PANDROL STRONG IN
US RAIL MARKET

DYNAMIC LOADING
OF TRACK

PANDROL IN CANADA

PANDROL PAD
DEVELOPMENT MOVES
ONTOS TRACK

REFORMING BASEPLATES

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Since the opening of Pandal, Incorporated's United States head-
quarters in Bridgeport, New Jersey in 1979 the company's state-side fortunes
have been on a fast track with production output steadily increasing. There are
currently more than 12 million clips in service on 25 railroads and transit
systems in the US.

The plant manufactures both the
PR 60I-A and the 'e' clip, but the 'e' clip has clearly outdistanced the PR 60I-A in
popularity. More than 90% of clip pro-
duction is in 'e' clips.

Also being manufactured at the
Bridgeport plant are 'i'-clips, hook-in
shoulders, and some specialized tie
plates.

The degree of Pandrol's success
in the US market can be measured in part
by the high visibility installations
using the Pandrol system: Installations
such as AMTRAK's 120 mph Northeast
Corridor service on concrete ties, linking
the Boston-to-Washington markets, and the
Burlington Northern's Horseshoe Curve near Crawford, Nebraska, which
commands more than 115 million gross tons
each year.

The Pandrol system is also in use
on Canadian Nationals track through the
Canadian Rockies; the Chessie Systems
sharp curves and tangent track in the
Appalachian Mountains; and 160 miles
on the Long Island Railroads 80 mph
routes.

While these installations have been
well-publicised, there are other projects
which have not received so much atten-
tion, but which clearly demonstrate the
versatility of the Pandrol system and its

Front cover: C P Rail
Back cover: The Pandroler MKV, on the
Norwegian State Railways.

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the railroads who have contributed to the production of this journal and
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The Pennsauken Farnham Bridge
ability to handle some extremely tough jobs. We would like to show four instances which prove our point.

**Burlington Northern’s Trinidad, Colorado 13’ Curve**

This crew change point includes a quarter-mile, 13’ curve, and even though the usual speed through this curve is only 10 mph, derailments and rail rollovers were common. In an effort to solve the problem, two guard rail plates were employed, then a brace plate, then two guard rail plates, etc. The problems continued.

An inspection by Pandrol showed that almost all the guard rail plates had been broken, and that in addition to rail rollover there were gauge problems.

In May 1973, the Pandrol system was installed, using drive screws to hold the plates down. At the time Burlington Northern’s engineers indicated that if even a six-month solution to the problem could be found, they would be very pleased. Since the installation, there have been no gauge problems, no broken plates, no rail rollovers, no derailments, and no clip problems.

**Southern Pacific**

In Klamath Falls, Oregon, the Southern Pacific tracks run along Upper Klamath Lake. Service through this section is 60 mph. When the track was originally installed, fill from the lake bottom was used along a five mile section.

Since the soft fill never solidified, the track structure moved vertically, laterally, and longitudinally with the passage of trains. The major problem was with the longitudinal movement.

There were actually three problems in connection with longitudinal rail movement. If the rail anchors were not properly installed, the rail would slip through the anchor. If the anchor held firmly and the tie was not in top condition, the longitudinal movement would cause the anchorage to gouge the tie until it fit the plate. The plate, in turn, would either pull or shear the spikes. If the other hand, you had a strong anchor and a good tie, the longitudinal movement would drag the tie through the ballast. In many cases, there was as much as eight inches of movement as a train traversed the five mile section.

In May of 84, Southern Pacific re-laid about 70 percent of the ties. Because the track gang was there before the Pandrol Brand clips were installed, there was a period of three weeks where the track and ties were again subjected to the aforementioned forces. Even in that brief period, the problem had begun again, with 1/16 inches of movement measured.

It was at this point that Pandrol arrived on the scene and the Pandrol system was installed using Camcar screws to hold down the plates. Since that installation, there have been no longitudinal movement along the entire five-mile stretch.

**The Benjamin Franklin Bridge**

In addition to a heavy volume of vehicular traffic, this 7400 foot span carries the tracks of the Lindenwood High Speed Commuter Rail Line, connecting the city of Philadelphia with southern New Jersey.

The bridge deck is being replaced, and with its rebuilding of the tracks. Originally the track consisted of CWR on the approaches to the suspension portion of the bridge. Then joined rail on the suspension structure itself. CWR tracks are now being used across the entire bridge span, along with a new rail fastening system that permits the rail to expand and contract independently of the bridge.

Pandrol ties with PR-671A clips are used. A special toe plate is installed between the clip and the plate which keeps the clip from contacting the top side of the rail base. The clearance created is only 1/16 inch, but its thoroughness to permit the rail to slide back and forth in expansion and contraction and remain unaffected by the reaction of the expansion and contraction of the bridge steel against the ties. To handle the extra displacement of the expanding or contracting rail, a total of ten Conley expansion joints are employed.

**Metropolitan Dade County Transit**

The MDCF is a brand new transit system serving the greater Miami, Florida area. Approximately 17 miles of this track is supported by concrete structures.

Because most of the line is aerial, a fastening system had to be designed that would isolate the supporting structures from the stresses of rail expansion and contraction. To accomplish this, Pandrol Inc. and Landis Rail Fastening Systems Inc. developed a system that allows a certain amount of longitudinal rail movement and at the same time is shock absorbing.

The Landis-Pandrol Direct Fixation Fastening System combines the Pandrol 601 B clip and the Pandrol Hook-In Shoulder with the Landis Plate. By virtue of a reduced 600 psi load, this system permits a reduced amount of longitudinal movement (as opposed to Pandrol’s Zero Longitudinal Restraint clip which permits full height rail movement). The Landis plate rests on a custom designed elastomeric pad which absorbs and isolates the shock forces from the support structure.

**A Look Ahead**

One of the things Pandrol will concentrate on is turnouts on wood and concrete ties. A turnout is subject to a wide variety of forces which will typically knock the switch out of adjustment in a relatively short time. In addition, shimming is always a problem.

The Pandrol system offers a number of very distinct advantages. It eliminates low ties, it eliminates the turnout, it improves track modulus and it strengthens the time before any track adjustment is needed.
Dynamic loading of track

Introduction

What are dynamic loads, and why is there such an interest in them? We at Pandrol believe that many if not most track problems are caused by dynamics: if we can understand dynamics this will help us to understand the cause of problems, propose solutions and develop components to minimise or eliminate those problems.

If we look at the improvements which have been made to railway vehicles and track, it would be unfair to say that until the last twenty years developments in both arose largely from intuition and inventiveness based upon practical experience. The limitations upon what could be achieved by these means are illustrated by the fact that most European railway authorities in particular have been driven into studies of vehicle dynamics and stability in their quest for faster trains; this has been particularly so in the last 20 years. Those studies have borne fruit in the faster and more comfortable trains whose design would otherwise have been impossible.

The key is what can be achieved in track design by intuition and practical experience. These are rapidly being reached: analysis and scientific study are now essential to make substantial progress by directing inventiveness into the areas of greatest need. Intuition derived from practical experience tends to give a good appreciation of static behaviour but not of the dynamic behaviour which is largely due to the unforeseen difficulties in present track. By understanding the dynamics of track, we hope to be able to make a greater contribution to better track as has been made to vehicle design by an understanding of vehicle dynamics. In order to consider dynamic loading on track, it is necessary to study the dynamic behaviour of both the track itself and the wheels which run on it. This article treats some basic aspects of the dynamic response of both track and wheels. It is in the frequency range up to about 1500 Hz, in which the greatest damage is caused to track. The emphasis is upon both track on concrete sleepers and upon vertical dynamic loading because we regard that as the principal cause of damage. The wheelset and track are first considered separately and data are given which validate the mathematical models proposed for the two subsystems. These subsystems are then combined to give a model from which can be calculated the dynamic behaviour of a vehicle on the track.

The basis of our experimental work and our mathematical modelling is the response to "harmonic" forces which vary sinusoidally in time with constant amplitude and frequency. This is a particularly attractive technique for several reasons. Amongst these are: simplicity, convenience and the possibility to separate effects of different aspects of dynamic behaviour using the harmonic response. The dynamic models also reveal the frequency range in which the wheels are particularly important with regard to high forces, large displacements and excessive slewing speeds.

Measurement of Dynamic Response

To measure the dynamic response of wheelsets and of the track in situ, we have found that it is particularly convenient to use an impact technique in which the wheelset is struck with an instrumented hammer and its response is measured using an accelerometer. The dynamic response is in terms of the receptance of the system which is the ratio of the displacement of the system to the applied force as a function of frequency and is a complex number i.e. it has magnitude and phase. The phase tells us how much the sinusoidally-varying displacement of the system lags behind the sinusoidally-varying force. If the force is a maximum, the phase lag is 90 degrees with a phase for example, force = stiffness x displacement therefore the receptance = displacement/force = stiffness: the receptance does not vary with frequency and its phase is zero.

This technique enables us to identify the significant resonant behaviour of the wheelset and track in conjunction with the simple mathematical models of track. The effects of effective ballast stiffness and the like in situ can be found which would be difficult to determine otherwise.

Mathematical Modelling

The track model includes the rail itself and the ballast and rail joints. The rail is represented as a continuous beam and the rail and ballast as infinite layers of distributed stiffness and damping. Sleepers are represented as a continuous layer of elements which flex around the track and zero flexural rigidity along it.

Similar models could be proposed for other types of track and to examine different aspects of dynamic behaviour using the harmonic response. The function is to examine the effects of changes to vehicle and track which would be both difficult and expensive to examine experimentally.

For frequencies above about 50 Hz, a typical bogged vehicle can be represented satisfactorily by the simple model shown in Fig. 1. In this model, two rigid bodies representing the bogie and the wheelset are connected by elements of stiffness and damping which represent the primary suspension.

We consider the dynamic behaviour of the track and of the vehicle separately. The two subsystems are subsequently combined to find their response to irregularities which exist on the wheel track and on the running surface of the rail.

Dynamic Response of Vehicle

Dynamic Response of the Track

The effects of railpad and of ballast on the dynamic contact force between wheel and rail on sleeper strain and on fastening deflection are considered here because their influence is particularly significant and interesting.

Rail Pad Stiffness

The dynamic contact force is shown in Fig. 4 for different railpad stiffness. The figure of 125 N/m is typical of a pad which we have developed for British Rail specifically to attenuate dynamic forces on sleepers and on the track. Our laboratory field

ballast. The receptance then decreases to a minimum at about 100 Hz where the sleepers bounce on the railpad - energy put into the track at the railhead is taken away in vibration of the sleepers. At about 200 Hz there is another resonance at the railhead: here the sleepers bounce and the rail moves on the resilience of the rail pad.
phase with an irregularity at low frequency which implies that the force is high in troughs of an irregularity. Hence, long wavelength irregularities on the rail tend to grow by cumulative plastic flow. The force is in antiphase to irregularities at high frequency, the normal force is low in troughs of irregularity which encourages slip and wear.

Exacerbation of the effects of sleeper resonance by a stiff railpad is even more noticeable at the sleeper itself (Fig. 3). The peaks which appear in contact force at frequencies of about 200 Hz and 700 Hz are even clearer in the behaviour of the sleeper and emphasize that these maxima arise largely from sleeper resonance. There is also a further resonance at about 1300 Hz whose effects are insignificant at the railhead. These maxima occur at about 200 Hz, 700 Hz and 1350 Hz. These correspond to symmetric modes of vibration in which the sleeper resonates in approximately V-W and V-V shapes respectively. There are.

which is either frozen solid or well-consolidated has relatively high damping. An explanation for this behaviour may be found if we look at where damping comes from in the ballast. A hypothesis which is both plausible and consistent with observed characteristics in track is that damping arises from accommodation of physical movement between the vibrating sleepers through the ballast to the ground, so that the path for wave transmission is improved, such as occurs with well-consolidated and frozen ballast. Damping is correspondingly increased.

Discrete Irregularities

Irregularities on the running surfaces of wheel and rail are rarely as uniform as has assumed in the idealisation described above. However, using the technique of Fourier transformation we can find the response to discrete and periodic irregularities from a knowledge of the character of the fluctuating load component of the force.

In this analysis our ability to predict many aspects of the track behaviour from a knowledge of the characteristics of the most significant components has been demonstrated. We have developed laboratory experiments which give us the ability to find those components from relatively simple measurements. These experiments combined with our measurements in track and our mathematical modelling are powerful tools to direct us to the requirements for a particular application, and to help us to develop the correct components for those applications.
As if the problems of traffic and terrain were not enough, the Canadian railways are also faced with something called winter. Naturally, the worst winter conditions are experienced in Western Canada where there are the most difficult operating conditions and heaviest traffic. Temperatures of -40 degrees C and snowfall accumulations of 1100 centimetres are quite normal. This reduces track maintenance time available to approximately 6 months per year.

In the late 1960s the railways were faced with deciding what to do in order to combat the growing problems caused by increasing axle loads and heavier train weights. Market pressures and car building technology had pushed car capacities up to 90 tons to 100 tons. The following figures from CN Rail show an example of traffic demands. CN Rail experience is very similar. Great, annual tonnage on the Winnipeg to Vancouver line increased by more than 30% between 1968 and 1978, and whereas in 1968 there were no 100 ton cars in service on that line by 1978, between 15 and 25% of the cars on the line were 100 ton cars. By 1988, CN Rail predicted that traffic would run to 60 MGT and 60% of the cars in service would be 100 ton cars.

Further the timber in Western Canada is predominantly softwood and certainly not ideal for sleepers. In many of the sharper curves, the softwood sleepers used were unable to withstand the vertical and lateral loads. With the result that the plate to sleeper fastenings began to fail under traffic. In many cases this would result in the rail rolling over with subsequent devastating effects. In one year alone, CN Rail experienced 93 derailments, the majority of which were attributable to track failures. To make matters worse, the predicted shortage of timber materialized which severely restricted sleeper replacement programmes.

In 1972, the initial major order for concrete sleepers and Pandrol clips was placed by CN Rail from UK sources. The four mile test site chosen was one that saw the heaviest annual tonnage in the system, had many sharp curves and a continuous descending grade ranging from 0.2 to 0.4%. The test section was completed by the end of the summer 1972 and monitoring of the performance of the new track began.

By 1974, the timber shortage continued to worsen and it was clear that the Railways would not be able to meet its replacement programme using wood sleepers. Further slow orders due to
track related problems with wood sleepers continued to increase and a decision to order 300,000 concrete sleepers with Pandrol Brand fasteners over three years was made. This was followed by a five year plan that involved installing 300,000 concrete sleepers per year.

The year 1974 was also the year of decision for Pandrol and, based on the CN Rail long range plans concerning concrete sleepers, Pandrol Canada Limited was born as a joint venture company between Elastic Rail Spike Company Limited and IEC-Holden Limited. Hiring of staff and installation of equipment commenced in the fall of that year. The plant was officially opened on May 14, 1975 with an order book of 120,000 clips for CN Rail and 50,000 clips for the Toronto Transit Commission. After this rather humble beginning, the Pandrol Rail Fastening System very quickly took hold in Canada and, as of this date, has produced almost 19 million clips.

All the above seems very simple and straightforward. In reality there were a number of hurdles to be overcome before the relatively sophisticated and expensive sleeper/fastening became acceptable for large scale use in Canada.

The first obstacle was the cost. CN Rail experimented first with sleeper spacing of 76.2cm but quickly found this was a mistake. The sleepers and rail were strong enough, but track line and surface could not be maintained. The shear strength of the ballast and subgrade had been exceeded, and in places the ballast lifted itself in ballast to the railroad.

In Pandrol's favour, the wood sleeper prices continued to escalate, the availability of suitable wood sleepers went down, and slow orders increased due to sleeper conditions the railways could do nothing about. Although marginally still more expensive than the conventional wood sleeper system, the Pandrol system was obviously the way out of the problem.

Having overcome the economics of using concrete sleepers on a large scale, the railway had to address the feasibility of installation at a labour cost that would make it economically attractive. It must be remembered that in Canada there is basically only a 6 month work season, most of the areas where concrete sleepers would be used were remote and, for the most part, inaccessible areas, and time on track was being reduced due to increasing traffic on the single main lines. This difficulty was overcome with the development of a highly organised, specialised and mechanised track laying system.

Pandrol too had its problems since accessory components suitable for lighter weight, faster trains were certainly not adequate for the heavy haul conditions of Canada. Rail pads and insulators were lasting less than one year and, this was certainly not acceptable. These problems were overcome with the development of an ENA rail pad and a heavy duty composite insulator. On a positive note, the Pandrol clip and shoulder designs have required no upgrading and have proven themselves capable of handling the most severe conditions encountered by the Canadian railways. In fact, CN Rail has had such good performance from the flat toe PR type clip that there is some difficulty in getting this railway to test the new type clip in spite of its obvious benefits.

As well as the large volume concrete sleeper business, Pandrol's local facility

C P Rail rail slab track

has contributed significantly to its success in the transit systems in Toronto, Calgary and Edmonton as well as to host of smaller industrial applications.

But in the end, the railways are the backbone of the Canadian operation and other advances have been made for example in turnouts. In conjunction with CN Rail, Pandrol has designed a completely Pandrolised wood sleeper main line turnout referred to by CN Engineering as their 'Super Switch'. The design incorporates field-on-pressed steel shoulders and a major conversion programme has been in place for over three years.

A logical extension of the above is the concrete beaver turnout and CN Rail installed in 1984 the first such turnout in North America on their main line in the Rocky Mountains of Western Canada.

After a year of heavy haul service the turnout is in perfect shape and will most certainly lead to more applications in the future. This has been a joint effort and many of the other Pandrol group companies have contributed to Pandrol Canada's success.

But not all development work is confined to CN Rail as might be indicated by the preceding. CP Rail is currently digging a 14.5 km tunnel in the Rocky Mountains to reduce their heavy haul line to the west coast of Canada. To get away from the problems associated with sleepers and ballast in tunnels, CP Rail is considering using a continuous paved slab for this project.

As a result, a trial slab of approximately 100 metres with Pandrol's clips was constructed in the fall of 1984 on the main line to test its performance under conditions which would be experienced in the tunnel. We realize that slab track construction is not new but we are not aware of any slab in service under the heavy haul conditions of CP Rail. Therefore the track fastenings to be used were designed by Pandrol specially to meet the requirements. After full discussion with CP Rail on the expected track conditions an extensive test programme was laid down. Corrosion, shoulder extraction, rail pad, assembly and clip static and fatigue tests were undertaken at normal and/or -30 degrees centigrade temperatures. At the end of the test programme Pandrol was able to put forward a package of tested components for the final test - the slab track trial length.

But where next? The Canadian railways feel concrete sleepers are the way to go but clearly are not for use everywhere. At their present cost they can only afford to install them on curves two degrees and over and tangents up to a mile long between them, where traffic exceeds 20 million gross tons annually. Under these conditions the superior system has paid off handsomely. But gradually the places where our system can be installed are running out.

CN Rail has now asked the sleeper manufacturer if a less expensive sleeper could be designed for use on tangents and easy curves on high speed track. Design of such a tie presents a double quandrum. A lighter sleeper necessarily would not be as strong as the current sleeper but on high speed track impacts from flat or shellled rails would be worse. To reduce shock a more effective rail pad is required.

Pandrol has made arrangements with CN Rail and Geometric Costain for a jointly financed and researched test on CN Rails main line east of Edmonton, Alberta, on a straight level stretch of track where the speed is 130 km/hr for passenger trains and 95 km/hr for freight. A number of concrete sleepers, modified to accept rail pads up to 19mm thick have been installed and sleeper stresses will be measured under both revenue trains and special work trains with wheel flats and shells. The stresses will be measured with rail pads of varying thicknesses and compositions. Analysis of the results will be done at Group Headquarters in London.

Something useful for the design of a new lighter sleeper may emerge from this analysis.
Pandrol pad development moves onto track

In the last issue of Track Report, we described the Batelle Type Impact Rig, which is used by Pandrol to obtain data on the impact attenuation behaviour of rail pads. Since then, extensive in-track trials have taken place, which have provided us with invaluable data.

In June 1985, thirteen special concrete sleepers were installed in British Rail's West Coast Main Line, between Wigan and Preston. The sleepers were fitted with high shoulders to enable pads to be used which were up to 20mm thick. Three of the sleepers were instrumented in the same way as those used in the Impact rig. As each train passed over the test site, the sleeper bending strains were measured and recorded on magnetic tape. The data was then taken back to Pandrol's London office, where it was played back and transferred to a Tektronix desk-top computer. A specially developed software package was used to evaluate the data and produce comparative statistics of sleeper bending behaviour under different types of pads.

During the course of the experiment, fourteen different experimental pad types were used and data recorded for a total of more than one thousand passing trains. These included a large number of fast passenger services (150-175 km/hr) and freight trains with axle loads up to 25 tonnes. The results have been compared with impact test results, and with the results of mathematical models of track dynamics, and in both cases excellent correlation has been found.

The graph shows data obtained on pads of 30mm thickness and indicates that high frequency sleeper bending strains may be reduced to less than half of the level expected with a conventional 5mm thick plastic rail pad. Pandrol's own resilient pad (letter G on the graph) and those of three other manufacturers (G, F and H) are being supplied to British Rail for evaluation on their new F40 sleeper.

Statistical analysis based on the in-track results suggest that in the case of the type G pad, the worst positive bending strains expected during the life of a sleeper would be reduced by about 16%, and the worst negative bending strains by as much as 65%, compared with sleepers fitted with 5mm EVA pads. Additional tests carried out on the same displacement transducers and by optical interferometers have met with very limited success. Conventional contacting transducers are unable to measure high frequency vibrations of the track, and are also subject to electromagnetic interference, particularly on electrified track. The use of a laser to measure track vibrations by interferometry requires a stable reference base for the laser. This is difficult to achieve in a railway environment because of the vibration of the ground induced by the passing train.

Pandrol is now evaluating a revolutionary new optical device which has been designed for us by Cambridge Consultants Limited. The use of optical fibre in conjunction with a miniature optical sensing head makes the system non-contacting, electronically passive and self-contained. The transducer is designed specifically to measure relative vibrations of rail and sleeper and can be quickly and easily installed on almost any type of track. Initial trials have been very encouraging, and we expect to include the use of this device in our inventory of routine test techniques in the near future.
Reforming baseplates

How do you convert existing track fastening components to provide a modern resilient system? That was the problem uppermost in the minds of Australia's Westrail Engineers, faced as they were by an accumulated stockpile containing in excess of one million rail baseplates. These were recovered from the upgrading of the Kiama-Knowsbleib railway, where timber sleepers had been replaced by concrete sleepers. The Westrail situation was a unique opportunity and a considerable challenge and this has now been successfully met by Pandrol Australia Pty Limited in conjunction with Westrail. This problem, which may also be faced by other railways under similar circumstances, now has a unique solution.

A method of reforming rail baseplates in an acceptable technical and economic way has been developed using a simple forging process. The standard double shouldered dogspike baseplate can now be modified and equipped with two Pandrol Brand rail clip housings before returning it to service.

The modified plate design incorporates the two new clip housings diagonally opposite one another. These housings may be incorporated in the original plate should, it be alternatively fitted away from the sleeper, as in the case of the Westrail design. In respect to the plate spike hole patterns, many configurations are encountered and these vary from railway to railway. The design of the modified plates has been developed to accommodate these hole variations and generally it is not necessary to punch any extra plate holes.

Pandrol Australia Pty Limited has also developed a special range of plate Lockspikes which can be used in the previous gauge spike holes. These new Lockspikes do not impede the insertion or withdrawal of the rail and there is no need to disturb them once they are installed, which considerably increases the life of the timber sleeper and reduces 'spike killing'.

The resulting assembly provides an 'indirect' rail fastening system whereby the rail is held in the baseplate by two Pandrol clip plates and the baseplate is securely and independently fastened to the timber sleeper. For those not familiar with the Pandrol system, the two Pandrol clips provide the resilient component and they can be readily installed and removed quickly by means of a hammer, Panderator tool or Pandroller machine.

In some instances the pre-plating of timber sleepers can substantially reduce site work and costs, and this modified Pandrol baseplate assembly can be used in this manner with the ensuing technical and cost benefits. So far design modifications have been made for three Australian 41/50 kg and 33/60 kg rail baseplates and several others.

In the early testing stages the clips were formed leaving tooth ends open. To improve the design further the plate end achieved a smooth profile; this was later modified so that only one end of the housing remains open to receive the Pandrol clip.

Some reduction in the plate bearing area results from the introduction of the clip housings. However any disadvantage from this is far outweighed by the accrued benefits of conversion to an indirect rail fastening system and by substantially reducing sleeper plate interaction which causes damage to the sleeper under traffic.

During the development period, Pandrol Laboratories successfully tested the assembly and proved the technical integrity of the system. As a parallel test Westrail installed assemblies provided by Pandrol Australia Pty Limited in an operational track adjacent to a mechanical joint. By doing so service confidence was established in the concept leading in due course to full-scale trials and ultimately to the acceptance in larger installations. The original in-track test
has now successfully carried in excess of 32 MGT. As an ongoing programme Pandrol has carried out further rigorous laboratory testing to provide additional technical data to meet customer requirements.

The baseplates may require inspection before being processed in order to establish the quality and suitability. Any tolerance variations in plate widths have to be assessed so that this can be accommodated in the design and ensure that all the technical requirements are met.

The plates are heated prior to pressing. This ensures that the plate material is normalised and any preconditioning effects from earlier service, such as work-hardening, are minimised or eradicated.

In the case of the Westrail baseplates the surplus stockpile was located adjacent to the Midland Railway workshops, so that by utilising their own manpower and facilities close at hand, Westrail substantially cut down handling and manufacturing costs.

Some 100,000 baseplates for rail with a 128mm foot width (i.e. 41, 47 and 50 kg/m rails) are planned or already installed by Westrail in 1983/84. These will be located in the Mundaring-Jarrahdale bausage line, the Kallandoorong-Kalgoorlie transcontinental railway and the South-West lines between Pinjarra and Bunbury. Axle loads of up to 25 tonnes are experienced on alignments incorporating minimum curvature radius of 200m and gradients up to 2.5%. In 40T Trains are operated at speeds up to 90 kph with consistent weights of up to 4800 tonnes.

This significant breakthrough in recycling a most important costly item of track componentry has also caught the imagination and interest of a number of railways. To support this Pandrol Australia Pty Limited has provided its own baseplate pressing facilities at its new Blacktown factory in New South Wales.

The co-operation between Westrail and Pandrol Australia Pty Limited in the first instance has shown that where logistical restraints exist and economics dictate, a workable, satisfactory and cost-effective solution can be mutually achieved. Other Railways in Australia have now acknowledged this development. Further installations have been made and will be reported on in a later issue of Track Report.