Speed for the Seventies

HST

High Speed Ahead

Many factors help to attract more passengers to rail. Better coaches, more frequent services, brighter stations, improved catering – these are some of the most obvious, and the steadily changing pattern throughout British Rail shows that they are not being overlooked.

But market research and analyses of service characteristics and traffic trends show that the most significant factor is speed and the shorter journey time that it brings.

This booklet explains how British Rail – on the track and in the workshops, at the drawing-board and in the laboratory – are gearing themselves to meet the progressive demands for faster travel.

The prototype High-Speed Train pictured (receding from the camera) during a trial run on 6 June 1973 when it reached 131 mph, beating a 35-year-old British speed record set by the steam locomotive Mallard in 1938. Five days later, on 11 June, HST broke the world record for diesel trains, held by Germany since 1939, by achieving 141 mph. On 12 June HST reached 143 mph on a further trial run.

The High-Speed Train (HST), now beginning its passenger-carrying trials, is the intermediate stage for non-electrified routes of a comprehensive high-speed programme for British Rail's Inter-City services.

Building a new kind of railway or a completely new kind of train to run on it is a long process – it can take 10 years to bring to operational fruition the first concept of a scheme.

So long-range planning is a vital feature of running a modern and progressive railway system.

There are three clear-cut stages in the plan for Inter-City.

STAGE I centred on two main projects –

(i) the electrification of the main rail artery between London, Birmingham and Manchester/Liverpool, using the 25kV overhead system;
(ii) the development of high-performance diesel locomotives for the routes not being electrified.

Between them, these projects created the Inter-City passenger services of today, with top speeds of 100 mph and average speeds close to and in some cases exceeding 80 mph. These services have set standards of combined speed and frequency which are unsurpassed in the world. With a reduction in journey time from nearly four hours to 2½ hours, traffic on the Euston–Manchester/Liverpool routes doubled in the first five years.

Building on success, British Rail are now extending electrification to Glasgow. When the work is completed in 1974, the rejuvenated route will link the country's five major centres of industry and population.

STAGE II of the programme is the introduction of the High-Speed Train, designed for a maximum operating speed of 125 mph.

As soon as service trials are completed and production models are built, the High-Speed Train will begin to take over the major Inter-City services on non-electrified lines, bringing higher average speeds to a steadily wider spread of those services and releasing more and more of the present Inter-City trains to give faster journey times to secondary services – so raising the average speed of *all* train services and making the railway as a whole more competitive with all other forms of passenger transport.

STAGE III will see the introduction of the Advanced Passenger Train (APT), an experimental version of which is already being tested. It will travel at speeds up to 155 mph but it is not just a fast train; it is a major technological breakthrough in advance of developments on any other railway in the world. Its still higher speed will come largely from better performance on curves. The first prototypes will use electric traction.

Why Two New Trains?

Why are two new types of train being developed?

There are limits to the extent to which British Rail can improve speeds with the present range and style of traction.

Existing diesel locomotives and coaches are operating at the maximum speed possible within their design limitations.

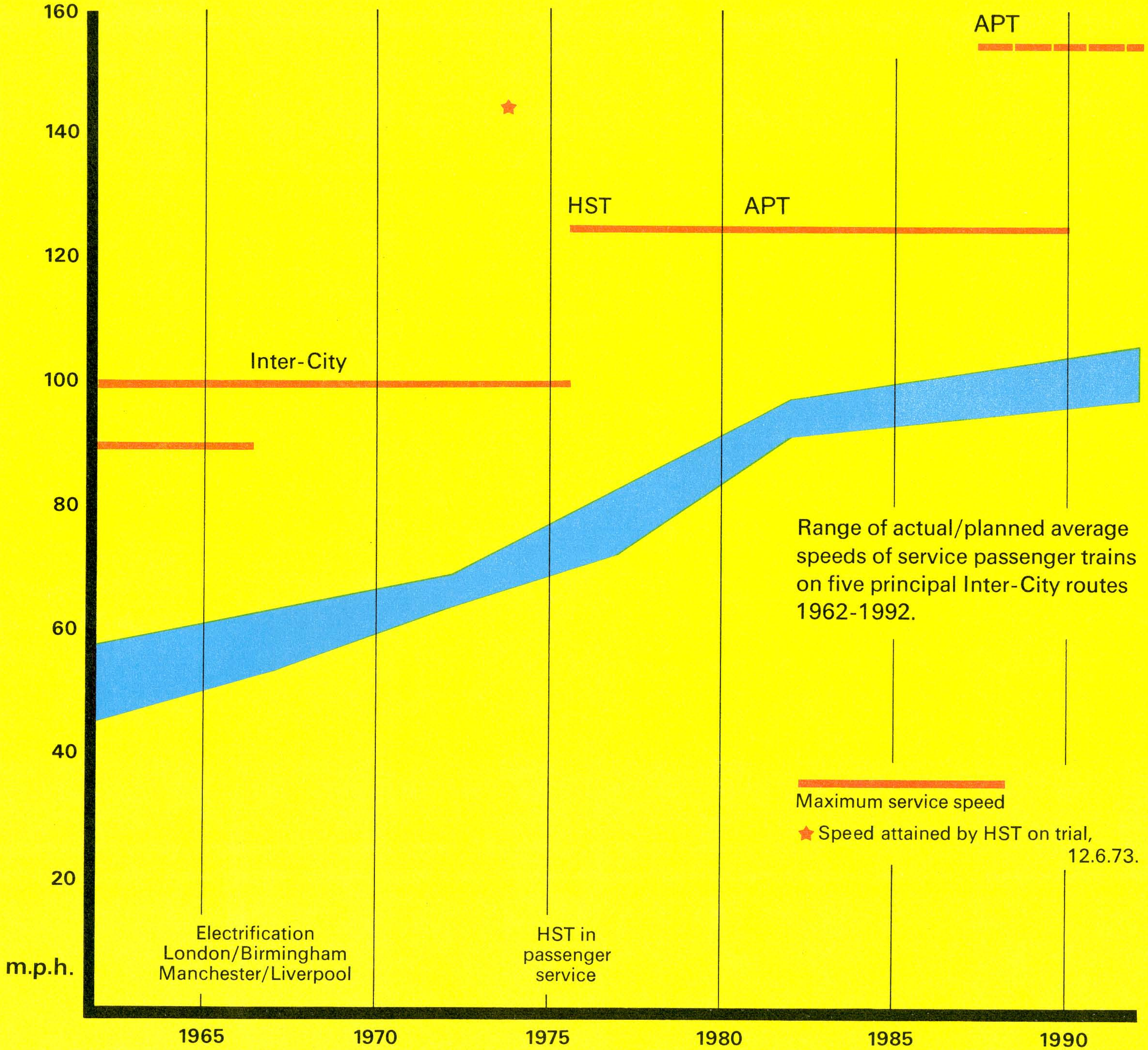
Reduced journey times are a vital commercial need, and the choice which ultimately determined British Rail's strategy was between building a totally new railway or adapting the existing railway to give better journey times with new rolling stock.

European administrations, faced with a similar problem, decided on the Trans-Europ Express (TEE) approach which has resulted in a network of excellent but all first-class trains, available to a limited number of passengers on payment of a supplement.

But BR decided that money for improvement should not be restricted to a few crack trains, but should instead be spent in such a way as to provide improvements in speed and comfort for all passengers on all British Rail's main services.

The design requirements of both HST and APT are that they must be able to operate on the existing railway and at a cost per seat-mile about the same as conventional trains.

Production models of the HST are scheduled to enter passenger service towards the end of 1975, and will generate new Inter-City business on the non-electrified routes. As the HSTs are displaced by APTs on the principal Inter-City routes they will be transferred to improve services on other routes where, although the top speed of 125 mph may not be so important, their rapid acceleration, resulting from the high power-to-weight ratio, can significantly cut journey times. This "cascade" effect will give another boost to the average speed of all long-distance services.



Planned Speeds

The power and 125 mph speed potential of the HST will enable journey times between major centres to be cut dramatically. And at the same time service frequencies will be increased.

High Speed Train Services

Fastest Times from London

	Present Service 1973			H.S.T. 1975/6	
	Miles	Time H M	Ave. Speed MPH	Time H M	Ave. Speed MPH
Bath	107	1.38	66	1.11	90
Bristol	118	1.50	65	1.22	87
Cardiff	145	2.11	67	1.46	82
Doncaster	156	2.04	75	1.39	95
York	188	2.22	79	2.00	94
Leeds	186	2.28	75	2.14	83
Darlington	232	2.52	81	2.31	92
Newcastle	268	3.38	74	2.57	91
Edinburgh	393	5.30	71	4.30	87

The Routes

Preliminary computer studies of likely costs and earnings have established that both HST and APT will be able to operate with advantage at speeds up to 125 mph as general replacements for locomotive-hauled trains. With minor modifications, existing colour-light signalling and automatic warning systems will cope safely with the new trains, and problems of compatibility with freight trains running at much lower speeds, at least during the next few years, can be resolved.

A variety of routes was examined from the point of view of the time-saving to be achieved. It was found that the electrified lines from London to the North West offered great potential for the use of APT because of their ability to take curves at high speed.

On the Western Region, however, easily-graded straight stretches favour the immediate use of HST with little preparatory work. The absence of intermediate restrictions and curves limits the further benefit to be derived from running the APT on the Bristol, South Wales routes until it can be operated at 155 mph. On the East Coast, HST will enable substantial time savings to be achieved, and the use of APT at 125 mph will bring appreciable extra benefit.

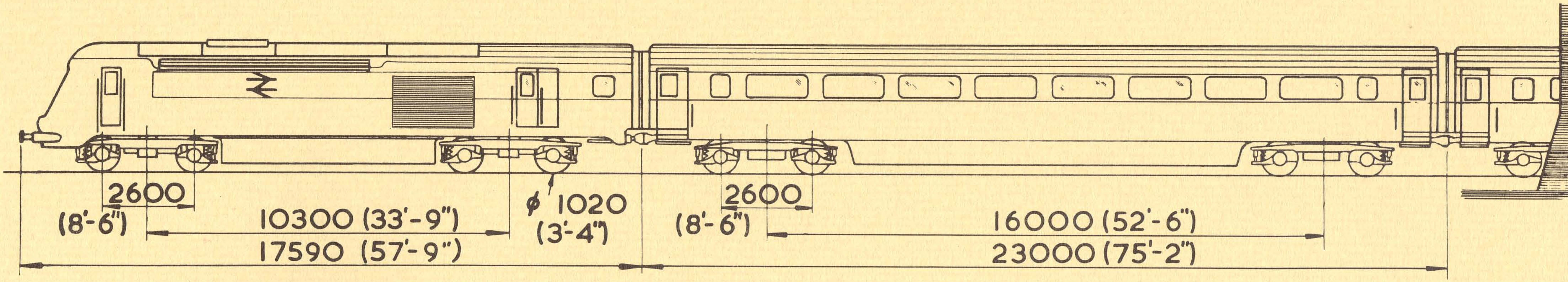


DIAGRAM & DATA FOR HIGH SPEED TRAIN

POWER CAR

Engine: Paxman "Valenta" 12 cylinder diesel
Rating for initial application to service: 2,250 hp per car
Engine-driven alternator & rectifier supplying D.C. to traction motors
Engine-driven auxiliary alternator & rectifier supplying 280 kW maximum dc. to train

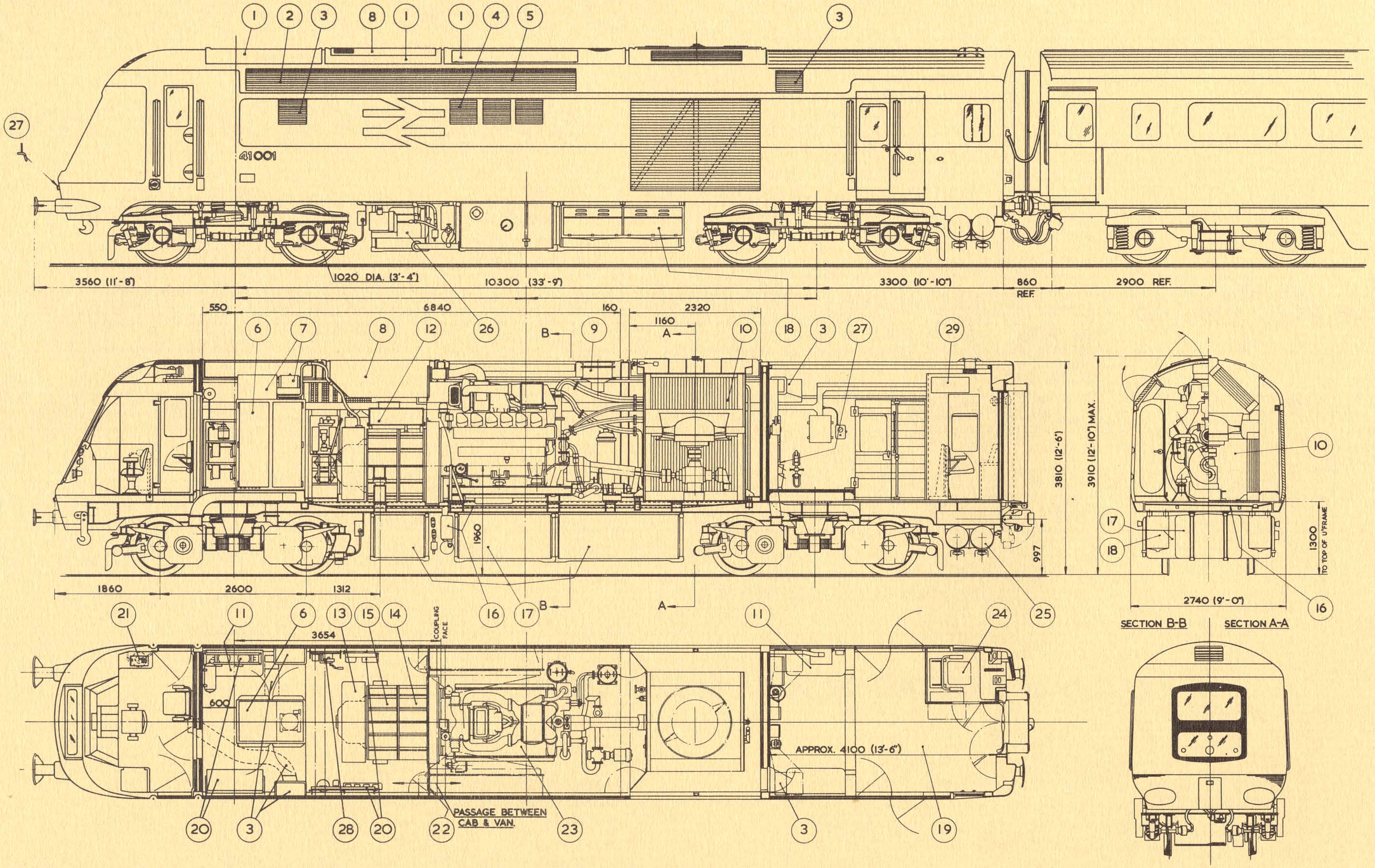
Net hp at rail: $\frac{3265}{2}$ = 1,632 hp per car

Total weight: 68 tonnes = 67 tons
Length: 17·3m — 57ft
Maximum service speed: 200 km/h = 125 mph
Nominal operating range: 1,600 km = 1,000 miles
Fuel: 4,500 litres = 1,000 gallons

MK III CARRIAGE

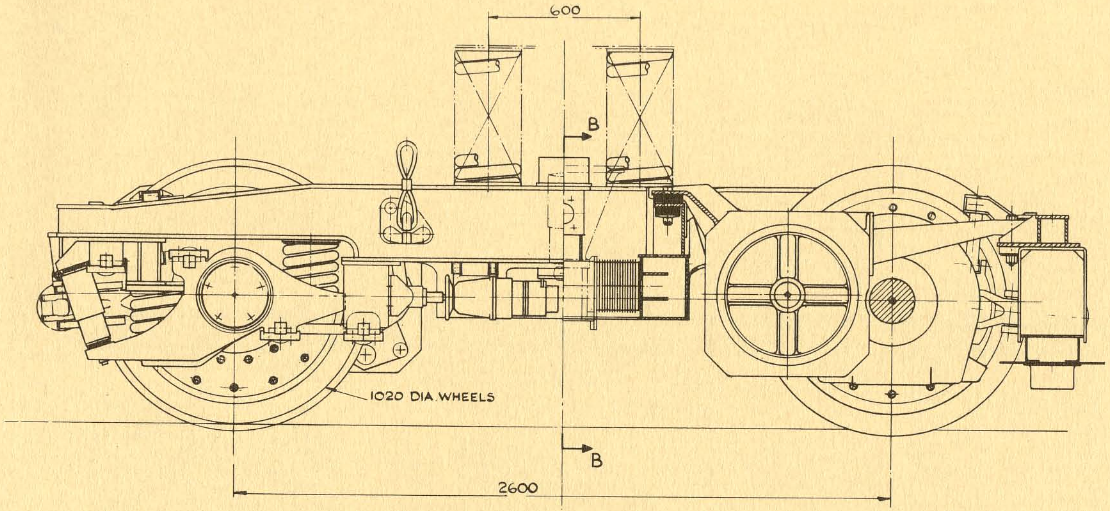
FEATURES
Lightweight welded-steel shell
Grouped equipment modules on underframe
Air-sprung disc-braked bogies
Air conditioning
Automatic interior doors
Public address
Double glazing
Modular constructed interior trim

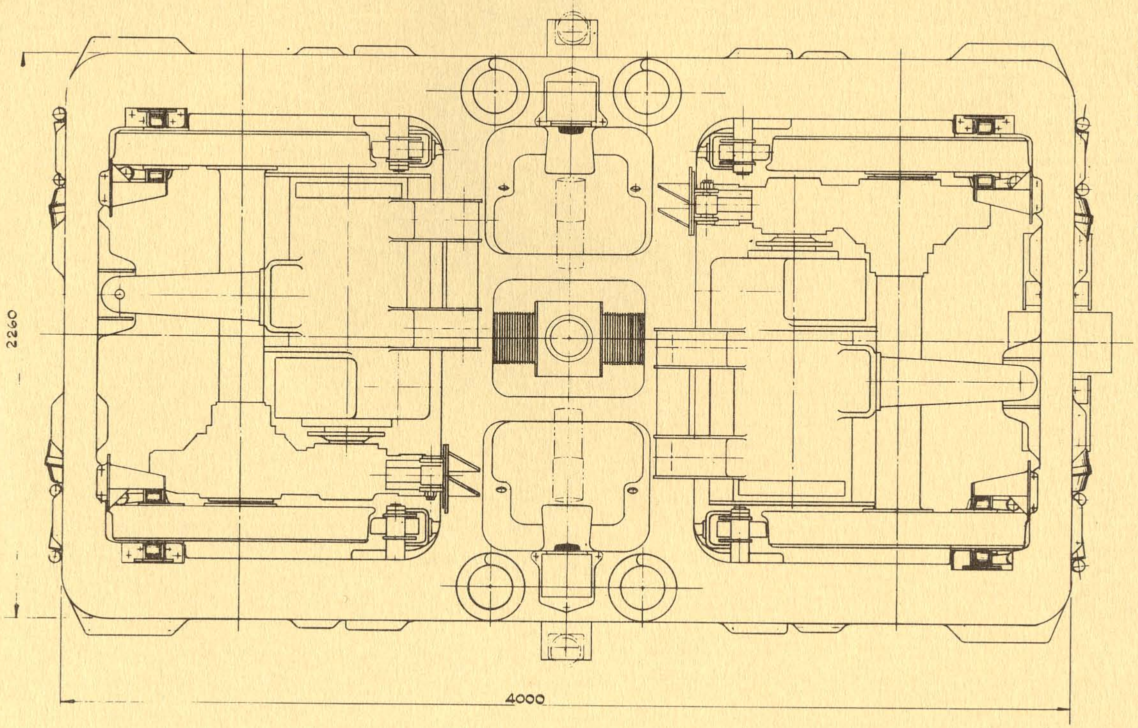
TYPES
Open Second 72 passenger seats
Open First 48 passenger seats
Kitchen vehicle 24 passenger seats
Buffet vehicle 35 passenger seats



1 Translucent roof
2 Filtered air for ventilating interior and electric machines
3 Air for ventilating traction motors
4 Air for ventilating engine room
5 Filtered air for engine combustion
6 Electric equipment cubicle
7 Resistance unit and short-circuiter
8 Silencer or ejector
9 Engine-room ventilating fan
10 Radiator group
11 Flexicoil spring boxes
12 Train supply and auxiliary rectifiers
13 Exciter and traction rectifier
14 Train supply and auxiliary alternators
15 Traction alternator
16 Spillage tray and collecting tank
17 Fuel tank: 4,500 litres (1,000 gallons) capacity
18 Battery
19 Luggage accommodation (1 tonne)
20 Pneumatic and miscellaneous equipment
21 Fire equipment
22 Clean air compartment partition
23 Paxman Valenta 12RP 200 engine
24 Guard's and auxiliary driving position
25 Main reservoirs
26 Air compressor
27 Emergency equipment
28 Hydraulic parking brake
29 Audio-navigator

POWER CAR FOR
HIGH-SPEED TRAIN
WEIGHT IN WORKING ORDER:
68 TONNES





Prototype HST – Description

HST provides new standards of passenger comfort as well as offering substantial reductions in journey time.

The prototype comprises two streamlined diesel-electric power units, one at each end of the train, and seven of the new 75ft-long Mark III passenger coaches, including catering vehicles. Each power car has a driving cab and is equipped with a Paxman 2,250 hp diesel engine with Brush electrical equipment, giving a total train output of 4,500 hp.

Advanced technology and design has enabled the weight of HST to be reduced to 379 tonnes, compared with 466 tonnes for trains of equivalent capacity now in use. The high power available for a lightweight train results in a rapid acceleration and a maximum service speed of 125 mph.

The bogies of the HST are fitted with disc brakes to ensure smooth and comfortable deceleration from 125 mph within the existing stopping distances for 100 mph trains. Wheel-slide protection is fitted on all axles.

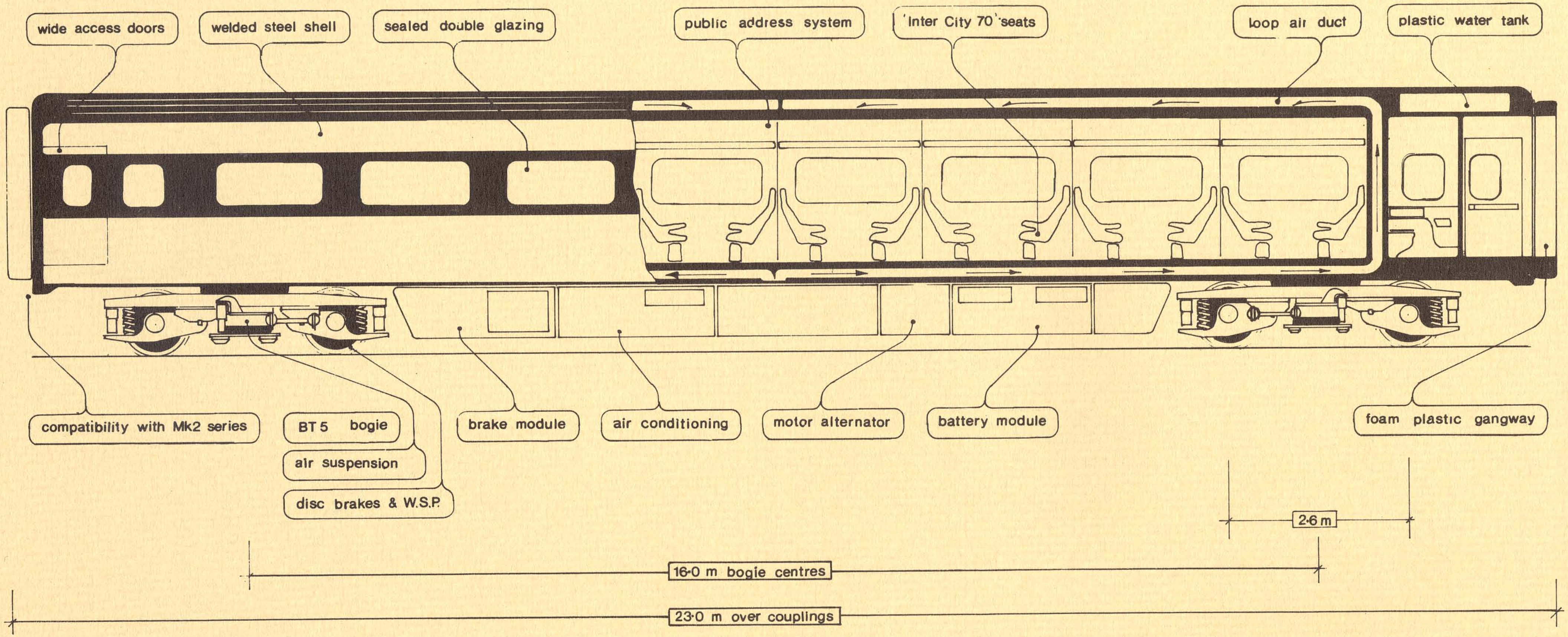
The passenger coaches, a completely new design, have a range of features. Notably, they are fully air-conditioned to provide an even temperature in all seasons regardless of fluctuations outside. Air filtration keeps the interior clean. Double-glazing and improved sound insulation have reduced noise levels – previously a source of travel strain and fatigue – to provide a restful and attractive travel environment.

Air springs are used for the secondary suspension. These provide a softer ride and require less maintenance than conventional suspension systems.

All interior doors are automatic, operated by tread-mats. This will help passengers with luggage, parents with small children, and catering staff taking refreshments along the train.

Seats are of a new design, and for the first time the second-class cars have carpets.

The coaches are easily convertible to give different interior seating layouts and formations. Two basic forms have been built for the prototype train: second open (72 seats) and first open (48 seats).



Mk3 day coach

The second-class saloon version of the Mk 3 Carriage provides 72 seats.

Interior doors operated automatically by tread-mats will help passengers with luggage to move easily along the train.

Catering

The quality of the meals on the new trains will match the new travel standards.

Reductions of journey, for example, from 90 minutes to 60 minutes reduce the demand for conventional meals but increase the need for quicker and simpler meals On longer journeys the requirement for substantial meals remains, and high-quality catering facilities will therefore still be a prime requirement.

In two of the HST coaches, half the total space is allocated to catering, the remainder to normal seating. They comprise a kitchen car offering a full range of meals and drinks to be served at passengers' seats, and a buffet car to serve breakfasts and light cooked meals as well as cold snacks and drinks. Both vehicles will have modern equipment, notably microwave ovens for rapid service of hot meals. In addition, a trolley service is planned to bring light refreshments to passengers at their seats.

APT

The introduction of the revolutionary Advanced Passenger Train will form the third stage of British Rail's high-speed programme.

This concept has been made possible by technological developments carried out by the Railways Board's Technical Centre, which occupies a site of 20 acres at Derby, and is among the world's best, if not the best, of its kind.

The APT is being developed as a high-performance train capable of running at up to 155 mph on existing track. The capital cost will therefore be mainly that of the train, and no expensive modifications are necessary to the fixed installations of the railway system. The *average* speed between city centres will be lifted to the 100 mph range.

The APT embodies lightweight construction and refined aerodynamic shape. The important technical feature is, however, a unique suspension system which has been designed to enable the train to negotiate curves in complete safety and with no discomfort to the passengers at speeds up to 50% faster than those of conventional trains.

The essence of the APT concept is that a substantial improvement in performance can be obtained immediately with the employment of new vehicles, without doing anything to the track. When track and signalling are improved it will be possible to gain still further improvement in performance without doing anything to the vehicles. This seems to British Rail to be the right approach, both technically and economically.

An experimental APT powered by gas turbines is already testing the systems which will go into the prototype electric version. This will go into service in the late 70s, beginning on the West Coast main line between London and Glasgow.

British Rail knows that the market for such a product is a substantial one, and is confident that the launching of the APT will ensure a continuing commercial success for the rail passenger business and a continuing travel improvement for the customer.

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