at 9.6kbit/s plus a couple of telegraph channels. Airlines use this scheme to fill seats and cargo space. Just visit the UK office of any major airline and within minutes you can be booked on any flight operated by that airline anywhere in the world. Similarly, dealers in the City of London now operate simultaneously in all the world's stock markets – buying in one and selling in another within seconds. Imagine the consequences of a 'dis' ILC for just a few minutes!

□ Special treatment warranted

It may seem strange to those aware only of the inland services, where a monopoly applies, that internationally we are in a highly competitive market. It is a constant struggle to hold onto – not to mention increase – our share of an extremely lucrative business. As an illustration, a company wanting to link its offices in London, Paris, Frankfurt and Rome may install a tandem switcher in whichever European city they choose as their communications 'hub'. From there, 'spokes' – the ILCs – will radiate out to each of the other cities involved. The country chosen for the 'hub' will derive revenue from all ILCs radiating from it, whereas the other countries will only receive revenue from their own 'spokes'. Experience shows, too, that the network centres stimulate considerable public network traffic thus producing a revenue 'bonus' for the country in which it is located. Obviously, it is important for the PO to persuade customers to locate, and keep, their 'hubs' within the UK. It has been known for a customer to transfer his 'hub' to another country, because of dissatisfaction due to:

- the time taken to install circuits
- the quality of maintenance

Often, ILCs are provided more quickly than their inland equivalents, but many overseas countries have a better record than ourselves. There are a number of reasons for this, not least of which is the complexity of the inland network. But customers will usually be tolerant of provision delays if they can be sure of a good maintenance service afterwards. Till now, our reputation has been second to none – but other countries are catching up fast. We need to remember that large companies employ communication managers – or network controllers – who exchange experiences with one another – so it's up to us all to give the best possible service.



Three Cases 200 (used for interfacing the customer's equipment to PO private circuits.) How was the customer expected to know which was which?

Because a customer is entitled to claim a rebate when his ILC is out of service for more than two hours, we have established a target figure of two hours for all outages on voice grade and wideband ILCs. Some 65 per cent of faulty ILCs are restored within the target time, but the remaining 35 per cent often need a lot of effort to restore.

For various reasons it has not been possible to include ILCs in the national PC fault statistics scheme, so the IE operates its own. A survey during the last 6 months of 1979 showed that the UK inland sections of ILCs had far fewer faults than the overseas sections but, disappointingly, it took us between two and three times longer to restore service than other administrations.

Our overseas competitors are taking steps to reduce their fault rates, so unless we improve our performance some of those valuable 'hubs' may be removed from the UK. It shouldn't be too difficult to improve both the inland fault rate and the restoration time on ILCs. Many of the faults proved within the UK are caused by cutting down jumpers due to incorrect or missing records. Dry joints, too, play havoc on circuits used for data transmission by introducing high error-rates, and they are often difficult to locate. So, if we improve our records and solder-up all those HRs, reliability can only get better.

On the question of long outages, doesn't it make sense that some degree of priority should be accorded to ILCs when they are faulty? After all, the policy on their provision is regarded as Priority 1 – Essential!

☐ What's in it for us?

Quite simply, money. Engineers are often unaware of the value of the circuits or services they are handling. On the inland network the longest PC a customer can rent is much shorter – and cheaper – than many ILCs. For example, a customer renting a speech-band circuit to the USA may be charged a tariff around £30,000 a year. But it might not be generally known that he also pays an equivalent sum to the USA. Then, as mentioned earlier, there's the business value of the circuit to him. No wonder customers get very upset when outages are prolonged.

■ Some questions for you

If you have one or more ILCs on your patch, ask yourself:

- are the records (cards and A886Ps) up to date?
- can they be easily found by the emergency man when he is called out at night?
- are all tags properly soldered?
- are High Grade Precautions applied?

☐ at serving exchanges

- if DC wetting is called for on the A886P, is it applied? (If not possible, please let us know.)
- can test access be obtained without unsoldering connections (*TI A8 K0401 para 8*)

☐ at customers' premises

- is there sufficient light by which to work on the customer's frame?
- is there a power point for a soldering iron?
- are the tag blocks and Dis Cases adequately labelled?
- is a Case 200 (or equivalent) fitted as called for on the A886P?
- is it securely fixed close to the customer's equipment?
- can it be reached while talking to Circuit Control on a telephone?
- it is properly labelled? See *TI A8 K1051 para 4.*

If you answer 'no' to any of the last seven questions why not use the A1024 procedure to have it put right? – see *TI E13 B0020.* If that doesn't work, call us! Finally, if you would like to visit one of our International Centres, or have any questions regarding ILCs, drop us a line at Room 121, Lintas House, New Fetter Lane, EC4P 4EU, and we'll do what we can to help. (01-353 8433)

Type approval of customers' SPC systems

by **Dave Manning** SP3.3.1

Our article in *MN15* on type approval of customers' PABXs mentioned future studies on SPC (stored program controlled) systems. We may have given some readers the impression that SPC maintenance consists simply of changing plug-in units (PIUs) when they become faulty; but in practice there is much other work, both faulting and non-faulting, that has to be done on site, particularly during the period when a new system is being type approved. Not all of this work is relevant to deciding whether the system can be approved. With increasing pressure from manufacturers and customers to approve systems in shorter times we are having to expand the use made of the form for reporting faults, and introduce another for analysing time spent. Similar forms will also be used in evaluating the PO-designed Monarch call connect system (CDSS1).

A5846 for faults

For all SPC PABXs faults are recorded on forms A5846 (introduced by *TI E5 D0011*). Each form has four copies, A for THQ, B kept as a site log, and C and D which accompany the faulty unit when repair is necessary. The B, C and D copies are self-carboning so that what the PABX maintenance officer writes on part 1 of the A copy is (with the exception of manhours spent) reproduced on them. Manhours are entered only during the type approval period, when they are essential for seeing how difficult the system is to fault, and can indicate, for instance, whether the system diagnostics need improving.

Because the C and D copies are needed for obtaining replacement PIUs, use of form A5846 has to continue after type approval. Also, we still need the A copy to monitor fault performance and show whether the system remains satisfactory in the long term. Sometimes approval is granted on condition that specified system modifications are done, and it is necessary to monitor whether these have the desired effect. Long-term fault trends can show whether customers are getting an acceptable standard of service or if field staff are being over-burdened by unreliable systems. We analyse the A copies so that we can keep informed those concerned in THQ, regions and areas including the 'field support' teams who help with difficult faults. The B copies also should meet a continuing need in providing a site log to aid regular and relief field staff and their supervising officers.

Although the A5846 is designed for recording faults requiring replacement of PIUs, it also provides for recording other faults on the system. These can include faults in the controlling software, and those indicated by the system diagnostics as non-urgent or intermittent that prove not to be traceable to PIUs. Experience shows that these can take up much of a maintenance man's time and, although the majority of software faults should have been eliminated by the time type approval is given, there is a need to watch trends after this stage.

The routeing of units sent for repair with accompanying C and D copies of A5846 is normally specified in the maintenance TI for each SPC PABX system. PIUs are repaired by the manufacturer, and part 1 of the C copy serves to indicate the in-service failure mode of the unit, but no use is made of part 2.
So far, form A5846 has been experimental. Field experience has shown a need for a smaller version, simplified for more effective recording of fault particulars. In the case of CDSS1, where units are to be repaired within the PO, there will be a similar form special to CDSS1. The repairer will complete part 2, listing the components found faulty, giving fault and clear codes for each, then sending the form to THQ for analysis. Since there are expected to be large numbers of CDSS1s the forms should yield enough information on components to be useful in research and design. The advantage of the C and D copies will be in giving both field and repair particulars, which are necessary for knowledge about the conditions under which failures have occurred.

Maintenance costs

For a new system to be type approved for maintenance, it must be reliable enough to give good service to customers, spares costs must be reasonable, and the expenditure of maintenance labour must be acceptable to the PO. Labour cost limits are quoted in 'Post Office Requirements' in terms of 'on-site maintenance man-hours per connected line per annum' to give targets to manufacturers' designers. They need to 'design-in' adequate reliability and system diagnostics to provide for rapid location of faults.

During the type approval process, there is naturally much pressure for manufacturers for quick PO approval of the system. But there may be a lot of on-site activity not relevant to system approval. What is needed, though, is an assessment of what the system will require in maintenance manhours in the long term – hence the need for a fairly detailed breakdown of time spent on site.

For this purpose we have designed a second form to supplement the A5846 called an 'Analysis of Time Spent on Site of PABX or Call Connect System'. It provides for system maintenance officers to account for all their time on site, and gives THQ enough detail to determine the time relevant to the type approval decision. Time spent on clearing the system of service-affecting faults and faults of a 'threshold' nature that, if not cleared, might affect service, together with time spent on any system routines, is regarded as relevant time. This excludes time spent on connected lines, power plant, and system 'peripherals' not under type approval.

The form is to be completed by the system maintenance officer for each visit he makes to site. Each month's accumulation of forms will be sent direct to us in THQ/SP3.3.1 for analysis. We hope the form provides enough work-items to book time against, to give a clear picture of the maintenance load, and prevent too much time going into the unspecific 'other work' boxes. It provides for faulting time to be split three ways:

- system hardware and software
- system peripherals such as the interfacing teleprinter and call-loggers
- faulting off the system (power plant, proving faults to extensions, exchange lines, or private circuits).

Recorded separately is time spent on what can be called preventive faulting, including clearing of faults indicated on fault logs or error tables before they give rise to customer reports of service being affected. The form also allows for booking of time on:

- necessary routines (software dumps, power plant and other)
- co-operating with other PO engineers (local-end testing of private circuits for example) and with manufacturer's engineers (software or hardware modifications for example)
- assisting customers with operating difficulties and facility changes
- on-site training and familiarisation
- paperwork.

To complete the picture, in case the system maintenance officer does other work on site, the form also provides a line each for extension maintenance, other maintenance on site, and non-maintenance work such as Clerk of Works duties supervising modifications.

It is in everyone's interest to minimise paperwork, and hence the analysis-of-time form is for use chiefly during the type approval period. Occasionally, however, we might want to take a confirmatory look at a system some time after type approval; in such a case we would probably not choose sites that were involved in the type approval. A successful system not requiring extensive modifications will take about six months to approve, but we should not need returns of time analysis forms for as long as this.
(01-739 3464 Ext 7722)

High voltages – some problems and answers

by **Ron Bayfield** SETR/SM1

As a follow-up to the SWTB article in *MN15*, on PO HV sub-stations, we now take a look at some of the problems associated with HV – and give some answers.

What are the differences between 'Engineers HV' and 'Authorised Persons HV'?
It's important to distinguish between these two titles. An Engineer HV is at least an AEE, and is responsible for one or more HV sub-stations. His duties include the issuing of Authorities to Work (A6940) and Supervision Authorities (A6941). On the other hand, an Authorised Person HV is at least a TO, with an adequate knowledge and experience of electricity, who has been trained locally on the sub-stations for which

he is responsible. His duties include actual work on the equipment and issuing Permits to Work (A6942).

Should 'Engineers HV' also be 'Authorised Persons HV'?

An Engineer HV does not have to be an Authorised Person as well. But, if you consider his duties, it's clear he needs as intimate a knowledge of his sub-stations as an Authorised Person. So it makes good sense that he should become 'authorised', and retain his familiarity by occasional switching.

What training is available?

For prospective Engineers HV there is course 459 at POTTC Stone. This deals with procedures, not technicalities. At present there is no centralised PO training on high-voltage techniques, although some regions have sent staff either to the Department of the Environment's College at Cardington, Bedfordshire, or to local technical colleges. THQ are looking into providing 'in house' HV training either at Stone or possibly at one of the regional colleges. But training in technicalities is not enough – there is still a need for training on individual sub-station layout and peculiarities This can only be given on site by area or regional staff.

Many sub-stations contain a high proportion of 240V switches and equipment, standby engines, and so on. Why must we keep them locked against staff who could otherwise operate and maintain such equipment?

Because whenever any HV equipment is installed, the whole room becomes an HV sub-station, so we have a legal obligation to control it with an Authorised Person. He cannot effectively do this if all and sundry have access There are two possible ways of overcoming this problem. One is to erect partitioning so that suites containing only 240V and DC equipment remain accessible to other staff, limiting the HV sub-station to the area beyond the partition. The other is to issue Access Certificates (A6946) to selected staff. This entitles them to enter the sub-station and carry out specified work on non-HV plant without supervision. Access Certificates can only be issued to PO staff.

When an Access Certificate is not appropriate, is it necessary to have an Authorised Person present at all times to supervise work in the sub-station?

Yes. But rather than tie up a regular Authorised Person for this purpose, it is permissible to issue a temporary certificate of authorisation to, say, a Clerk of Works to supervise contractors' staff – though first, he must be trained on the layout of the sub-station, so he knows which areas to avoid.

How many keys should there be to the sub-station?

A system having only one key is the safest – the Authorised Person in charge of the sub-station controlling its issue. One possible system is to keep the key in a locked cabinet to which only Authorised Persons have keys. Some areas operate a system in which every Authorised Person holds keys for the sub-station/s for which each is authorised. If this system is used, it must be approved by the Senior Engineer HV (See *TI E12 B7001 para 8.7*) and it is essential that the Authorised Person in charge knows when anyone else enters the sub-station with his own key. Under no circumstances may such a person lend his key to anyone else. Where an Access Certificate holder requires access when no Authorised Person is on duty, the procedure by which be obtains a key must be laid down in local instructions.

How comprehensive should local instructions be?

A comprehensive set of local instructions saves a lot of work. When HV switching is involved, the Engineer HV need only specify the appropriate local instructions on the Authority to Work rather than give a step-by-step description of the work. Operations which do not involve any HV work must also be listed in local instructions to avoid the necessity of issuing an Authority to Work or a Supervision Authority, such as:

- connection of a mobile standby engine
- routines on non-HV plant
- escorting Electricity Board staff and other visitors
- non-electrical tasks—cleaning, for example.

The local instruction in such cases must specify who may do the work and the supervision arrangements. They need not describe the work in detail, since the procedures will be identical to those in non-HV power rooms.

Can Telecommunications staff operate Electricity Board switches or circuit breakers in an emergency?

Only if the Electricity Board concerned has formally authorised a named Telecommunications officer to do so.

Why do we use expensive circuit breakers to protect our transformers when Electricity Boards use only a fused switch?

Firstly, as it is difficult to obtain good 'discrimination' with fuses, under some

circumstances a Board's circuit breaker could trip before our fuses would blow. Secondly, a high-resistance earth fault could go undetected if the current was insufficient to blow the fuse, and again the Board's circuit breaker would operate, cutting off our supply. Finally, it is easier to reset a protection relay than replace a set of HV fuses.
(0273 201218)

Engineering safety–2

by **Henry Brown,** OP11.2

In *MN15* we looked at the sorts of accidents that happen and to whom, and our respective responsibilities under the Health & Safety at Work Act. We found that handling still causes the greatest number of accidents, so action in that area can possibly do the greatest good.

Mechanical aids are expected to be the most effective in reducing handling accidents. The object of applying machines to do work is to make manual tasks that much lighter. Examples of these are:

- stores vehicles equipped with cranes.
- pole erection units taking the heavier work from pole handling.
- fork-lift trucks for moving stores.
- cabling vehicles with better winches, and draw-rope handling equipment for reducing the physical effort required.
- manhole cover lifting mechanisms.
- internally, rack-handling equipment to ease much strain.

PBX handling has always been a problem. But, by thinking through in advance the problem of siting, the difficulties and hazards of handling PABXs in customers' premises can be avoided. The PABX harness (see *TI C1 A8150*), the planning of accommodation and practicable handling routes (see *TI C3 D3010*) should all help.

Things to come

Other aids are in the pipe-line specifically to reduce the strain on maintenance staff. One is for battery handling – carriers for the 21 and 22 series of cells and their glass-cased counterparts. They will shortly be coming into production following a successful trial. They are simple, effective, and seem easy to use – unless you know better? Another is for teleprinter handling – always a source of back injury and strain. The truck telegraph 1 was superseded by the 2A, but neither really solved the problem. Then the light dawned. The back breaking job was not merely transporting the teleprinter – it was loading and unloading the low-level horizontal trolley itself. Obvious you might think – things often are after the event – but with the elimination of so much manual carrying, the short exercise of loading did not stand out as being all that significant. Now, an ingenious trolley – the 5A – has been produced. This new design,

Trolley 5A in use as a sack truck

. . . in use as a trolley

incorporating a hinged table to carry 2 printers (the good one and faulty one) will be on field trial as soon as possible (*TIs J3 C0011* and *J3 F0029* refer).

Another aid (see *External Plant News 48*) is the tripod and winch for lowering air cylinders into manholes. With the trolleys and dollies already described in TIs, this should help to avoid air cylinder handling injuries – if they are properly used. (*TIs A2 M0052, J2 A6201, J3 D0045* and *J3 D0046* refer).

Special Research

The aids already mentioned should all help in reducing handling and back injuries. Yet over the last few years they have increased slightly. What could cause this ? To help answer this question the PO took part in research being done at Surrey University. For 10 years useful work had been done for others – including the Army and National Coal Board – using a radio pill which measured internal abdominal pressure. Past research suggested that this could be related directly to spinal stress.

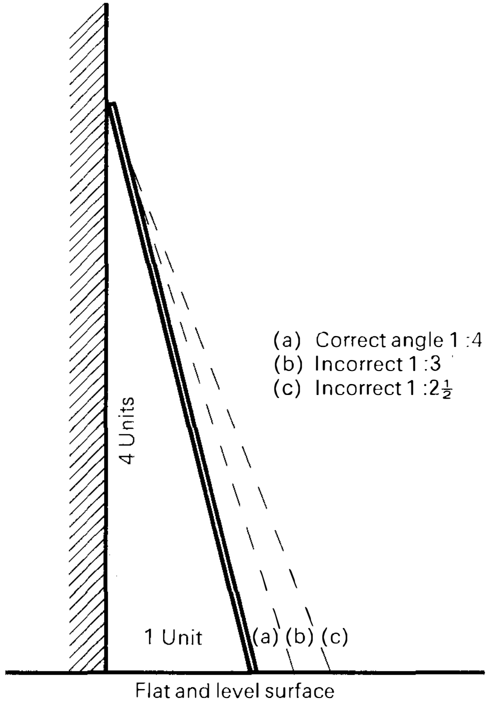
During the new investigations an analysis of one year's accidents was used to pinpoint the occupational groups at risk. Also, 200 volunteers covering all age ranges did lifting, pulling and pushing exercises in controlled laboratory conditions. During these tests the radio pill was used to determine, for PO staff, the profiles for safe limits of exertion in various positions, at varying radii from the body. When analysed, these results should enable us to define more accurately safe lifting loads in differing situations.

One of Cwmcarn's safety labels – see 'THE LABEL BUSINESS' page 23

The final exercise was to 'pill' individuals in work areas of greatest risk to discover the precise actions in normal field work which produced risky peak loads on the spine. The PO is indebted to volunteers from Guildford and Reading Areas who so willingly consented to be guinea-pigs for these investigations.

Cumulative damage

It was found that many of our back injuries, which we assume are the direct result of a particular accident, are most likely the result of several years of cumulative damage. The fact is that effort involving moderately severe back strain peaking above safety level can be tolerated because it does not produce immediate effects, therefore is not noticed. But it does damage tissues in a cumulative fashion until one day, a moderate effort causes the 'accident'. This finding has enabled the research team to single out a number of areas where peak strains over the safety level tends to occur fairly regularly, though none so large as to cause immediate pain. THQ and the University are examining possible design/technique changes which would eliminate these.



Correct ladder angle

We hope that some run-of-the-mill

actions can be improved to eliminate those peak strains, thereby reducing handling and back injuries.

Falls and ladders

Falls cause the next largest number of accidents. The University analysis showed that nearly one-quarter were falls from ladders. Other major causes were ice, falls from stationary vehicles and from steps. It is up to staff and supervisors alike to keep floors clear, report and repair defects and so on. Anti-slip floor polishes are used, but no one can allow for incautious haste on stairs, for instance.

To return to ladders – the two most important safety factors are erecting the ladder at the correct angle (1 :4) and using the fireman's technique of climbing with hands unencumbered. These points are most important where ladders cannot be lashed. The fireman's method involves moving the hand and foot at the same side of the body simultaneously. It is surprising how many people cannot recognise the 1 :4 safety angle. Tests have shown that 'Mr Average' puts his ladder up between 1 :2½ and 1 :3, although the angle shown by the indicator on the ladder stile should be 1 :4 for maximum stability. It is generally steeper than you think. Its very steepness means you have to climb it carefully, you can't run up and down it. And its stability will be least disturbed by careful and proper climbing techniques.

Finally, it seems that however much investigation is done, we always come back to individual knowledge of techniques, and care. In a word – expertise.

Computerised A51s

by **John Gore,** SP3.3.1

Fault report summaries are far from new. They were being compiled even before your longest-serving colleague joined the PO. Fault report analysis has long been a valuable tool for pinpointing trouble spots as a first step towards improving quality of service. Currently, fault report summaries are published on documents identified as form A51 – generally known in the Repair Service as 'A51s'.

In the early days, a great number of clerical staff were needed in area and regional offices to process the fault report data sent in by Repair Service Controls (RCSs). A full analysis was only made once each quarter. This changed in April 1976 when the A51 was computerised. Since then the tedious calculations have been carried out by computer. Now, the analysis – comprising various useful outputs – is produced each month at the Harmondsworth Computer Centre, and benefits local, area, regional and THQ management.

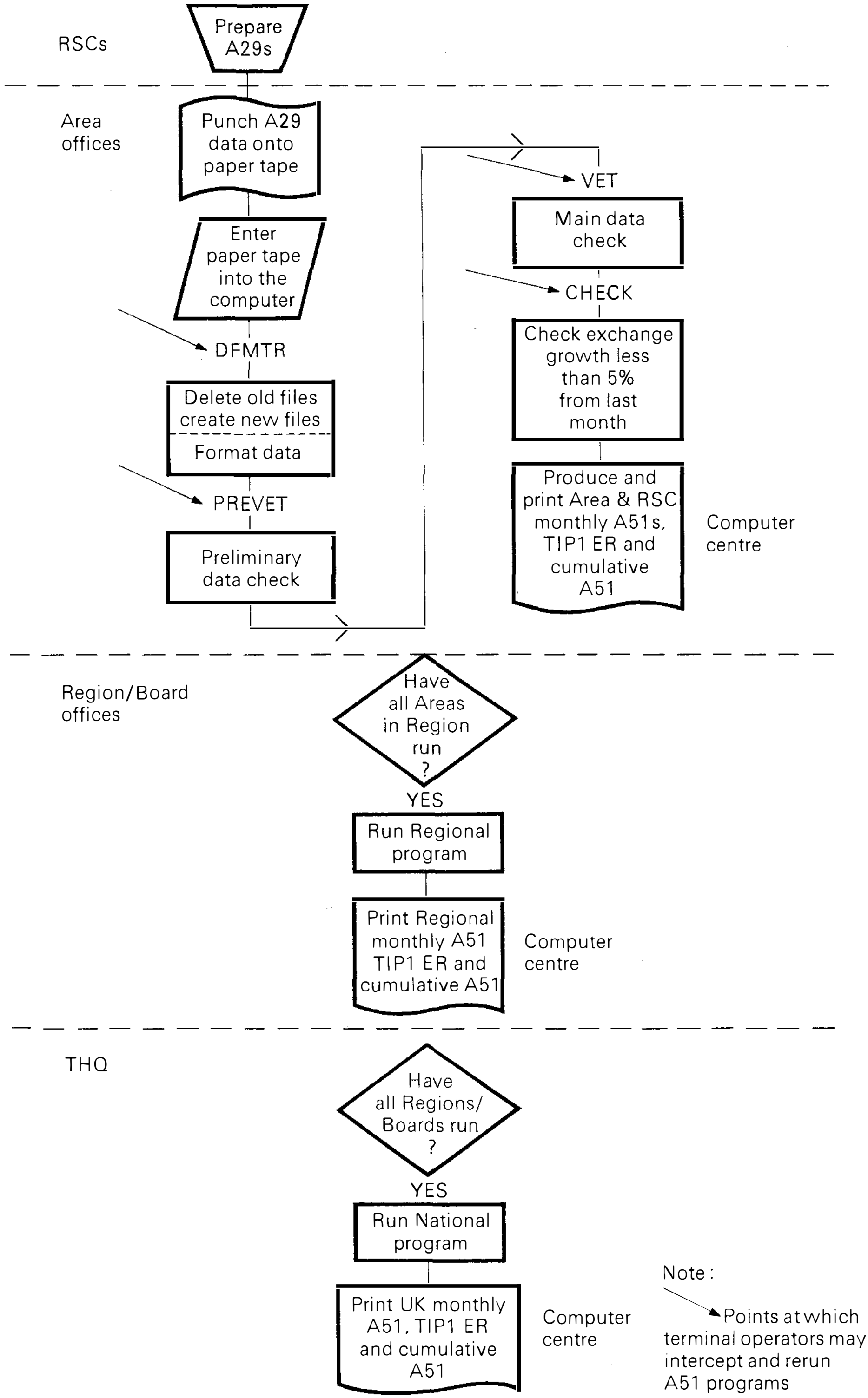
The A51 process starts with the collection of data at the RSC. Each fault handled by the RSC is classified with a 'line' number relating to the faulty equipment when the fault report is cleared. For example, line 6 is for fault reports located and cleared on customer apparatus. These 'line' numbers – one per fault category – are carried right through the analysis process to the final A51 output. Each week the RSC counts up the clears and enters totals for each 'line' number on an A29 form for each exchange, and each month sends completed A29s to the area office.

The area office then makes a punched tape of the data from the A29s together with area identification data in a prescribed order. They then dial up the IBM 370/168 computer at Harmondsworth, and send the data from the teletype terminal by running the tape through the tape reader. The data is then held in a temporary store in the computer. Alternatively, the data may be entered directly from the teletype keyboard. (See simplified flow diagram).

Next, by typing the characters DFMTR, the data is re-arranged into a suitable format for the A51 computer program, and placed into a file for the new month's data. At the same time the computer is instructed not to destroy the data at the end of the session. The DFMTR command is followed by instructions identifying the month and detailing the number of copies of output required.

When the data formatter has run, the computer moves straight into the next part of the program known as PREVET. This checks that data has been input for each of the specific RSC codes listed, and that the correct number of lines per exchange have been entered.

Next, once any errors have been corrected, the VET program automatically runs to perform the main data checks. In one of these checks, the program converts codes in the input data into numbers and words, and


RSCs
Prepare A29s
Area offices
Punch A29 data onto paper tape
Enter paper tape into the computer
DFMTR
Delete old files create new files
Format data
PREVET
Preliminary data check
VET
Main data check
CHECK
Check exchange growth less than 5% from last month
Produce and print Area & RSC monthly A51s, TIP1 ER and cumulative A51
Computer centre
Region/Board offices
Have all Areas in Region run ?
YES
Run Regional program
Print Regional monthly A51 TIP1 ER and cumulative A51
Computer centre
THQ
Have all Regions/ Boards run ?
YES
Run National program
Print UK monthly A51, TIP1 ER and cumulative A51
Computer centre
Note:
Points at which terminal operators may intercept and rerun A51 programs

asks the terminal operator to state if they are correct. An example is checking that the month and number of RSCs in the area are correct. Other checks are to see that numerical information is in fact numerical, that punctuation characters are correct, and so on. If discrepancies are shown up, the terminal operator is given the opportunity to correct them.

On successful completion of the VET program, the CHECK program is automatically called up. This causes a printout of any exchanges where the system size has changed by more than 5 per cent since the previous month – normally an unlikely occurrence. But this gives the terminal operator the opportunity to check with a particular RSC and to correct any errors.

When all errors shown up by the CHECK program have been dealt with, the computer asks the terminal operator 'DO YOU WISH TO RUN THE A51 PROGRAM ?'

The outputs

On receiving the answer 'YES' to the above question, the results for the month will be output at Harmondsworth.

Many hundreds of different A51 sheets are produced monthly, including three for each RSC for that month. Also two sheets are output giving cumulative results from the start of the financial year. The pattern is repeated for the areas, the regions and for the UK. The sheet known as the A51 (A) gives fault report totals for each fault report category for an RSC code by exchange, or group of small exchanges. Similarly, for an area, region or the UK by exchange type.

The A51 (B) sheets give details on the number of stations – or system size, and the fault reports per station per annum – the fault report indices, for the same fault report categories as the A51 (A).

Computerisation has enabled TIP1 (see *MN15* 'Service to the Customer') exceptions reports to be readily produced for the first time. A *TIP1 Exceptions Report*, taking the RSC version as an example, weights the performance of each exchange in accordance with the number of stations served. This is to assess its effect on the overall fault reports per station per annum index for the exchange areas concerned. The exchange having the most detrimental effect is shown at the top of the list and so on. To indicate which type of plant has the most beneficial or detrimental effect on the index, 'significance' figures are entered against each. This helps local management pinpoint the cause of any deterioration of the index to a particular exchange or exchanges, and type or types of plant, alerting them to take remedial action. This pattern is repeated for area, regional and UK TIP1 Exceptions Reports.

The A51 fault report summaries and the exceptions reports are used by local management to direct maintenance effort, and by higher management to monitor area, region and UK performance.

Having ascertained that all its areas have run, the region runs its A51 for the month, and likewise running the UK A51 awaits the completion of all the regional runs.

It now remains for the computer centre to despatch the output to the appropriate destinations.

Further details of the A51 process including information on how the statistics are calculated are given in *TIs E1 E2013, E1 E2014* and *E1 E2015*.

Possible future developments

The A51 program is under review to take account of experience gained over the past three years. The following outputs are being considered:

- 12-month moving average indices to enable longer term trends to be monitored
- *TIP2 Exceptions Report* to draw attention to the plant causing most carried-forward faults
- work-load orientated outputs showing only the lines relevant to particular level 1 management loads, for example underground only.

The new program will contain more automatic data checks to reduce the work-load of the terminal operator.

It will also be compatible with the proposed DPRS/OMR (Data Processing in the Repair Service Optical Mark Recognition docket) scheme which is now on field trial at two RSCs. This will allow for more detailed analysis of fault reports.

The overall object of the revision is to make fuller use of the data supplied by the Repair Service to help the man on the spot do his job more effectively and give a better service to the customer.

(01-739 3464 Ext 7777)

A new private automatic telegraph branch exchange–PATBX2A

by **Dave Nutbeam** NE/ES2.3.1

Many large firms need private telegraph networks with automatic switching to route calls between office buildings. In the past the only PO equipment available to switch calls on these networks has been a small, electromechanical, private telegraph exchange – the PATX1A. This exchange suffers from the disadvantages common to electromechanical systems, so the PO has introduced a new processor-controlled, solid-state switching unit.

The PATBX2A, as it is called, is designed for use in customers' offices. It is quiet in operation and requires no routine maintenance.

Two sizes of exchange are available, 36 and 48 terminations – or ports. If a customer requires a larger network, PATBX2As can be connected together with trunk circuits in a linked numbering scheme.

Facilities

The PATBX has a number of new and novel facilities, the main ones being:

- Keyboard selection – all the selection information is sent from the teleprinter keyboard instead of the dial. Any necessary conversion to dial pulsing is done by the PATBX2A.
- Broadcasts – all extensions on the PATBX2A can make a wide variety of broadcast calls including calls to short code selection groups.
- Priority calls – extensions can be allowed to make priority calls. These calls will override existing calls to allow urgent messages to be sent immediately.
- Correction of mistakes – 'finger trouble' occurs even when using the keyboard instead of the dial. If a mistake is made while setting up the call, the last character(s) can be 'erased' by keying the slash (/) character.
- Automatic retest – if a line called by the PATBX2A does not respond correctly, it is automatically removed from service and retested regularly until it reacts properly.

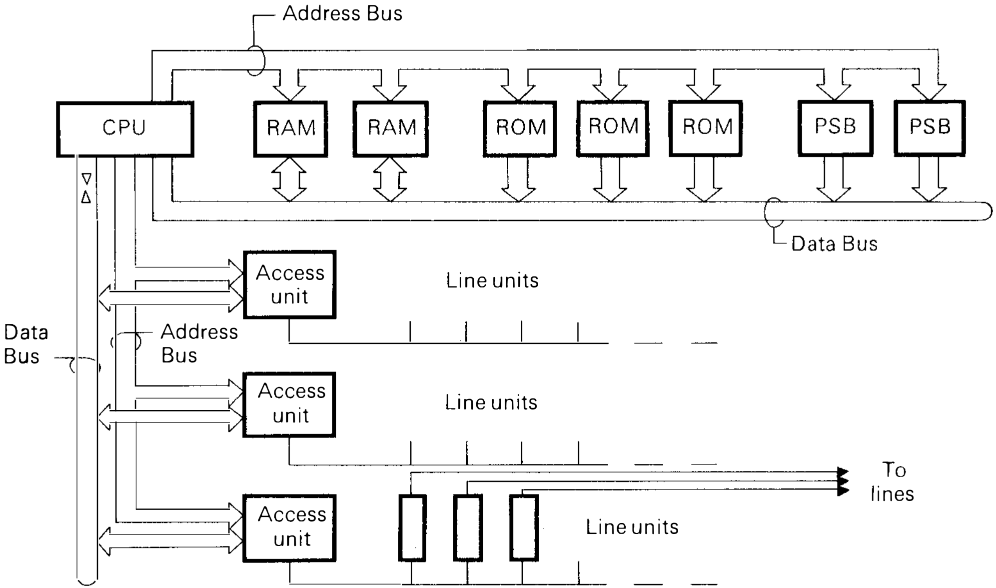
Operation

The units making up the PATBX are shown in the block diagram. The line and access units are used to interface the exchange with the external lines and to set the facilities of individual lines. The other units are time-shared between all lines. The central processing unit (CPU) performs the main functions of the PATBX2A under the control of instructions received from the program stored in the Read Only Memory units (ROMs). As the CPU can deal with only one call at a time, information about other calls taking place is temporarily stored in Random Access Memory (RAM) units and each call is progressed in turn. Pre-selected Broadcast (PSB) units contain information about the make up of short code selection broadcast groups.

Maintenance

The PATBX2A has four main built-in maintenance aids. All these facilities are used by keying a maintenance code into the exchange. Three of these aids can be thought of as testers for the ROM, RAM and Access units, the fourth provides a simple test message allowing maintenance staff to check the performance of the extension teleprinters.

The new PATBX2A, in the background, harmonises with the office environment.



Future developments

A third generation of PATBX is at present under development by the PO and a number of orders have been received for installation during 1980. The equipment design is highly flexible and adaptable for use in circuit switching and message switching modes, or a combination of both. We intend to meet customers' 'one-off' requirements using software 'specials' with a common set of hardware modules. Further details will be given in a future *MN* article.

Useful references

TI C3 H2016 – PATBX2A Installation and Testing.
TI E7 C4505 – PATBX2A General Description and Maintenance.
Diagram TG 5972 Sheet 1 – Index of diagrams.
(01-432 1319)

Some telex tips

by **John Pyrah** NE/ES2.3.1

For many years the quality of service offered to telex customers has been measured using basic information obtained from:

- Telegraph Report Register (A159) – prepared by telegraph Repair Service Controls.
- Service Observations – taken on a sample of outgoing inland telex calls.

From these sources RHQ and THQ compile the number of customer-reported faults per station per annum and the percentage of calls failing due to system faults.

If we already have a way of measuring the quality of telex service, why do we now need Telecomms Improvement Plans (TIP's) for telex?

Well, there are two reasons –

First, the PO is pledged to improve customers' service in all fields of telecomms and to publish performance statistics regularly.

Second, there have been no formally agreed plans between THQ, regions and areas to improve telex quality of service.

So by introducing TIP's to telex we will be helping management to plan improvements and more closely monitor the overall quality of service offered to our customers.

The new TIP's are:

TIP 37 – faults per Telex station per annum,
TIP 38 – percentage calls failing due to plant defects and congestion.

To keep additional recording work to a minimum, the TIP's have been based on the existing A159 and Service Observation returns referred to above. We hope that with the introduction of TIP's, which started in April 1979, there will be a better awareness of telex system performance – leading to a steady improvement in customers' service.
(01-432 1318)

Closed circuit TV—new testers

by **Peter Watson,** NE/T5.2.3
For closed circuit television (CCTV) systems such as those used for traffic surveillance, PO transmission equipment is often housed in external cabinets. Two new instruments have been designed specifically for the maintenance testing of such links (*TI E10 C0010* refers).

Both items are powered from disposable dry batteries. The generator may also be driven from an external DC supply when extended testing periods are required. The instruments are suitable for use out of doors where mains powered test equipment is not permitted.

Amplifier 231A
When used with a variable attenuator and an oscilloscope, this instrument enables unwanted noise on the link to be measured. Known as hum, low frequency noise (50Hz-10kHz) and luminance weighted noise (10kHz-5MHz) each would cause television picture impairment if excessive.

Generator waveform 17A
This small portable generator has facilities for manual selection of 2T pulse-and-bar waveform, 50Hz waveform and 75ohm termination. Automatic selection is also incorporated, enabling the generator to be left unattended to cycle through the three conditions. The waveforms provide a sensitive method of measuring variations in signal amplitude, gain/frequency response and phase/frequency response of a TV link under test. As with noise, picture impairment will be caused if these parameter distortions are excessive.
(01-432 1424)

The label business

by **Dave Pinwell** PE/F Cwmcarn

At the end of the last century the PO factory at Holloway, London, started making labels for telephone exchange equipment. By 1969 the operation had grown considerably and was transferred to the Factories Division site at Cwmcarn in South Wales.

Every day the label centre receives 300 orders for labels, mainly from engineering staff in telephone areas. Many are for standard labels – parts for exchanges, transmission equipment, manual boards and so on. But frequently orders are received for a variety of others – self-adhesive vinyl film, or rigid PVC to be cut to size and printed as information or warning labels.

In the early days all label work was done using pantograph engraving machines – where a rotating cutter followed a brass template, cutting into labelling materials which were then colour-filled if required. But the engraving process was slow and expensive, cutting one character at a time, and limited to rigid materials. About ten years ago the hot press printing technique was introduced, whereby a brass type is set into a press and heated. When the press is operated, the combination of heat and pressure transfers ink pigment from a carrier foil and bonds it onto the label's surface. Although restricted to thermoplastic materials this process produces the whole label in one operation – rather than one character at a time – so is quicker, cheaper and more versatile.

Our difficulties

With the growth in production rising to 27 million labels per year several problems arose which tended to disrupt the service provided by the factory –

- because an average of 600 orders were being processed at any one time it was difficult to give the appropriate priority to urgent jobs, or to progress jobs on an individual basis
- often we found that similar, or even identical, orders had been processed within a few days of each other. Although it would have saved a significant amount of machine set-up time to produce such jobs together, there was no means of bringing them together
- large orders could tie up a production machine for several weeks, sometimes disrupting the flow and delivery of smaller orders
- while the majority of engineering groups used form A1097/8 to order labels, a variety of other ordering methods had been used. This led to inefficiencies in interpreting and handling orders.

Our solution

To overcome the problems mentioned, we reviewed our procedures and have taken a number of steps to improve efficiency and service –

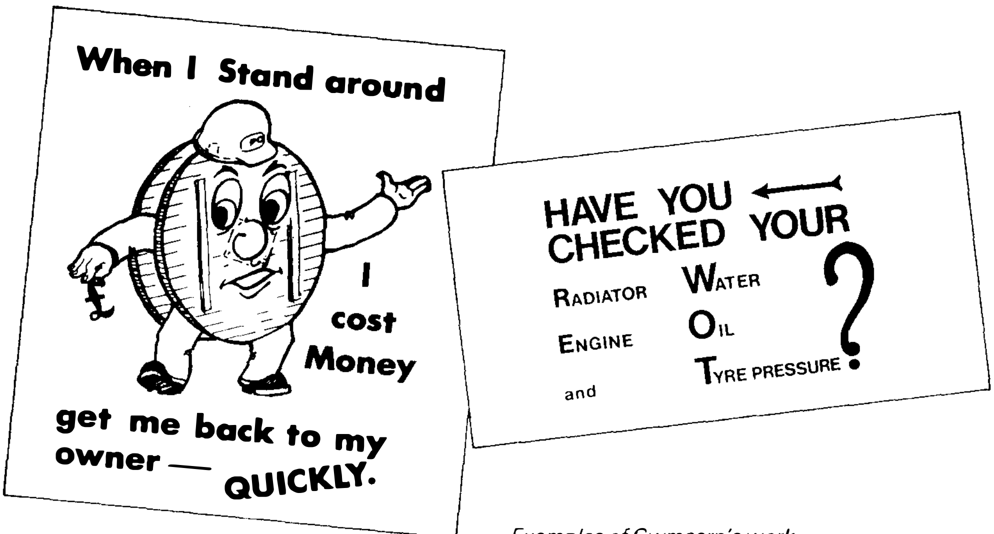
- first, we rationalised the range of items and materials stocked for printing. The self-adhesive vinyl film and rigid PVC label will now be available in a wide range of fixed sizes and colours. Metrication has also been introduced, so for future orders sizes will need to be specified in millimetres rather than inches.
- next we have introduced an 'off the shelf' service for a new range of labels covering common requirements. This range will be printed first and held in stock awaiting orders, rather than being printed to order. It will cover a variety of labelling needs for office, marketing, safety and engineering
- a new *Catalogue of Factories Division Labels* – widely distributed to areas – describes the standard ranges of labels and the facilities which the label centre can provide. All planning, works and maintenance groups will have access to a copy
- a new label requisition form M638 has been introduced for use by all groups within the business when ordering from Cwmcarn. Ordering codes are given for each item in the catalogue, also guidance on completing the form
- production control and work scheduling is being streamlined by a computerised system which will allocate jobs and machines in priority order bringing similar and identical needs together
- in future large orders will not disrupt other, smaller, orders and may be produced over extended periods by prior agreement with customers.

As a result of these measures the Cwmcarn label centre is offering a three-level service, representing a significant overall improvement. These are in line with the three divisions of the catalogue:

- *Part A* illustrates the new range of pre-printed 'off the shelf' labels. These will be dispatched within three days of receiving an order.
- *Part B* describes the standard stocked ranges of engineering labels, accommodation labels and thermoplastic materials for printing to order. These will normally be dispatched within four weeks of receiving an order, but the date required can be specified on the requisition. Work which is urgently required can be dispatched within as little as a week and, where a due date is specified, the computer system notes this and allocates it to a production machine accordingly.
- *Part C* outlines the non-standard facilities which are available at Cwmcarn. When special provision has to be made for such a job, a delay of two to three months may be incurred.

This means that by selecting a standard label, anyone with an urgent need will be able to have it by the date required. Special labels to non-standard requirements can be produced, but more notice is required to avoid impairing the efficiency of standard label production.

Another feature of introducing computer techniques is to enable staff at the label centre to provide an advisory service to anyone with non-standard labelling requirements not covered by the catalogue. (0495 270521)



Examples of Cwmcarn's work

PETs on cables

by **Dave Haffenden** NE/T5.1.2

Over the last ten years the PO has purchased several different makes and models of Pulse Echo Testers (PETs) which are used by area staff to locate various types of conductor defect in the Trunk and Junction (MU/CJ) cable network.

The most common types of defects are crosstalk between circuits – usually caused by the condition known as split pairs – and disconnections. Most of these defects occur at or near jointing points.

Compared with previous methods involving the use of AC or DC bridges, PETs are portable and provide a quicker and easier method of locating most defects. They are powered by internal rechargeable cells or direct from mains.

The various models of PET are used on the following types of cable:

- Unloaded audio and coaxial cable – Biccotest T215, T235, Cossor 500 and Echometer T03/3, T03/4
- Loaded Cables.– Biccotest T216, Cossor 600 and Echometer T08/3.
- Coaxial Cables Only – Echometer T07/1.

Principle

When energy is transmitted to line its velocity of propagation is determined by the line characteristics. Any impedance mis-match on the line will reflect part of that energy back to the sending end, the actual amount depending upon the degree of mis-match. This reflected energy will return at the same velocity as the transmitted energy. Thus it will take a finite time for an energy pulse to reach a fault point and return to the sending end. By accurately measuring this transit time and knowing the velocity of propagation the distance to the fault can be calculated.

The choice of the shape and frequency of the transmitted pulse is a compromise between the need to test over a certain type and length of cable and the required accuracy in subsequent fault location. The higher the frequency of the pulse the more accurately it will locate the fault, but reflections become less detectable because high frequencies are attenuated more than low ones.

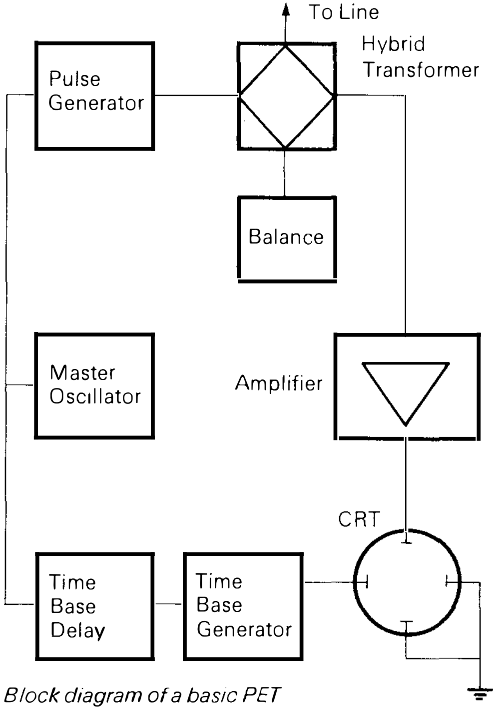
Basic PET

The block diagram shows the basic PET.

PETs for use on the MU/CJ network are of two types for use either with loaded cables or with unloaded cables, both audio and coaxial. The pulse shape and width generated by each PET is chosen to suit the type of cable on which it is used.

The pulse repetition rate is chosen such that there is sufficient time for the transmitted pulse to travel to the far end of the cable and to be reflected back to the sending end before the next pulse is transmitted.

The hybrid transformer ensures that the generated pulses are transmitted to the line and that the reflected pulses are fed via the amplifier to produce a clear trace on the



Block diagram of a basic PET

cathode ray tube (CRT). A graticule placed over the CRT allows the delay time between the transmitted pulse and the reflected pulse to be measured. These times are given as milliseconds on the PETs used on loaded lines, and as microseconds for those used on unloaded lines. A time-base delay feature allows the response from the cable under test to be displayed on the CRT over its whole length or to be divided up into short sections and inspected in more detail.

Using the appropriate PET for loaded or unloaded lines, the time to the fault is measured in milliseconds or microseconds. As already mentioned, all impedance mis-matches – some of which may be due to changes of cable type and/or conductor size – reflect some of the transmitted pulse. So, the determination of the actual fault point is dependant, in most cases, upon the operator's experience. Occasionally, the PET will display two or more faults on the same cable pair, but in such cases it will only give an accurate location of the first or nearest fault. Accurate location of the second fault will have to be made after the first fault has been cleared. Alternatively it can be located from the far end.

The PET is then connected to an adjacent good pair in the same cable to determine the velocity of propagation. To do this, a fault such as an intermittent short circuit is applied to the cable at a known distance, usually at the far end. This action temporarily inverts the reflected pulse which can then be easily identified on the CRT.

If the good and faulty pairs are adjacent pairs in the same cable, the distance to the fault is given by:

$$x = \frac{TF}{TG} \times L \quad \text{Km from testing end;}$$

where TF = time to fault
TG = time to far end
L = length of pair.

By reference to the cable records, especially the Pocket Book Record for the particular cable, this distance is converted to an address to which the external maintenance jointers are sent to clear the fault.

As PETs used on loaded lines are only accurate to the nearest half loading coil section, the loading coil joint(s) nearest to the location are opened first. Depending upon the type of fault reported – missing or wrongly loaded for instance – the loading coils are checked. If the fault is not at one of the loading points a more accurate location is carried out by testing between loading points with a PET designed for use on unloaded lines. This means that at least two joints will have to be opened. But, depending on the type of fault reported, the joint(s) at the loading coil need not be opened if it is known that some jointing activity has taken place recently in that particular section.

Facilities exist, by temporarily disconnecting the PET hybrid, to enable crosstalk coupling points to be located. For these tests the pulses are transmitted on the disturbing pair and received on the disturbed pair.

Coaxial pair tests

The techniques used are similar to those on unloaded audio cables. The same equipment can be used but, where greater accuracy is required, the T07/1 with its shorter pulse width, is used.

The history of existing analogue systems shows they are affected by defective joints on the coaxial cables. Usually these have been high resistance (HR) –

- where a solder joint has deteriorated, acting as a diode between the two surfaces;
- where joints have not been soldered on installation, and did not show as faults during acceptance testing. Only after some time when the copper started to oxidise, did the consequential diode action cause the fault to become apparent.

These HR faults are very difficult to locate by normal PETs and are generally located using the Second Harmonic Tester (Tester 238A).

New equipment

There is a possibility that most of the existing cables and all new cables will carry Digital Line Systems (DLS), and defective joints at or near to terminations will be particularly liable to affect service. Areas will need to be able to check that such cables, after repair, still meet the requirements for a DLS. To achieve this, it is proposed to equip each Region/Board Service Division with a Tektronix type 1503 PET. These PETs were originally provided to those regions with a 60MHz cable route maintenance responsibility. With their pulse width of 10, 100 and 1000 nanoseconds, these instruments are now considered suitable for testing cables carrying DLS. As an additional refinement, these PETs have been supplied with plug-in chart recorders so records of various traces may be retained for future use if required.

New technique

Another type of defect that is becoming increasingly apparent is where the back joint or outer conductor has been incompletely soldered. This provides a window which allows leakage of the signal and can eventually cause crosstalk problems.

A new quick and positive technique has been developed by THQ for locating defective joints at or near the termination. It uses a modified Tektronix 1503 and a pulse generator, attenuator and adaptor, to make 1 nanosecond pulse crosstalk measurements with outer conductor injection. In this test pulses are transmitted over the outer conductors of two coaxial pairs. The induced pulses are received on one coaxial pair in the normal manner. Although this method is limited to testing over short sections of cable – the termination and the first joint – it has the advantage over normal crosstalk tests in that it will locate single faults. The normal test requires a crosstalk path between two faults. It is proposed to equip each Board/Regional Service Division with this facility.

In conclusion, using pulse-echo techniques, HR joints at or near terminations should be located more quickly and easily than with the second harmonic tester which will still be required for HR joints in mid-sections.

For the future, new developments – including digital readout – will save time and increase location accuracy, so enabling a more reliable service to be achieved.
(01-432 1310)

MAC – experience at the sharp end

by **Robert Clarke** SETR/Guildford Area

Starting up

The first Measurement and Analysis Centre (MAC) processor was delivered to Aldershot telephone exchange on 2 June 1977. The following day it was making its first test calls using prototype exchange access equipment at six exchanges in the Guildford Area. During the following four weeks tests of hardware and software were carried out by THQ. On July 4 the first MAC measurement month was started with Measurement Series Sequences (MSS) 1 and 4 (see Table) on five of the exchanges. The first exchanges to go on MAC were a TXE2 (Mark 1), a TXK1, two small Strowger, one trunk portion of a GSC and a large Strowger GSC.

During August that year the prototype exchange access equipments were replaced with production units and additional exchanges began to be connected. Industrial action prevented further developments until the end of September 1978, by which time all exchange access units had been installed.

To ensure the smooth introduction of the measurement sequences, the strategy adopted was to start MSS1 first, closely followed by MSS4. In the case of GSC access, MSS6 was started first where the international service was accessible. When all exchanges in the area had MSS1 running, and had achieved a plant defect failure rate of 3 per cent or better, MSS5 on the GSC accesses and MSS2 on the local exchange accesses were started.

MSS2 brought with it some frustrations, the worst of which was – and still is – that of finding suitable test numbers at exchanges available at the local charge rate.

The most difficult sequence to introduce was MSS3, again mainly due to test number availability. We are still having difficulty with test numbers, some reasons being:

- Not yet provided – returning NU.
- Number changed but THQ not notified.
- Returning wrong conditions. MAC requires test numbers to be of the multi-metering type, that is, only CSA reversal returned.

It would help all MACs if those areas not yet supplied with a MAC would ensure that each of their exchanges had a working multimetering test number. By informing their regional MAC liaison officer everyone will benefit.

MSS8 has now been decided, but causes problems – so we are running it slightly differently at present. Calls on this sequence are made from register access relay sets in the GSC, so we are using it to test the GSC portion of MSS4.

The last sequence to be run was MSS9 which is controlled by THQ. At present we have three GSCs running this.

MAC and the area

From an early stage visits to the MAC in Guildford Area by exchange maintenance staff have been arranged. One or two TOs from each measured exchange meet the centre staff to gain some knowledge of what we do and why we do it. We have an open door to all interested staff regardless of rank or division – and the training officer has us on his list for day visits by third-year apprentices.

Seminars have been held in the area for all levels of management, and continue to be augmented by a fluid interchange of information. Area management is now beginning to use MAC-based statistics in conjunction with the other well established ones, to guide deployment of staff.

MAC centre staff need the cooperation of many divisions within both area and region. Some of the duties involed are: Number Allocation, Clerks of Works, Planning, Trunking and Grading, Internal Works Control, Circuit Provision Group, ASCE, STAR, Traffic Planning, Traffic Routing and – of course – Maintenance or Service.

MAC staff

We have found that MAC staff need to have a broad knowledge of all the switching systems in their area. They can then appreciate how MAC can be used to test specific parts of an exchange or the network. They also need to understand the principles of transmission, as MAC performs transmission tests on approximately one in twenty calls. MAC staff are also trained to operate and maintain the processor – the heart of the system – requiring a knowledge extending from basic Strowger to computers.

Visitors

As Guildford Area's MAC was the first, we expected many visitors. From the very start a variety of interesting people have been entertained. Apart from THQ and regional staff at all levels, we have received visits from a number of engineers from overseas.

Equipment (hardware) experience

Since installation the processor has given over 22 000 hours' service. After a few teething troubles only four failures have occurred.

The twelve special interfaces (sender/receivers) have passed about 1.8M calls with only three amplifier-chip failures.

On the MAC service circuits a single dry joint was found and swarf under a type 23 relay armature caused intermittent lock-up of a concentrator.

The 42 exchange access equipments also had some faults but, generally, we have found the MAC equipment very reliable and easy to maintain.

As with any new system some design problems were found – and we assisted THQ in solving them.

Program (software) experience

Considering the complexity of the MAC software it has been quite reliable. The main problem with software is the time delay between identifying an error and corrective action being taken.

The most interesting – and most difficult – to prove was on CCB timing. The original timings were so tight that a C&FC which passed the tester would fail MAC. This has now been corrected and it works very well.

Sometimes, even our experienced MAC staff have found it difficult to differentiate between a software error and a data error. (Data is the information specifying the particular Area and the calls to be made).

Exchange performance

The improvement in the area MAC results for Plant Defects is shown below, and we expect further improvement during the coming months as MAC-based management strategy takes effect.

	ORIGINAL	AFTER 1 YEAR
MSS1	1.60%	1.00%
MSS2	2.70%	2.10%
MSS3	6.40%	4.80%

Since starting up, hundreds of individual faults have been found with the aid of MAC Analysis Sequences, most of them being common faults such as broken wipers, dis wiper cords, HR solder connections and dirty or out-of-adjustment contacts. But there have been some unexpected faults, such as those described below.

- ☐ A TXE2 Mark 1 exchange, when connected to MAC, had a high percentage of *No Dial Tone*. Extensive investigation revealed two causes:
  - ● low output from the CNG amplifiers, and
  - ● a permanent wiring reversal of the +ve and –ve wires into a register.
- ☐ A rural non-director exchange also had a high percentage of *No Dial Tone*. Investigation revealed that the ringing machine was wrongly connected internally so that it produced pulses all with the same polarity.
- ☐ A new TXK1 exchange was connected to MAC before it was brought into service and promptly failed every subsequent metering check. The Clerk of Works found every ratchet relay had 36 teeth instead of 33. The contractor was able to change them all before the exchange was brought into service so the PO did not lose money.

These are just three of the many cases which show how MAC can highlight

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Measurement Series Sequences (MSS)

MSS1	own exchange	call pattern as customer traffic pattern
MSS2	local dialling area	call pattern as customer traffic pattern
MSS3	STD overall	call pattern as customer traffic pattern
MSS4	STD originating	
MSS5	STD terminating	call pattern as customer traffic pattern
MSS6	ISD	
MSS7	director tandem	call pattern as customer traffic pattern
MSS8	transit access	
MSS9	transit multilink	

Analysis Series Sequences

ASS1	automatic retest with call holding
ASS2	special measurement or call holding

(for a full description of sequences see *POEEJ Vol 71 p28 APR 1978*) problems which may otherwise go unnoticed, and can assist in subsequent fault finding.

Probably the most useful facility on MAC is the ability to use ASS2 (see Table) throughout the 24-hour day without the need for staff to be present. This is particularly useful for testing common equipment during very low traffic periods. We have found, too, that it is not just the maintenance group that benefits from MAC. The area trunking and grading duties use the Plant Engaged figures as a check on overflows and traffic records. Any discrepancies are investigated.

Enthusiastic

We in SETR are enthusiastic about MAC. After two and a half years it is still gaining momentum and we are learning new ways of putting MAC to use in assisting maintenance staff to give our customers an even better quality of service.

(0252 55777)

Key system 4+12– a proprietary SBS

by **Tony Sarginson** STB/S143/2

Edinburgh Telephone Area is about to market trial a proprietary small business system (SBS) – known as Key System 4+12. Twenty are to be installed. The Key System 4+12 has many similarities to the PO developed 'Herald' call connect system to be introduced in London during 1980.

System outline

The versatile, electronic Key System 4+12 offers both intercom and direct public or private exchange access. Designed to be installed in offices, it is small and silent in operation and includes advanced features normally associated with more elaborate systems, such as hold, transfer and conference facilities. It provides for a maximum of 4 exchange lines and 12 extensions. A 4-wire cable connects the extension instruments to a central switching cabinet, two wires being used for speech and two for signalling. The photograph shows the central switching cabinet – or Processor Unit – and a station instrument. The units are fully factory wired. Standard plug-in printed wiring boards (PWB) are inserted to meet the specific requirement – exchange lines and extensions – of each installation. There are four different types of PWB, a fully equipped unit having a total of thirteen.

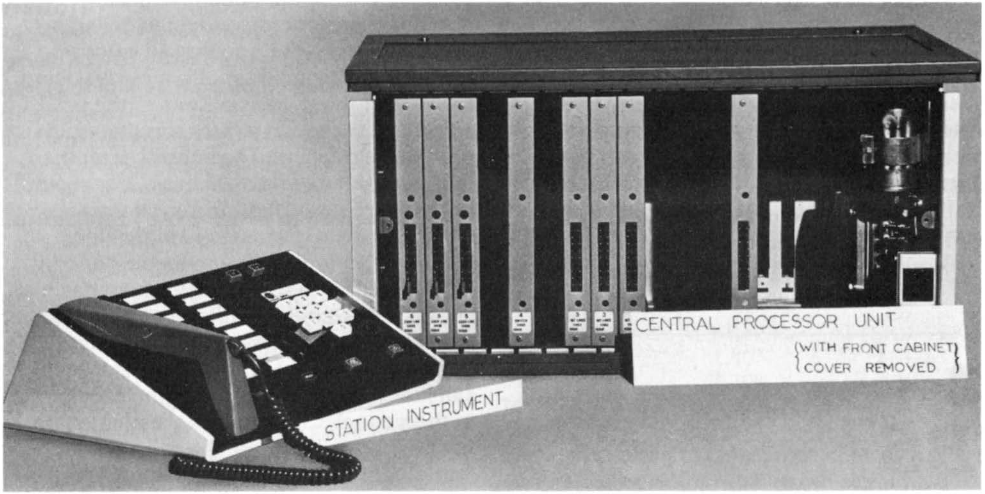
Digital control

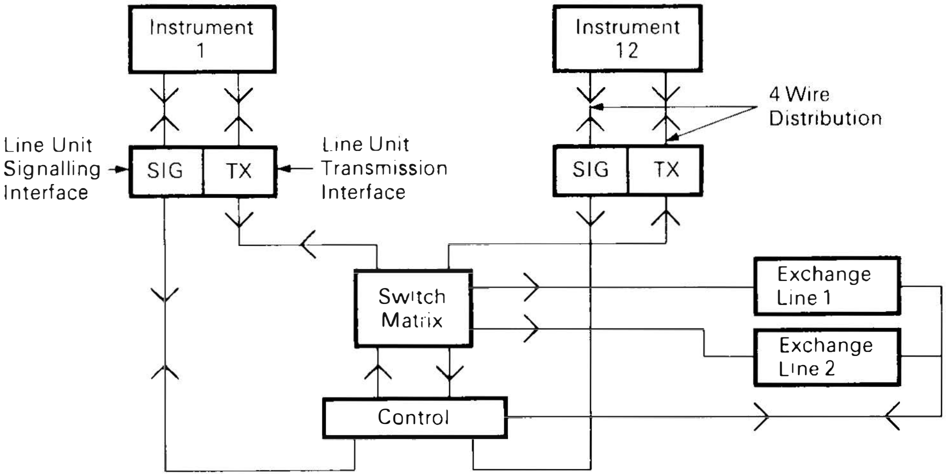
The switching element for the speech circuits uses a single stage of reed relays. The folded matrix arrangement only needs a single crosspoint to be operated per call, the number of crosspoints provided giving a non-blocking system so that all extension stations can be used simultaneously. Using a time-sharing digital technique, the signalling system caters for simultaneous bothway signalling. The control equipment looks at each extension in a cyclic scan and during each interrogation period the extension instrument is sent eight clock pulses. In periods between the first and fifth clock pulses, the station instrument has access to the central equipment during which it sends five data pulses. These five data pulses provide a possible 32 codes which satisfies the maximum signalling requirement of the system. Clock pulses six to eight are used for signalling from the central equipment to the extension instrument.

Maintenance

A handbook has been prepared to help maintenance staff in localising faults. Maintenance of the Processor Unit is based on defective card identification and replacement procedures, that is, associating the loss of certain facilities on the system with the functions of specific cards. Fault location down to a specific card is achieved using logical deduction with the aid of faulting/flow charts and tables contained in the handbook. A faulty card, once identified, is changed with a serviceable replacement. The defective card is then returned to the maintenance AEE who arranges for its repair.

Two complete sets of spare cards and power supplies are held in two purpose-built suitcases designed to protect the cards





Block diagram of the key system 4 + 12 SBS

during transportation between customers' premises and the designated holding/storage area. When a faultsman is called to repair the Processor Unit he collects a suitcase, returning it to the holding point once the repair has been completed. This method ensures that a faultsman has all the necessary equipment to deal with most faults and any spares deficiency can be easily monitored.

Training

Familiarisation training has been given to 21 faultsmen at STB/HQ's Engineering Training Centre in Edinburgh. This one-day course gave them a working knowledge of the facilities available and the operating principles of the system. Special emphasis was placed on faulting techniques using the flow charts, tables and diagrams contained in the maintenance handbook.

Forerunner

The Key System 4+12 will be one of the first modern electronic switching systems available in the customer apparatus market. It is likely to rival present systems such as key and lamp units, small PBXs and house exchange systems. Experience gained by Edinburgh and STB/HQ staff will be useful when the Herald call connect system comes on stream in Scotland.
(031-222 2442)

Stamp it out!

Kaly Sundaran NE/ES5.4.3

Despite an earlier article (*MN* 7) titled 'Why we reject 12 000 requisitions every year', Piece Parts Depot (PPD) of Factories Division at Fordrough Lane, Birmingham, continues to receive incomplete or incorrectly-filled requisition forms. The photograph shows four actual examples recently received by PPD.

When an incorrect or incomplete requisition is received, the depot staff make every effort to dispatch the goods. They consult either with the originator – in cases where the delivery is missing or not clear – or with us if there is a query on the piece part item. Requisitions in which addresses and originator code are missing end up in the WASTE BIN!

It is the intention of PPD and THQ to minimise delays in the supply of piece parts, and to try to overcome the frustration felt when delays occur.

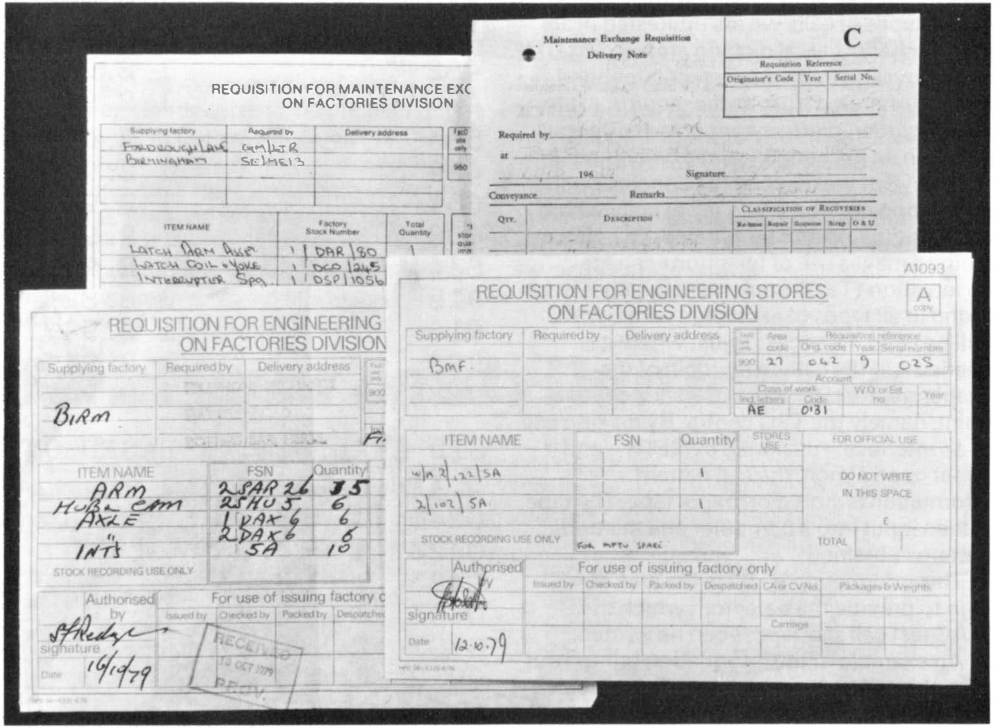
Only with your help can we STAMP OUT the bad practices illustrated. (01-739 3464 Ext 7707)

● *Top left*
No delivery address, incomplete addresses of the originator and the PPD.

● *Bottom left*
Incomplete name and address of the supplying factory. The originator's address which is faint and not easily read is rubber-stamped across the 'Required by' and 'Delivery address' columns.

● *Top right*
Although a legible delivery address is given the handwriting is faint – and no quantity is specified.

● *Bottom right*
The worst example. The full address of Piece Parts Depot should be given. The Originator's Name and Address and that of the stores recipient are missing. Factory Stock Numbers (FSN) have been entered in the column for item names – which are also missing.



Traffic patterns for MAC

by **Geoff Collins** SETR/SM114

To ensure that Measurement and Analysis Centres (MACs) can do their job properly it is important that the test calls sent by MACs are closely related to the patterns of calls made by our customers. In SETR we set out to find an accurate method of achieving this using available equipment.

The types of calls we are interested in are own exchange, local dialling area and STD O/G.

We investigated various recommended methods ranging from traffic records, route calls recorder, printers connected to various points in an exchange – and a 'wet finger in the air!'. But we reached the conclusion that no existing method could tell exactly where a call originated and terminated. Our chosen method makes use of telephone service observation (TSO) equipment which is to be found in all types of exchange where MAC will be used. Its access is just where it is needed – at the calling multiple of the exchange – and it can be used at a central point, namely the TSO centre. By making use of an interface – designed by SETR – and paper-tape punch, the call pattern information is stored on paper tape. The tape is then input into a computer and the traffic patterns obtained.

This information enables the area MAC man to provide the data from which the MAC test call sequences can be written.

An example of the information printed out from the computer analysis is shown below. For clarity, only about 30 calls have been analysed, but it illustrates how the traffic pattern from an exchange is obtained for the types of call of interest – own exchange, local dialling area and STD.

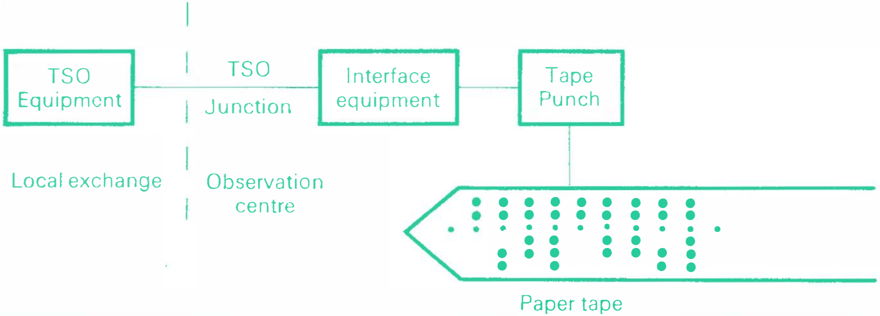
ROUTE ANALYSIS (% BASED ON TOTAL VALID CALLS)

207	2	5.88%	
373	1	2.94%	
410	1	2.94%	OWN
439	1	2.94%	EXCHANGE
440	1	2.94%	CALLS
465	1	2.94%	
482	1	2.94%	
497	1	2.94%	
583	1	2.94%	
629	1	2.94%	
631	1	2.94%	
608	1	2.94%	LOCAL
834	1	2.94%	DIALLING
915	3	8.82%	AREA
916	1	2.94%	CALLS
926	1	2.94%	
9286	1	2.94%	

STD ANALYSIS (% BASED ON TOTAL STD CALLS)

AFN	CALLS	%	AFN	CALLS	%
0240	1	8.33	0255	1	8.33
0323	1	8.33	0424	1	8.33
0483	1	8.33	0504	1	8.33
0603	1	8.33	0634	1	8.33
0701	2	16.67	0895	1	8.33
0912	1	8.33			

(0273 201237)



Stop Press

Prestel – the POs viewdata service – is already available on a local call basis in London, Birmingham and Nottingham, and will spread to more than half the UK telephones during 1980. That was the message put over by Prestel's Director at the 'Fanfare for Prestel' presentation at Wembley recently.

In our next issue of *Maintenance News* we hope to feature an article outlining what Prestel will mean for maintenance staff.

— Editor

Maintenance News aims to provide a medium for two-way communication – that is, between Headquarters and the field. If you want to write about anything you may have seen in *Maintenance News*, or indeed, about any maintenance topic, send your letter to: The Editor, Maintenance News, Room 1130, 207 Old Street, London EC1V 9PS.

Say what you like, but the Editor may tone comments down if he decides to publish.

Do please give your full address.

If you have a contribution to offer to Maintenance News other than a letter to the editor, please forward it through normal channels to the *Maintenance News* agent for your Region or Telecommunications Board. The list is shown below. The editor cannot publish anything to do with current awards suggestions.

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