Tomorrow's train, today.
InterCity APT

InterCity APT marks the biggest single advance in improved train performance achieved by any railway in the world.

APT offers:

- Ability to run on trains at speeds 20% to 40% higher than conventional trains.
- Journey times reduced by 20% or more on existing tracks.
- Energy consumption at 125 mph - 20% less than a conventional electric train at 100 mph. Less than a High Speed Train at full speed.
- Operating costs per seat-mile similar to conventional trains.
- Improved productivity through higher utilisation of trains and reduced manpower.
Faster trains—commercial rewards

The Advanced Passenger Train (APT) has been developed in direct response to the need for reduced journey times achieved by high average speeds. Market research and analysis in Britain and many other countries has shown conclusively that the most important factor in attracting passengers to rail travel is a shorter journey time.

One solution is to build new lines or to redevelop existing lines. There are, however, constraints to building new lines which are both economic and political. The other solution is to develop high-speed trains which can run on existing tracks to achieve the required reduction in journey times. These trains are capable of running at speeds of up to 125 mph, resulting in considerable increase in passenger journeys.

Electric traction - the route from London to Liverpool and Manchester was completed in 1966-7 and provided a major improvement in passenger and freight journey times. As a result, four years' passenger turnover had doubled and British Rail invested the 1970s with plans to build on this success.

The aim was to build a new route - the Midland Main Line - to compete head-on with the existing competitor on traffic routes. The new route is more direct, more convenient and more efficient for rail traffic.

The experience of the West Coast main line, the new route of the year 2000, is that the route is able to achieve a 15% increase in passenger traffic and a 25% increase in freight traffic.

The basic design of the Advanced Passenger Train (APT) is based on the Electric Multiple Unit (EMU) technology, which is already in use on the West Coast main line. The APT is designed to run on existing tracks and to be capable of running at speeds of up to 125 mph. The APT is designed to be able to run on existing tracks and to be capable of running at speeds of up to 125 mph.
APT-the objectives

The primary aim of the Advanced Passenger Train (APT) project has been to evolve a new design of train which combines higher speeds to local stations with lower running costs, operating costs similar to slower, conventional trains.

This objective was seen by British Rail as the best solution to their customers' requirement for shorter journey times but also retained the existing system to be exploited for its productivity to be improved. It resulted in a design which could be translated by another country who thought significant increases in train speeds required for the more costly construction of new routes.

But the development of a train which could operate economically meant that it would be attractive to others. The initial concern was being carried out in our nation, but the trials defined the standards no one would want to alter.

As the driving wheels are no longer much inside the vehicle, it has to be capable of travelling round curves at higher speeds than conventional vehicles.

The major factors governing a design speed on conventional lines is speed restrictions due to the maximum axle weights permitted. Approximately 30 per cent of the UK main lines in the UK are of this nature, and the maximum safe speed is usually 100 km/h.

APT allows shorter journeys to be achieved because of lower friction. This enabled trains to operate at much higher speeds in isolation, many conventional trains, while maintaining passenger comfort by having the coaches bodies moved by up to some degree.

Also included in the rough objectives set for APT were energy efficiency, low environmental impact, acceptable to rail network, and a cost per seat mile similar to conventional trains.

APT's achievement

This last one of energy has been attained by lightweight construction, by a substantial reduction in aerodynamic drag through careful attention to a maximising of the train nose and tail profiles, and by achieving overall smoothness of the external surfaces.

An APT at 125 mph (200 km/h) uses only as much energy as a conventional train of equivalent passenger capacity travelling at 100 mph (160 km/h) and is electrically powered. APT thus has a lower energy of 125 mph (200 km/h) than a diesel powered High Speed Train at the same speed.

Train weight has been minimised by using aluminium alloy and the use of aerodynamic Parlours. The centre of gravity is related to a central position, this reduces the power needed to move APT, and reduces costs and means less noise inside the train.

In order to travel round curves at higher speeds, APT has a completely new suspension system that combines stiffness and hearing ride quality. The train achieves a maximum speed of 125 mph (200 km/h).
Theory into practice

Javelin APT began in 1967 as an integral part of fundamental research into the dynamic effects of train running on track. This important project was conceived by British Rail Research Directorate Derby and sponsored jointly by British Rail and the UK Government. The prime target of the project was the design, development, and testing of an electrically driven train for operation in normal service along conventional, unmodified track. Its construction was intended to be used for running APT prototype trains on the Derby to Nottingham route at speeds of up to 125 mph (200 km/h) to assess the dynamic effects of trains running at such speeds on track. The project also aimed to develop a new generation of electric traction technology and to investigate the potential for using electric trains in rolling stock applications.

A prototype electric train was developed for the Javelin APT project in the late 1960s. The train was designed to operate on conventional, unmodified track and was intended to be used for running prototype trains on the Derby to Nottingham route at speeds of up to 125 mph (200 km/h) to assess the dynamic effects of trains running at such speeds on track. The project also aimed to develop a new generation of electric traction technology and to investigate the potential for using electric trains in rolling stock applications.

After testing, the prototype train was subjected to dynamic tests. The vehicle was then fitted with a new traction system and tested on track. The performance of the prototype train was assessed based on the results of these tests. The project also aimed to develop a new generation of electric traction technology and to investigate the potential for using electric trains in rolling stock applications.

The train was then subjected to further dynamic tests and was fitted with a new traction system before being returned to service. The project also aimed to develop a new generation of electric traction technology and to investigate the potential for using electric trains in rolling stock applications.

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The title Advanced Passenger Train was no
accident, for the basic concept throughout the project
has been the use of advanced technology to achieve
higher speeds on all routes.

Not only has the project required the designers
to incorporate and develop new technological
techniques in the train itself, but it has required
advanced methods and systems to be used on all its
associated aspects, including the manufacturing stage.

Development of APT has been the theoretical
precedent through to construction of four
pre-production prototypes, each built on the
site of Derby and, in recognition of this, one of two
4,000 horse power D222 electric power cars
for the first passenger-carrying APT has been
named after the city.

Following the experimental development stage
by the Research Division, the design plans for
passenger service was undertaken by British Rail's
Chief Mechanical and Electrical Engineer's
department at Derby, working closely with Salford
Engineering Limited.

RRL provided the manufacturing facilities and
its workshops in Derby were developed to handle
APT's advanced design, particularly the construction
of passenger vehicles using automatic aluminium
welding techniques.
APT into service

Pre-production APTs
Experience gained from the APT's trial enabled British Railways to prepare plans for an even larger-scale APT operation during the 1980's.

The first step to the decision to build a limited number of electrically powered trains which would be used in passenger service. These would provide experience of construction and operating techniques, on which quantity production of an APT fleet could be based.

Each APT - which offers the best combination of speed, cost and energy efficiency - can be built as a single vehicle. With 10 pressurized vehicles and one power car, it is capable of a maximum speed of 125 mph (200 km/h). The other, with 12 passenger cars and one power car, has a maximum speed of 155 mph (250 km/h) and this configuration has been adopted for his three pre-production trains.

Power car
Each power car, using lightweight steel construction and a multi-year cycle electrical equipment supplied by power of three converters (Max=6000 kVA) and power of three driving four axles. In this type of train, various electrical motor-generator sets are mounted inside the body of the power car, with normal shut-down at relay signals. The power at the rear end is conveyed to the front end, while the additional wheels are also provided with motors. This is a characteristic feature of the current, to continue to maintain adequate contact with the overhead wire.
APT into service

Passenger vehicles

The passenger vehicles, including first and second class, are accommodated within three and four vehicle units. All passenger units are equipped with air conditioning.

A new seating arrangement has been adopted to ensure satisfactory cabin conditions, and to provide maximum passenger comfort.

Each group of six passenger vehicles is centrally controlled and monitored, and the power car can be left unattended while the train is in motion, with a minimal crew of one or two men.

Passenger facilities

The internal environment of APT has been planned and designed to the highest standards and follows the trend already set in the popular high-speed trains.

To save energy, the passenger vehicles are built from lightweight all-aluminium alloy, which gives an overall weight saving of 35% as compared to conventional designs. This, in turn, helps to ensure a good balance at high speeds.

Once inside, and at the front of the passenger power car, are electrically operated sink and plug points, with extractable steps, and a passenger car which has two doors opposed diagonally, so saving vehicle length and weight.

Each second class coach with 22 passengers, and 47 seats are provided in the first class sections.

Seats are attractively finished in the new blue, and fitted with armrests, headrests, and a luggage rack.

The cars are air conditioned.
APT into service

Catering facilities

The configuration of the passenger trains and the reduction of passenger times, which have been achieved with APT's latest models, have led to a new approach to catering arrangements.

The popular range of food, from the evening meal to breakfast, and snacks and drinks, available to the passengers, is one of the many facilities that make the journey enjoyable. APT's catering staff are trained to offer a wide variety of dishes and drinks, ensuring a comfortable and enjoyable trip.

Train staff

The high-quality environment for passengers is maintained by the dedicated staff who work on the trains, and are supported by the catering teams.

Driver and crew control

APT's trains are equipped with advanced train information systems which enable them to work in close cooperation with the drivers. These systems provide the necessary information to the driver, such as speed limits, platform numbers, and other important details, ensuring a safe and smooth journey.

Easy maintenance

All electrical equipment, including the control mechanisms and the brake control system, is easily accessible. This makes it possible to repair or replace components quickly and efficiently.

1. Driver's cab features
2. Electronic equipment layout
3. Offichi design of the driver's cab and rear controls
4. Easy access to the control panel
5. Control devices and monitoring systems for passenger comfort and safety

APT into service

Passenger facilities

All the vehicles are lightweight and also incorporate electronic control and monitoring systems, which can provide real-time 'on-board' operating reports. The system also includes a graphics interface allowing the driver to identify potential service or vehicle problems.

Vehicle tilting

Passenger comfort is maximised where the train is running round curves at high speed by tilting each wheel to an angle according to the speed of the train. This provides a smooth ride for the passengers. The tilting is achieved by the driver's commands, and the system uses precision sensors to measure the inclination of the track.

Braking

British Rail's decision to develop a train capable of higher speeds on its existing track required the development of a braking system that would handle an APT's stop with the distance between running signals.

The braking system achieved a maximum speed of 155 mph (249 km/h) and maintained a positive braking effect under any weather conditions. The system consists of a vacuum-operated electro-mechanical brake and a hydraulically operated emergency braking system, both of which are designed specifically for APT operation.
Inter-City APT—the next steps

Inter-City APT has already proven exceptionally successful and will see a significant extension of its network in the next five years. The present APT service operates 12 trains per day through 13 stations on a 440-mile route between London and Manchester. It is expected that the new service will operate five trains per day between London and Manchester, with an additional service to Liverpool and Leeds. The new service will commence operation in 1983, and a further extension to Edinburgh in 1984.

Inter-City APT currently operates with a maximum service speed of 220 mph. The new service is expected to operate at a maximum speed of 250 mph.

A major achievement in the development of APT is the introduction of a new type of train, the BAE 146/200, which will be introduced into service in 1983. This new train will be able to accelerate from 0 to 250 mph in 3.5 minutes, and is designed to operate on the high-speed lines.

The new service is expected to reduce journey times significantly. For example, the journey time from London to Manchester will be reduced from 3.5 hours to 2.5 hours.

The new service will also provide a significant improvement in the level of service, with more frequent stops and a more comfortable environment for passengers.