T45 The development story

Contents

Foreword

The dedicated, intensive and frequently inspired efforts of a team of designers, engineers and technicians, brought into existence the outstanding Leyland truck that is the subject of this book. That team, together with the Leyland production workforce who built this remarkable vehicle in Lancashire, dedicate their efforts and their craftsmanship to those who will ultimately enjoy the benefits of the end product – the truck operators and drivers of the road transport industry.

Why T45?

Back at the beginning of the 1970's Leyland's engineers and product planners sat down to set out their projections for the future. There would, they agreed, be a need for an entirely different kind of truck by the 80's. Severe economic pressures, unprecedented workloads, social restraints, safety and environmental demands, would all be such that even highly advanced truck developments then existing would be inadequate for the standards of the 80's. It was therefore necessary to conceive a family of trucks that would not only meet those critical projected standards for 1980 onwards, but be capable of progressive development over the following two decades, to take the company up to the turn of the next century.

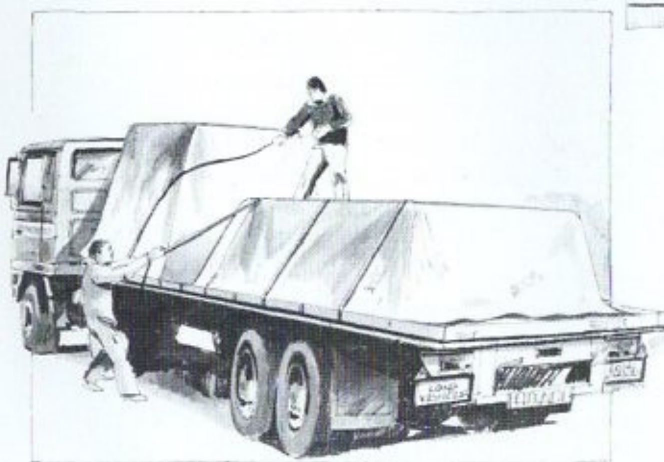
Advanced thinking of that kind must, perforce, be tempered with caution and practicality. A wholly revolutionary transport machine has very little attraction for the user. He prefers to rely on concepts and systems that he knows will produce the right answers, and he looks with deep suspicion on spectacular innovation or untried ideas. He prefers the process of evolution from known factors, rather than a revolution that introduces the unknown. With those ideas firmly in mind, Leyland's task force went ahead with their plans. Within this guideline a new kind of truck was needed. But also new factories capable of producing those trucks to hitherto unattainable standards of quality. That meant the development of manufacturing, assembly and testing techniques at a totally new level, in addition to actual vehicle development. It meant the investment of huge sums in terms of building a new truck satisfactorily and economically, with modern production methods, as well as in the design and development of the truck itself.

Consequently parallel with the concept for the new truck, the outline blueprints for new assembly facilities in a sophisticated new factory were laid down. With them went the plans for an advanced engineering test facility with both laboratory and track facilities on a scale never before contemplated by a single truck manufacturer. Together, those plans effectively bade farewell to the traditional days when truck manufacturing was a low-technology industry. It became clear that the highest standards of engineering skill and technology would be necessary in the design, development and production of a truck fit for the next generation.

Despite that high degree of technological application, it was vital that one all-important concept should not be lost. Out on the highways of the world, the truck must still be simple to handle and maintain. Combined with that advanced image, must be a down-to-earth practicality that would give the user an unprecedented capacity for profitable work, so that the strained economic equations of the 80's might be met squarely and honestly, and so enable transport to continue to run as a vital and profitable business. That is why the concept born in those early days means not simply a new truck, but a whole new way of life, in both the manufactuing and operating sectors of the industry. By late 1973 the seed was sown, and beginning to germinate.


LEYLAN


POLICE



First steps

A broad concept of what future requirements might comprise is one thing; a detailed assessment of all the aspects and connotations of such a project is quite different. The first task was to lay down in positive terms just what was wanted in the new design, and then as a closely following process, to examine how that was to be achieved. Furthermore, it was necessary to examine what contribution could reasonably be expected from experience within the company, and where outside assistance would be required. In many ways this was the most critical phase of the whole project. Errors at that stage would mean a misdirected programme at every subsequent stage.

In establishing what would be required, the future market trends had to be examined in minute detail for a great number of years ahead, with as many economic and industrial predictions from the world's highest sources brought in to guide the assessors in the right direction. The clear answers emerged; an extremely high standard of earning performance would be needed in order to make such a truck a saleable proposition in the 1980's and onwards. That meant not just the ability to achieve good journey times over rough conditions, but to do it on fuel and maintenance costs that, relatively speaking, were unobtainable at that time. It also demanded an unprecedented minimum of time for maintenance and repair, so that the truck could be out on the road earning for an absolute maximum number of hours in each and every month. The restrictions of forthcoming legislation on driving time had to be blended into the equation, as did the effects of inflation, labour relations, and social and environmental effects.

In order to arrive at the full answers, over 40 special reports were commissioned on various aspects of the vehicle, 22 of them concerning the driver and his cab. A vast amount of experience was available "in house", from work done over many years on the Ergomatic truck range, of the Marathon, the National Bus and the Titan, all of which offered valuable contributions both in major concepts and in detail design.

In order that the project should not be seen in isolation, examples of the best and newest competitive European trucks were examined in detail too. All that effort put together comprised what was called the "pre-concept" stage. By the winter of 1974, more than 90 percent of the answers to questions concerning *what* was required had been established and about 50 percent of the answers as to *how* it should be achieved had been arrived at.

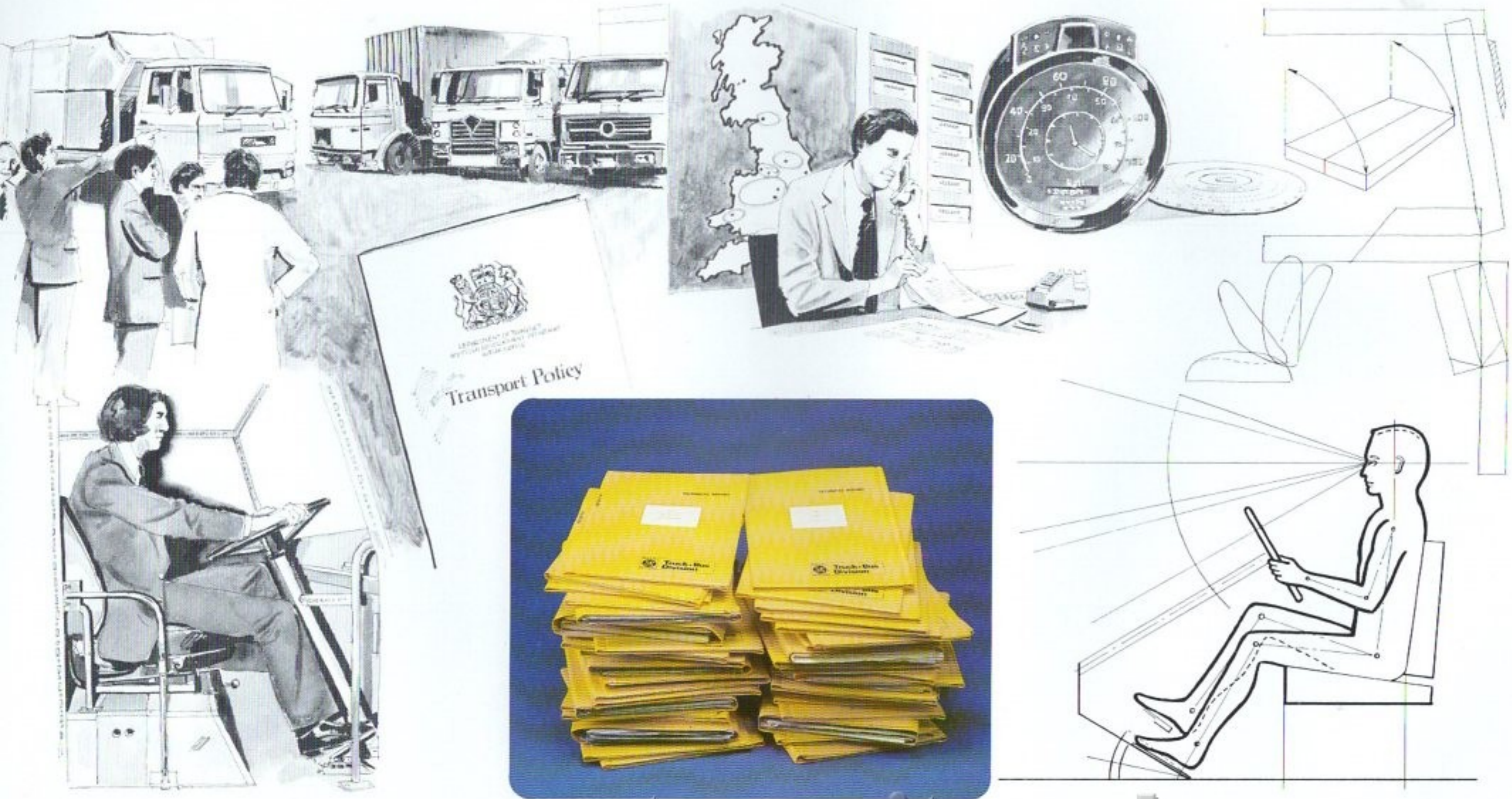
At that stage in 1974, it had still not been decided whether the truck would be a conventional design or not. Additional studies were included in these systems reports such as whether the vertical front engine really was the best solution; whether the basically rectangular forward control cab over the engine was the best way out; whether a power-to-weight ratio in the region of 7 to 9 horsepower per tonne was the optimum, and many other factors. From that point of view, the project began with a clean sheet of paper on the drawing board.

Perhaps the most important train of thought was dedicated to making the vehicle an on-the-road practicality, easy to drive properly, easy to load and handle, easy to maintain and repair. Only when all the answers were put together, could a prototype or pre-concept specification be written out, and that turned out demand what was essentially a conventionally laid out design. But within the layout there was a vast amount of scope for development and improvement.

The combination of new techniques and systems within broadly traditional design approach gave the best opportunities to meet the critical market requirements, and at the same time permit the engineers to produce a truck that would win acceptability on pure capacity for work and profit. The die was cast. A new truck was in the making.

Above all, the opportunities to meet all future specifications were well recognised as a result of the ve[r]y thorough pre-concept stage. As well as meeting the 'breadth' of specification requirements there was 'depth' built-in to the concept.

The cab was also designed on a "modular" system throughout giving scope for later flexibility in dimension[s] and specification.

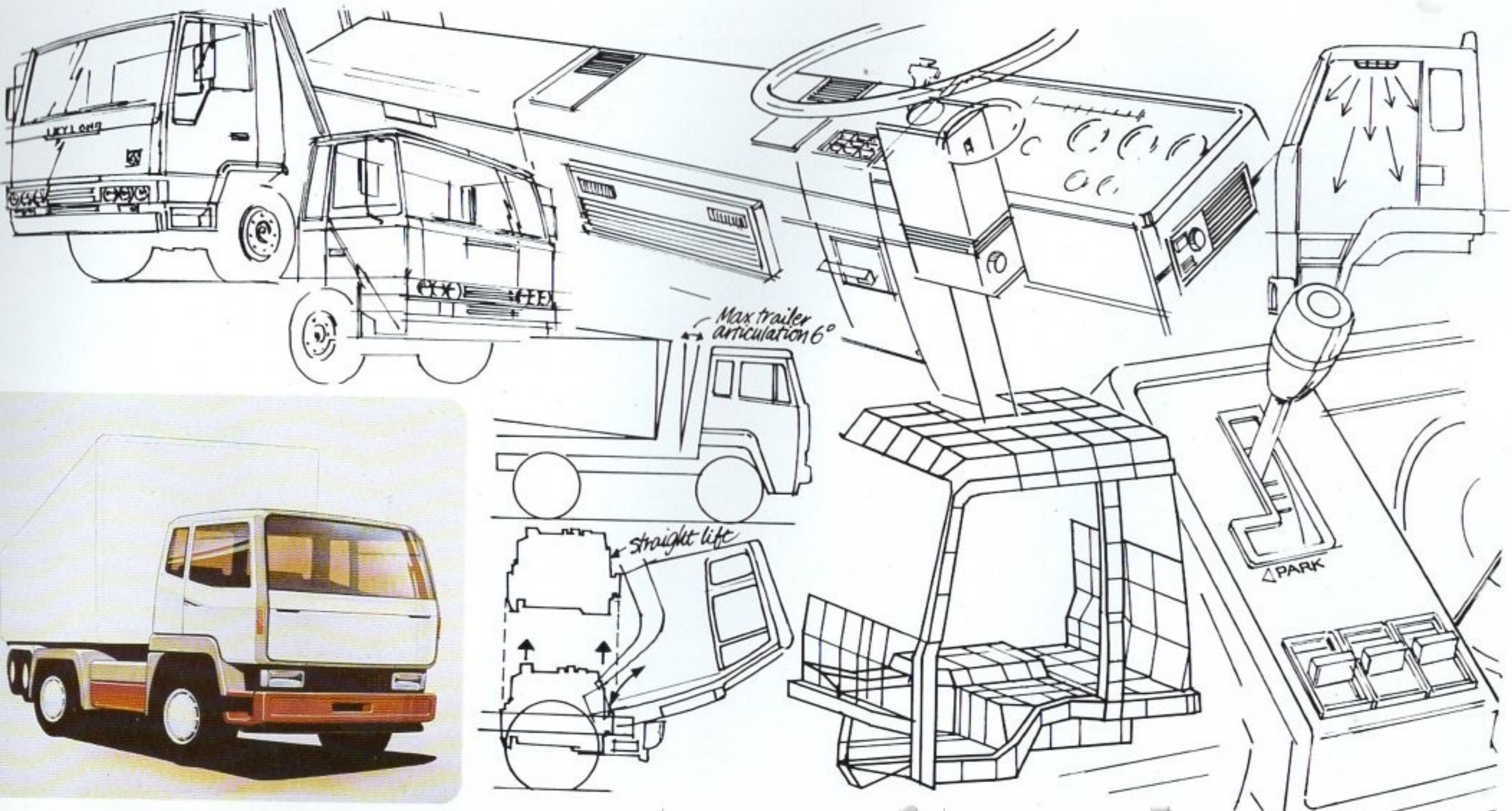

Transport Policy

Shaping a dream

Once the broad specification of what was required had been defined, it was time to examine in greater detail how that specification might be met, and what the principal features of the vehicle were to be. In terms of manufacture, a wide range of variants would have to be derived from one cab system, replacing six cabs in use during the 1960's and 1970's, and moreover each variant should be adaptable to both home and overseas market needs. That in turn would provide the economies of scale essential if a new cab was to be economically acceptable. From an environmental point of view the vehicle would need to have low noise and emission levels, a non-aggressive appearance, and a high standard of primary safety built into it.

While scores of individual features were outlined on drawing boards, it was decided to run a competition to obtain the best overall styling package. Ogle Design of Letchworth were the winners and with only minor changes their design went forward into the project plan. Among the required features which the successful design emphasised were, high aerodynamic efficiency, an appearance giving the illusion of small size, facility for a high degree of mechanical access, remarkably safe and easy entry and exit for the crew, superb vision from the driver's seat, and a high degree of built in strength and safety within a low overall weight figure.

Into that handsome design, all manner of detailed systems had to be fitted. What was probably the most extensive study of human factors ever mounted in connection with a commercial vehicle led to a closely defined pattern of body movements within the cab's envelope. All the controls, from the steering wheel down to the smallest switch and warning light, were given a definite and positive location, they didn't simply arrive by accident. External factors like optimum clearance for the trailer, and easy engine removal were taken into account. The unique angled rear bulkhead, for example, is a direct result of a fresh approach to the trailer clearance question, to obtain maximum trailer length. An additional benefit was a reduction in noise as the engine was more enclosed. When all those design criteria were assembled, critical examination was necessary, not only of the whole design, but of every detail. The main questions were, "Does it meet the original design requirement?", "Can it be manufactured at a reasonable and acceptable cost?", and "Can it be serviced and maintained easily and quickly?". Not surprisingly, not all the answers were positive, and re-assessment and re-design had to be carried out until the necessary answers emerged. An illustration of the extent and thoroughness of all that work, which took the engineering team a full year, can be seen in a total of 42 distinct system reports – 22 of them on the cab – each of which dealt with a particular aspect of the design, analysing the result against the design requirement. No detail was left unattended. When all that was completed, the project was still a lot of paper, and very little metal had yet been involved. The next stage would see a marked change.


Max trailer articulation 6°
straight lift
PARK

Cab prototypes

In the winter of 1975-1976, the team working on the new truck started to grow. The concept engineers who had conceived the original, highly detailed and closely defined design concept handed it over to a team of draughtsmen. They produced the first working drawings.

The next stage was for the prototype engineers to translate the two- dimensional designs of the project stage into 3-dimensional hardware resembling the production item.

The entire process with revisions took 3 years. With all the teams involved working hard and long hours, in the laboratory, the tool room, the workshop and on the roads of several countries.

Any single part which didn't come out right went back to the beginning and through all three stages again: concept engineers, draughtsmen, prototype engineers. Until the entire package was perfect.

At the same time as the cab was being developed, major systems such as the power unit, frame, suspension and brakes were being developed by individual specialists. The disciplines adhered to at every stage of the design ensured that when they were all individually right, they were all perfectly compatible.

Undoubtedly the largest group involved the cab structure and the systems it contained, for much of the environmental, safety and serviceability functions depended on that. Aesthetically the cab was important too. The shape had to be developed around the driver and engine packages, and following the Ogle styling design, a series of models were built to develop the precise shape that would meet all the design criteria, being aerodynamically and aesthetically correct. These models were tested in the B.A.C. wind tunnel, in which the shape of Concorde was also developed. In extraordinary detail the profile, down to the precise section of the windscreen pillars and the shape and position of the mirrors was determined to give absolute minimum air resistance.

Even before the styling was "signed off" the basic shape which had been established had been converted into metal, since it was important that even the prototypes should be made from pressed panels. That way, in testing, the results would relate to the production article.

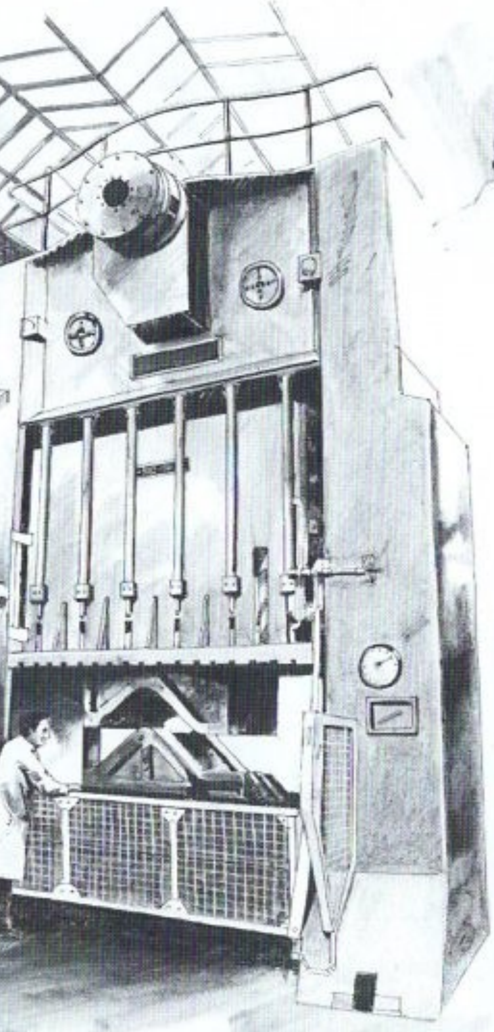
Pre-production press tools were cast and machined in aluminium. These were sufficient to make a limited number of cab pressing sets. These panels were assembled on a jig into complete cabs which could be tested for major problems in the construction and component areas.

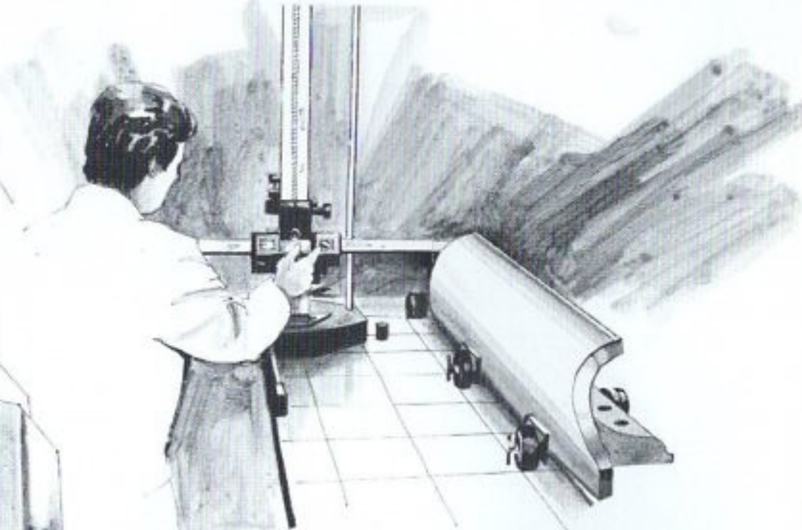
Had they been wrong in any way, the aluminium tools were cheap enough to scrap and re-make.

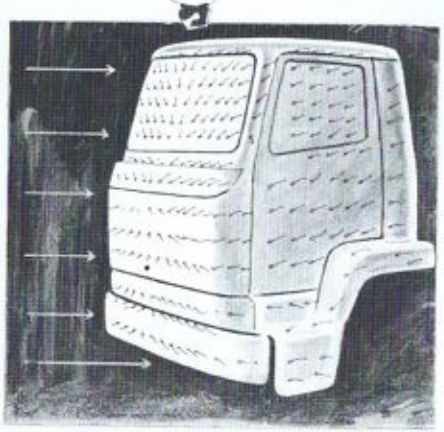
In this way the full prototype and testing procedure could run its course, and the styling could be "signed off" later. It was also a relatively simple matter to reproduce the press tools in durable and expensive steel. And, at the same time, any minor problems could be ironed out.

At a later stage fully tested and full styled cabs, including all holes for wiring and components would be assembled by an incredibly accurate technique called "the cube" for pre-production checking.

Before this however, the prototype cabs went through the most extensive testing and proving programme Leyland have ever staged, while parallel engineering procedures made sure that the rest of the vehicle kept pace.







Shake it 'till the answers come out

Because of the rigid disciplines at the design stage, it was not necessary to build a complete vehicle before testing began. A strenuous programme of tests in laboratories, and on special tests rigs, could be initiated at an early stage, so building up a remarkably complete picture of performance and durability of every component. Those component tests extended to vehicle trials, and in fact several million miles of that kind of testing was logged before the first complete prototype truck was put together. Some components went into selected commercial fleets for test, others into factory vehicles running between the various plants, and still more into special engineering mobile test-rig trucks.

The cab was one of the most crucial components. Road and test-track vibration and shock patterns were recorded on magnetic tape, and apart from providing valuable data for computer stress analysis work, those patterns could then be reproduced in a controlled manner, electro- hydraulically. That is exactly what was done on a test rig at the National Engineering Laboratory at East Kilbride, Scotland, and later at Leyland. Exact replicas of the road shocks were fed into the cab structure, magnified and accelerated to provide a controlled but speeded up test to the point of destruction. That was the equivalent of 8-10 years use on bad roads. Only minor changes were needed to the designs subsequently to ensure complete durability. All that was backed up by testing on a "slave" chassis on pavé track, to confirm the laboratory result. Yet more tests were run to check vibration and noise patterns, paint adhesion and potential corrosion points, the durability of door hinges, retention of the glass under severe distortion and countless detail items.

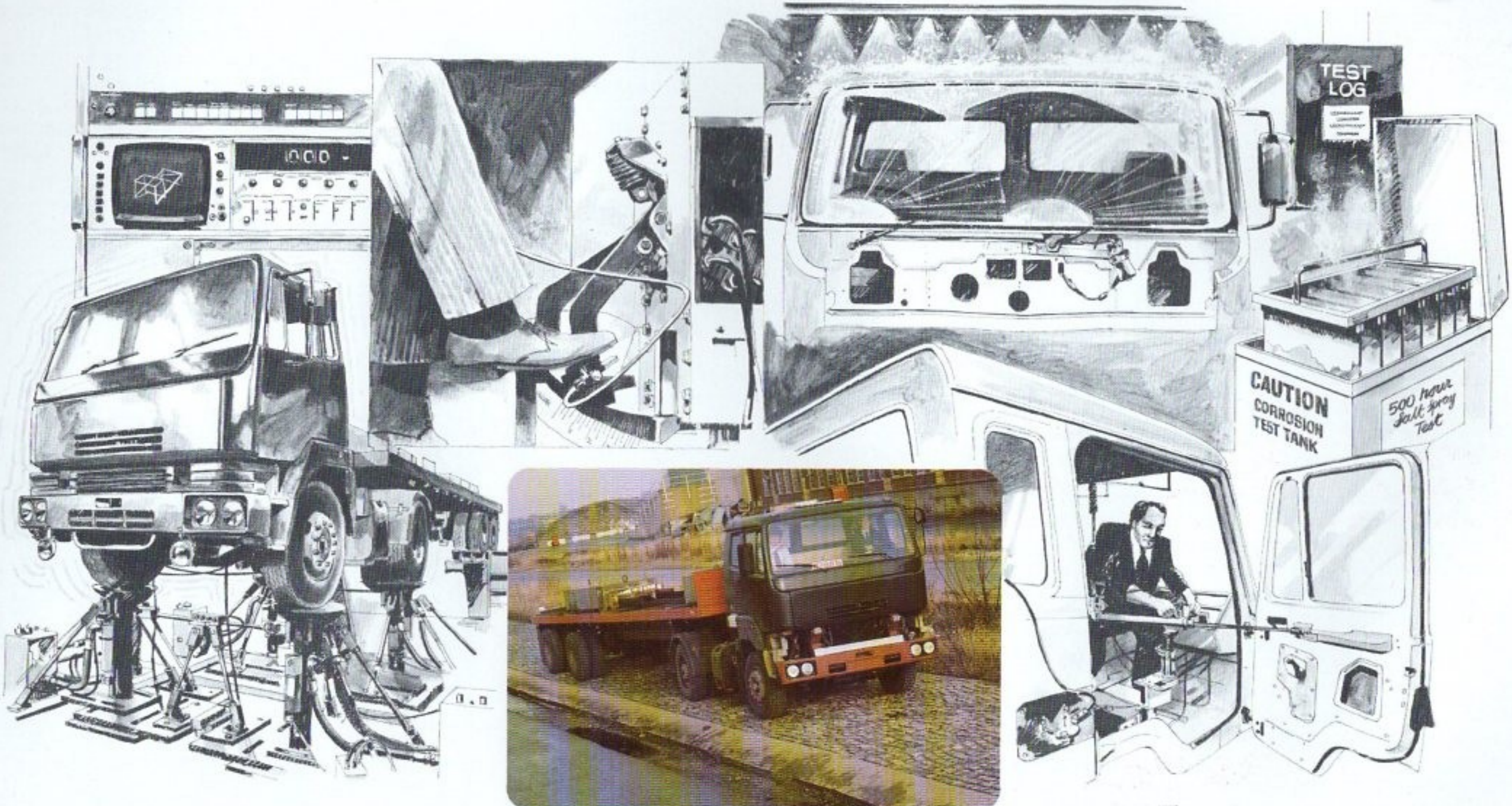
All that took place before a single complete vehicle was built. The value of these techniques, used for the first time at Leyland was in the immense saving of time, and also in the pinpointing of problems at an early stage, when correction would still be relatively easy and inexpensive.

Throughout the programme checks were made to ensure that the original specification for the new truck was being met. This included service accessibility, feasibility for production, the human factors aspects and the million-and-one items that go to make up a modern truck.

It is worth dwelling briefly on how these original specifications were formulated. To begin with the major elements that go to make up a truck were analysed and the performance of each of these elements from Leyland's competitors were monitored. From this a series of values were achieved. For example, service time for an engine change, noise level at speed, ride and handling and so on for each element.

The best achievement for each item from any vehicle was then used as the guideline for T45. In this way an absolute performance requirement in advance of our competition was built up which made it quick and simple to establish progress and performance against specifications.

Once the basic structure was found to be acceptable, different versions in right and left hand drive forms, and in differing widths and lengths, went forward into the test programme, then specific legislation - testing, like the ECE roof strength tests could proceed. In the background, further research and testing in the field of anti-corrosion treatment, paint penetration and adhesion, reduction of noise generation from steel panels, went on quietly, but relentlessly. The fact that many modern trucks rust away faster than they wear out could not be overlooked. By the time the first chassis was available for testing, the prototype cab was already at an advanced state of readiness.


1000
TEST LOG
CAUTION
CORROSION
TEST TANK
500 hour
Salt spray
Test

Power train — making it go

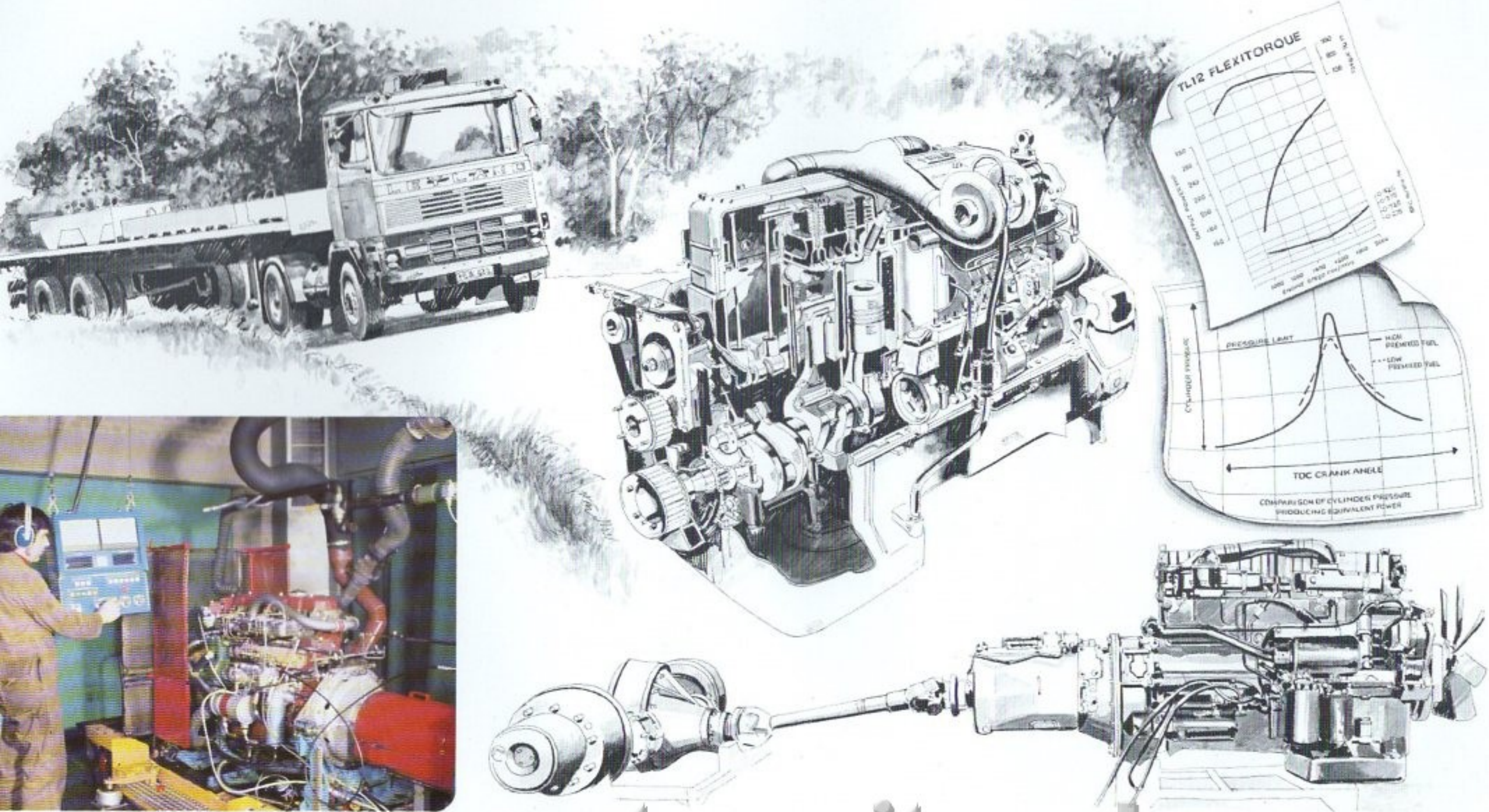
When planning a cab and truck system for a long term production run, it is clearly essential to provide adequate installation space for a full variety of engines. That flexibility of installation is built into Leyland's new design and consequently any reasonable choice of engine for future special needs is feasible. However, the first truck model to be available had for its power unit a new version of the Leyland engine, developed from an outstandingly successful history in the Marathon.

That development of the TL12 'Flexitorque' engine was aimed at improvement in economy, reliability and durability, and took the form of slower, and therefore more efficient, combustion which produced marginally more power on less fuel, and perhaps more important, nine percent more torque at lower speed. Peak loads and temperatures within the engine were reduced by virtue of the revised combustion characteristic, so reducing stress, wear and noise.

In order to match the engine output against the projected road performance, a wide range of transmission ratios was clearly needed and it was a simple matter to calculate the spread for the required performance spectrum. However, within that clearly defined range, there were many decisions to be made, the most important of which was what kind of transmission should be used. Automatic and semi-automatic types were ruled out at an early stage simply because the relative expense and complexity of such equipment was unwarranted in a long haul vehicle likely to spend at least 90 percent of its time in top gear. A service life of around half a million miles was required and these criteria eventually lead to the choice of a constant mesh manual gearbox as being the most suitable. The big question was, should it be a range change or a splitter type. After a long series of tests, driver clinics, and fleet appraisals, a splitter type transmission was chosen. This, it was agreed, would be easier to drive, having a more logical sequence of movements, and moreover the consequences of a mis-shift were likely to be less disastrous than with a range change type. Furthermore a ten speed splitter lent itself to use as a five speed box in light or part- laden running conditions. The box finally chosen was the Spicer SST10, a unit with the very highest reputation for toughness and reliability in various world markets. Even so, only after considerable development and modification to provide a pre-select facility for the splitter, could that transmission be considered good enough for a new maximum-weight Leyland truck. An equally durable clutch, a twin-plate Dana-Spicer unit, coupled engine to gearbox.

Again considering durability and efficiency in service as the principal criteria, a hub reduction design was the eventual choice for the drive axle. A great deal of experience with such axles over more than 20 years in numerous Leyland models made a vast amount of design and service data available and that, together with considerations of ground clearance, abnormal use situations and component weight, cemented the final decision. In order to match exactly the new engine characteristics and the gearbox ratio spread, a new gearing combination was required in the axle, which gave a good motorway cruise performance at the maximum-economy speed of the engine, but which also gave satisfactory gradeability. The resulting standard final drive ratio of 4.82 to 1 is unusually "long" for a hub reduction axle design.

That was the theory. It had to be proved in practice and engines, gearboxes, clutches and axles were exhaustively tested in slave chassis and on bench rigs, i[n] isolation and in combination, until a satisfactory level of performance and durability was forthcoming. Most of th[is] work was complete before the first prototype of the new truck took to the road. All that work applied to the new "flagship" of the Leyland truck range, and parallel procedures were adopted for other variants, developing for example the TL11 engine for the next lower group of models in the weight scale.


TL12 FLEXITORQUE
PRESSURE LIMIT
HIGH PREMIXED FUEL
LOW PREMIXED FUEL
CYLINDER PRESSURE
TDC CRANK ANGLE
COMPARISON OF CYLINDER PRESSURE PRODUCING EQUIVALENT POWER

A new chassis concept

In order to match the unprecedented standards of the cab system, clearly a corresponding standard in the chassis engineering field was called for, and that, of course, involved the questions of ride, stability, weight, durability and versatility. Modern techniques in chassis frame design have proved that, for example, ride is not only a question of suspension, but of the stiffness of the frame on which the suspension is mounted. Once the broad outline of the shape of the frame had been established, largely dictated by the trailer coupling and clearance dimensions, and the lateral space between a set of tyres with snow chains fitted, computer studies were run to illustrate the kind of stress and deflection that might be expected in normal and abnormal road conditions. These were illuminating, as they showed among other things a marked "whipping" movement at the point where the rear cab mounting would be located, although the behaviour of the whole frame was not unreasonable. Various redesign exercises took place using those computer techniques and finally an advanced frame design was worked out and a prototype built.

This did not work as well as required.

The next stage was to identify what had gone wrong so that the same problem would not recur, and with that successfully done, a different approach was tried. The traditional method of building a frame was used as a base design, embodying the experience of decades with earlier Leyland group trucks. Computer analysis techniques were then applied for refining and removing undesirable stress and deflection patterns from areas where they were critical,like the cab and fifth wheel mountings and the suspension anchorages. That composite approach worked admirably. The frame that it produced improved upon the original design criteria by a comfortable margin. That perhaps was a salutary lesson; there is still room for plain traditional experience, even in the most advanced new engineering processes. Indeed, the whole new truck project is a combination of the best of both worlds – the craftsman's experience and the scientist's research.

Some of the frame features are worthy of individual examination. For example the combined coupling reinforcement and centre section stiffening saves weight and makes the frame easier to manufacture and repair. The new technique in fastening employs a closely fitting (but not tight fitting) bolt, installed on the frame with a chemical locking compound so that it will not shake free no matter how hard the going. It is in effect a removable rivet, and even in the toughest endurance and pavé tests, there has never been any problem with the frame fastenings. The end result of that far-reaching probe into truck frame technology is a standard of lightness and durability that, without going into undesirable expense of unconventional materials like aluminium alloys, has achieved a standard not previously attained by any heavy truck design. It is by no means as visually spectacular as the cab, not as noticeable day-by-day as the engine's economy and performance, but the engineering standard remains on an equally high plane.

Systems and serviceability

Analysis of truck service problems over a number of years has shown that a disproportionately high number of lost working hours and days occur through comparatively minor faults, many of which have needed more man-hours to repair or rectify than major breakdowns such as engine failures. A major part of the new Leyland programme was from the very outset devoted to designing into the truck, systems that would avoid such time losses in normal service. That was a very major task. It meant that every detail of equipment, ancilliaries and components had to be identified at a very early stage in the design, and of course that is far from easy. In fact there were numerous instances where perfectly good equipment or component designs had to be scrapped because an adjacent structure was changed as part of the intensive development programme. Despite all the difficulties, the standards were never relaxed. The hand-in-hand requirements of easy service and inspection of every single unit, together with easy removal for repair or replacement had been achieved. Without sacrificing the base requirement of high performance and reliability.

There are far too many such systems on the new truck for them all to be described here, but some examples will adequately illustrate the point.

The broad target in brake installations was set for approximately double the normal accepted life with a higher level of retardation and with minimal attention for adjustment. Of course, the actual specification went into a great deal more detail than that. It demanded the largest possible lining area within a given drum size, which in turn dictated the use of a twin wedge layout. Unfortunately, twin wedge systems available in the component market were not renowned for reliability or consistency in service. Working with the component suppliers, Leyland's engineers established a brake development programme on slave chassis as early as 1974, and slowly the units were modified, developed, made more reliable, more durable, until they reached the target requirement. That was an extremely long process, occupying engineering teams from both Leyland and component suppliers for a total of four years. The results are very worthwhile however. Not only does the new truck, possess an ability to produce stops exceeding 0.7g fully laden, time after time – something that no other production heavy truck can achieve – but will do so without loss of stability, without excessive fade, and what is most important without requiring constant service attention. There can be no doubt that the brake programme in connection with this truck has advanced heavy vehicle braking technology in a spectacular manner – and this was achieved in an area where British trucks were already considered to be world leaders.

Obviously the brakes were just one of the systems that received close attention. There were many more. The electrical installation as a whole, together with individual components of that group came in for detailed development work over and above the basic specification. The heating, ventilation and cooling systems received similar treatment. Clutch mechanisms, the whole package, the pedal group, air systems, instrumentation, lighting and wiper-washer systems were among the major groups to be subjected to prolonged and detailed scrutiny and development.

The results were spectacular. The wiper motor, for example, which operates two blades covering a glass area equivalent to most three blade layouts, has been developed to a life of around 7000 hours, which is three times the life of any previous system. Brushes will last about 2000 hours, and when they need changing the job can be done literally in less than a minute, because the serviceability factor was a prime requirement in the original concept.

The instrumentation is unique. Not only is it easier to rea than other panels, with all needles pointing upwards wh everything is in order, but every ancillary gauge is identical, with the same part number. That is because each one is simply a repeater instrument connected to the appropriate sender or transducer on the chassis, an the individual scales are etched on the non reflective glass panel which covers the whole instrument group. Apart from the ability to interchange gauges in an emergency, the reduction in parts inventory is substant The installation of pedal controls is a complex matter in heavy truck, but not on T45. The whole pack can be withdrawn forwards from the bulkhead after the front grille panel is raised, so that it can be given attention on the bench in the event of a fault. This whole pack can be removed and replaced in around a quarter of an hour by an average skilled truck fitter. This highlights the level c detail thinking – and applies equally to more obvious items such as transmission/engine removal.

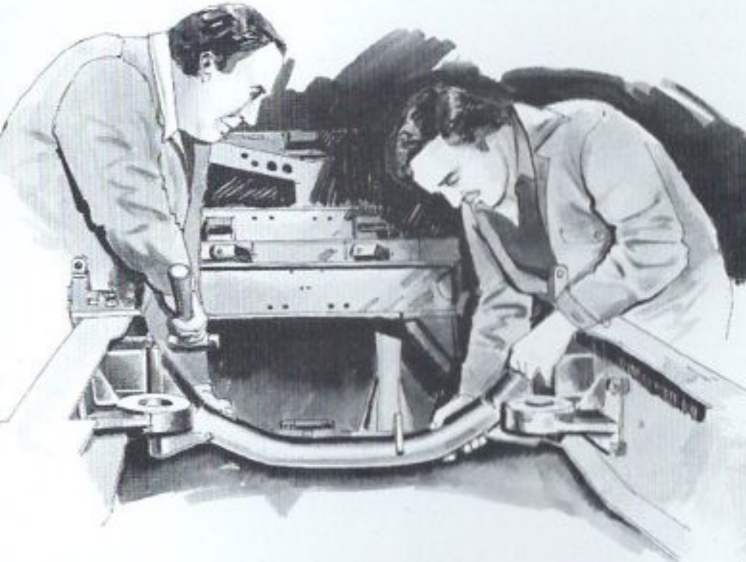
The result is that the truck can spend a far higher proportion of its working year out on the road earning revenue, instead of wasting time in the workshop. That is vital part of the potential earning force represented by these new trucks from Leyland Vehicles.

Putting it all together

Because the early cabs were complete but not fully "signed off" the actual assembly of the first full prototype vehicle took place, as has already been explained, at an unusual stage in the total development process and with an unusually high volume. Also, such were the strict disciplines of the design concept, that it was perfectly safe and admissible for the numerous sections to be developed separately and tested on rigs and slave chassis and then to be finally brought together when they were approaching maturity. In this way, there was no possibility of a large part of the design having to be scrapped or fundamentally changed, simply because one particular system or component was unsatisfactory. In other words, in the short space of time in which a prototype truck was required, each and every part of it was in an advanced and satisfactory state of readiness in relation to the original design specification. That was a totally new way of doing things in Leyland Vehicles.

When the prototypes were eventually assembled, they were not just simply put together to produce a vehicle. At every stage, detailed assessments took place to ensure that in subsequent production the numerous components would fit or go into place without difficulty or damage. This was an essential part of the development, for if shortcomings were not discovered here until later, the whole process might be too far advanced to change so the deficiency would be committed to production. This was something that had to be avoided at all costs. Consequently, the first complete truck assemblies went ahead very slowly, with engineers in attendance from every section of the programme. That in itself was a prolonged process. Not only the UK market trucks in their various versions were involved, but the left hand export types too, some of which would not be required for several years.

Every component, large and small, was checked in the greatest possible detail and with incredible foresight to see if, first of all, it would fit easily at the assembly line stage, and how it should fit in with its fellows in the order of assembly. Secondly but equally important, were checks establishing whether it could be reached or removed easily with all the other components in place on a complete vehicle. Each and every problem or potential problem was carefully measured and noted, before reassessment in the total environment. In fact there were relatively few changes to be made at that point, none of them major, so strict had been the original disciplines. The outcome was a high standard of accessibility and 'buildability' that would be invaluable in the years to come.



Proof of the pudding

The size and extent of the task of testing, proving, developing and retesting all the designs and systems that go to make up the new truck, was truly formidable. The facts and figures only tell part of the story. There were 265 major rig tests in the laboratories and workshops, supported by at least twice that number of detail tests. More than eighty test vehicles ran with new components or structures over a period of five years, excluding the work of the actual new truck prototypes. Around four million miles of such component test work were completed with slave vehicles on 260 distinct test programmes while the representative complete prototype trucks themselves covered about 1½ million miles up to the end of 1979, when initial series production began.

It would be a mistake to think that all was plain sailing during that frenzied, concentrated testing period. The temptation is always there when a component comes close to its design target to allow its acceptance. Such were the disciplines in this programme, and so stringent the requirement, that more than 2000 items were rejected during the test programme and referred back for modification or redesign. Some only fell marginally short of their targets, but were rejected none the less.

From an early stage, endurance testing of components and complete prototypes got under way, simply because time is a major factor in such testing. Accelerated tests on rigs, or on special tracks like pavé, will give good indication of ultimate durability, but the only way to be absolutely sure is to actually cover the miles in realistically severe conditions. A major part of this work was covered over a specially selected route in the Pennine hills of northern England, and day and night, summer and winter, the test fleet trucks climbed 1 in 6 gradients, clung to twisty cambered byways and sped flat-out down motorways. By the time production job 1 came along, close on half a million miles had been successfully completed by the leading endurance test trucks. A promising sign that all that had gone before was worthwhile.

While all this mileage was being accumulated, accelerated endurance testing went on, using both laboratory rigs and special trucks. Low temperature testing in the winter of northern Canada in temperatures as low as −30°C, gave experience in cold start performance, heater and defroster warm up, and chassis behaviour with chains fitted to the wheels for long periods. Other trucks ran a detailed series of tests to establish performance standards, fuel consumption levels, and noise levels both inside and out. Cabs went back to the wind tunnel for aerodynamic checks against the original wooden models. "Clinics" to sound out the opinions of drivers and operators were held periodically in order to compare the new model's characteristics with the accepted highest standards in the market.

A very necessary but often neglected test programme concerned the service aspects. Removal and replacement of every single component from a wiper motor brush to the engine or gearbox was carried out, timed, examined against the design target, and in many instances modified to achieve an even better service performance. This was a particularly severe programme aimed at reducing down-time on the production chassis to an absolute minimum, no matter how major the task.

The final, and perhaps the most important test stage involved users of the trucks in fleet service, on the valid assumption that a fleet driver never handles a vehicle in quite the same way as a test driver. Their verification of earlier results was a vital contribution.

The sum total of all that work represents a level of research testing unprecedented in the British heavy vehicle industry and arguably unmatched anywhere in Europe. The result of the most extensively proven vehic ever to have emerged from Leyland in its long history.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Furnishing in taste

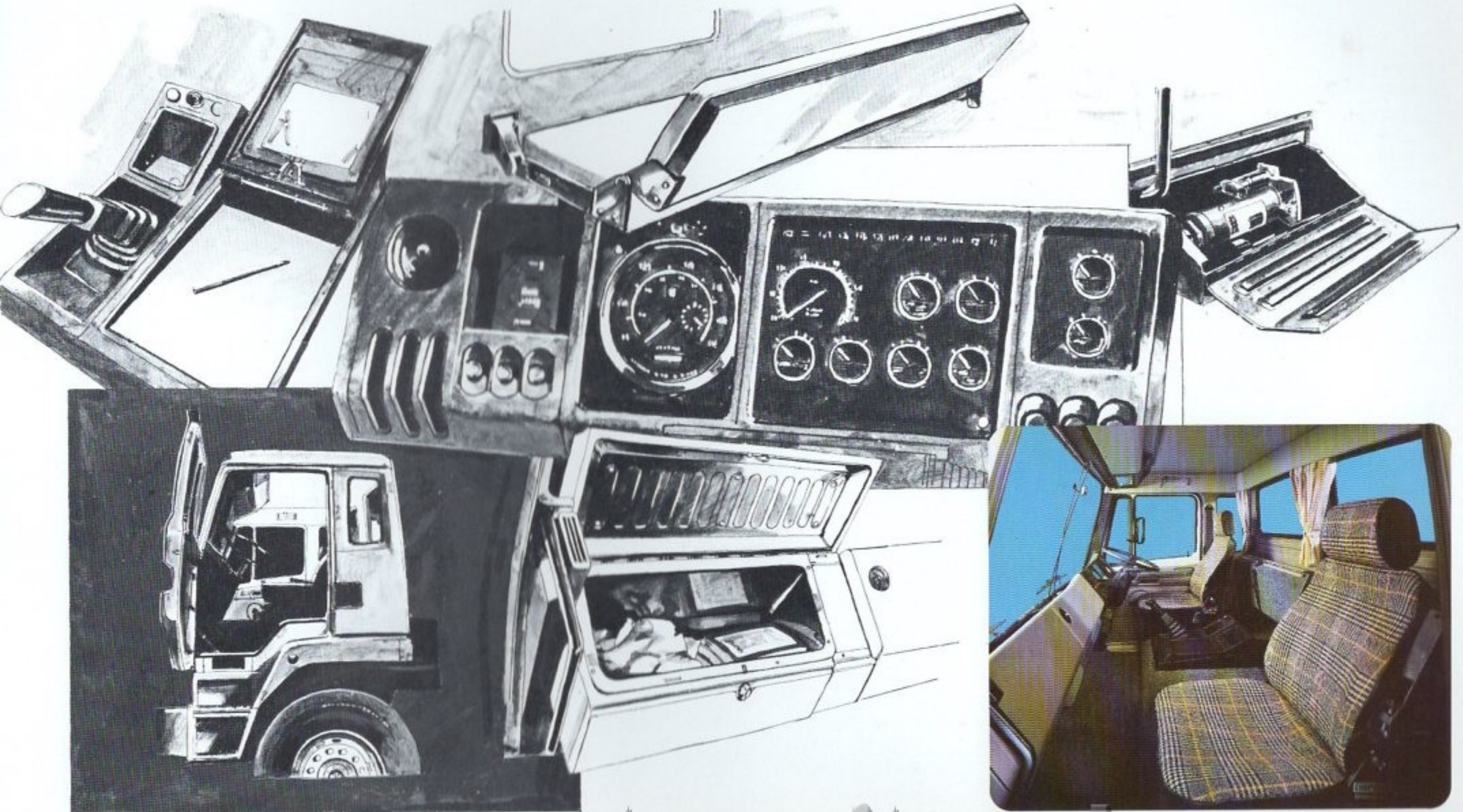
Although the work that went into the cab structure probably represented the largest single engineering effort of the many involved, it was appreciated from an early stage that the interior furnishings and fittings would also play a major role in ensuring acceptance by truck drivers and owners alike. Here again, a combination of attractive styling, efficient production techniques, and in-service practicality was required. Many combinations of colour and material were considered, particularly at Ogle Design who had responsibility for the interior, as well as the overall styling concept. One such combination was extremely eye-catching, in a combination of reds, but for a variety of reasons, including the very good one that red was not a restful colour for the eyes, it was rejected along with dozens of others. Eventually, a less spectacular but very durable and practical combination of greys and blue-greys was selected. Human factors study showed that to be pleasing and restful to the eye. It also blended well with a wide range of exterior cab colours as well as masking the effects of everyday use.

Colour was only a small part of the job, however. Materials and manufacturing methods represented a bigger task altogether. The dash panels and part of the trim panels around the pillars, had to be moulded in order to make them a good fit in production, and to look good in service over several years. The preferred method in the past was to vacuum-mould such panels, due to the relatively low-volume of a truck cab run. By clever rationalising of the interior, so that the main panels suit every cab version, much higher volumes than normal were projected, and that enabled injection moulding techniques to be contemplated. Tools for this process are much more expensive than vacuum-moulding tools. However a careful costing assessment showed that with the high volumes attainable by this rationalisation, injection moulding would not only be financially feasible, but would produce a far better standard of fit and finish.

Behind the trim panels and floor coverings, extensive use of sandwich insulation materials specifically developed for T45, keep noise intrusion to a minimum. These materials are only part of the reason for the cab's low noise level. The engine itself is basically quiet, and the double skin construction of the floor and bulk-head aid insulation significantly.

Paint standards needed to be on the same level as all the other advanced features of the truck, and in that area, Leyland Vehicles already had a great deal of know-how, from the National Bus programme. The story of the development of techniques for painting and giving corrosion resistance is long and fascinating but cannot unfortunately be given adequate justice here.

Techniques such as electro-phoretic painting for corrosion resistance, production paint techniques that seep into the metal seams and coat the interiors of the box and double skin sections, and ex-factory finish paints that are attractive enough to form the basis of a bright and serviceable livery or act as a primer for overpainting in operators own colours. Suffice to say that, the standard of paint application, protection and finish, reaches levels not previously seen in a British truck, and matches the very best standards anywhere in the world.



Setting up for production

Designing and building a new truck to advanced standards, to provide new concepts of performance, economy, and reliability in a prototype or specially-built vehicle brings one set of problems. Building that same truck to those same high standards as a production item, brings in a whole new set of problems. Long before the prototypes had even been built, consideration was given to translating the engineering specification into a feasible production exercise. The fact that at every stage in the design, the accessibility of every single item was studied, and elaborate assembly routines were worked out as the prototypes took shape, laid a good groundwork for the subsequent production plans. That was not enough, despite the depth of those prototype-stage trials. A more positive means of establishing production routines was required, which should if possible provide a means of training personnel in the techniques of assembling the finest truck ever to carry the Leyland name.

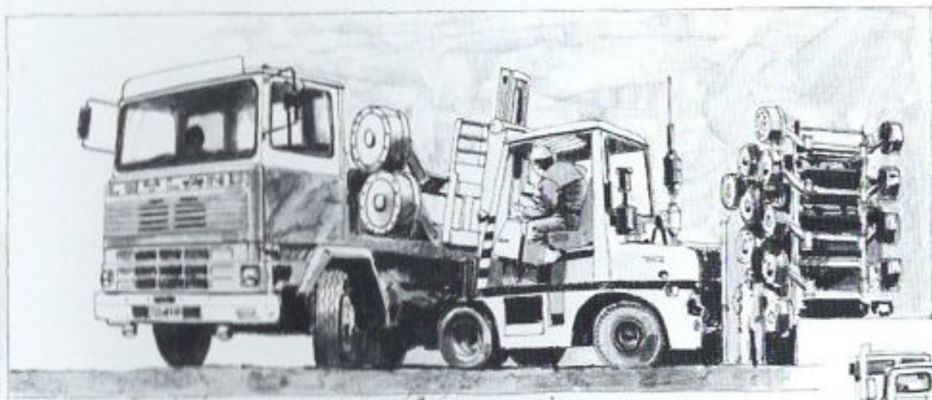
The answer was fairly obvious. A small pilot production line was established in part of the existing truck plant at Leyland, to turn out a limited number of trucks. The actual number was difficult to forecast, but it was thought that about 200 would suffice and that figure was, in the event, fairly accurate. This enabled all the earlier work at prototype stage to be verified in practice and last minute detailed changes made. This avoided any chaos that could have ensued, had it waited until the proper production facility was in motion. In the event very few changes of any significance were necessary, and most of those concerned the order in which components were assembled onto the chassis rather than basic problems. Secondly, it enabled representative trucks to go into service with selected fleets and the Leyland fleet, as the last stage in the testing programme. Moreover it enabled all the special tools and fixtures planned for the ultimate production process to be tested and perfected under actual live-build conditions. In this way, when actual production began, the vehicles from job number one were built by men who were totally familiar with what they were doing, on tools tested in practice, and according to sequences and techniques that had been worked out by them and their colleagues without the rush and panic of a production deadline. That meant that quality of build from the word go was at an optimum level, and that has never before been achieved with a heavy truck.

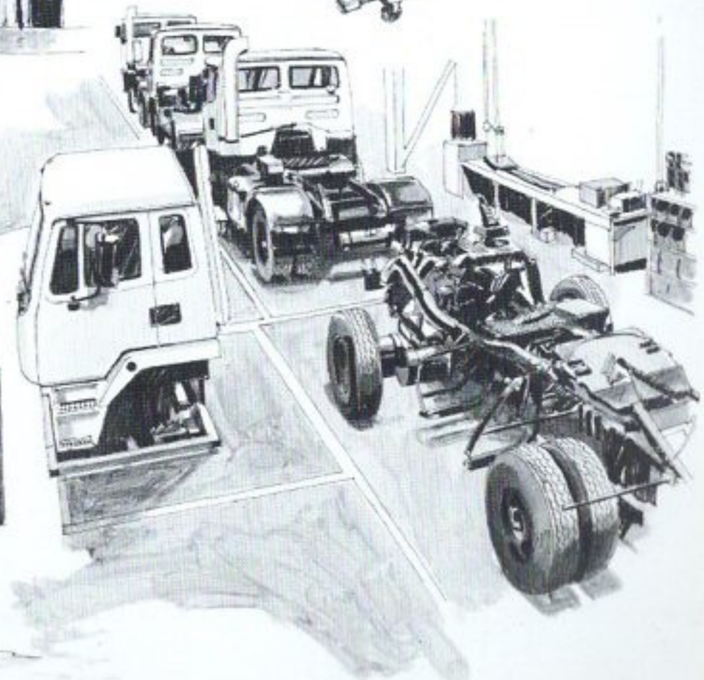
From the point of view of the company's huge investment in the new assembly plant that builds the truck in its full production state, the pilot process meant that from an early stage the plant and equipment was producing efficiently. Therefore contributing a satisfactory return on the investment from an early stage – an important factor in the efficient running of any company.

A new facility for producing the TL12 Flexitorque engine, steadily took shape during 1978-79. Its aim was to produce engines to a standard of engineering quality never before achieved, and to that end, a wholly new inventory of machine tools and inspection techniques was installed at Leyland. Parallel to that, a computer controlled engine test centre, working not just for the new models but all Leyland truck engines, went into action in 1978 to make a detailed test of every single engine made, record all the running data on computer discs from where it could also be printed out on paper. Such a comprehensive procedure was never before feasible, but now made possible with the help of advanced technology in electronics. Thus ensuring that every engine is up to required operating quality and efficiency. The result is flow of engines into production that are as reliable and durable as any on the market today.

The last major task had little to do with engineering in a direct sense, but was more of a housekeeping operatio It involved the advance ordering and supply of the hundreds of components large and small, that are essential parts of the new truck. That work began as ea as 1978 in broad outline, simply because the chain of supply, from the raw material stage onwards, goes back long way beyond the supplier himself. It would have bee unforgivable had all the millions of man-hours of work o the new truck been put in jeopardy simply because one component or another was not there when it was neede Part of this immense task of course was now to translate the early aluminium pressing tools to complete production presses, revising them as necessary now th the final design for the cab had been "signed-off." From manufacture of presses to finished pressings is a long way, and immense care was taken to ensure that th tools being made gave the most accurate possible resu

Panels from the pressings made were assembled on a 'cube.' the most accurate 'all-square' configuration that man can produce. Panels with their mounting holes or brackets were hung on the cube and minutely adjusted make absolutely certain that they would fit perfectly, bo as a complete structure and to adjacent components. By that stage in the process of evolution, the number of people involved had grown from the dozen or so in 1974 several hundreds. Soon those numbers were to be measured in thousands.





Object achieved

Finally, at the very end of 1979, the culmination of all those years of intensive effort, all the heartbreaks, the jubilation, and the plain sweat, produced the first production truck. It went through the build programme as if hundreds had gone before it, without as much as a hitch or a pause. But the final months that led to that historic moment were as busy if not busier, than any that had passed during the five years up to that date. Most vital of all the work at that stage, was the fleet assessment programme, aimed at proving all the earlier theories and practices in fleet working conditions.

Working on the basis that a company driver never handles a vehicle in quite the same way as a trained test driver, the Fleet Evaluation Trucks went into selected fleets all over Britain, carrying cargoes commercially. They also carried the hopes and prayers of the engineering team that had produced them from a clean sheet of paper in five years. The object was to subject the trucks to intensive but typical work conditions, as the final stage in the testing and proving programme. The truck's progress was closely monitored day by day, no matter where they were. Operators were encouraged to put them onto their busiest routes, in order to accumulate the highest possible mileage. At the slightest sign of a problem, a field engineer went out to the truck to investigate, and reported back. No truck is ever perfect from the drawing board, and the new T45 was no exception. Such problems as did occur were minor matters, largely associated with assembly methods or pre-production items. As patterns emerged from the assessment trucks, so action could be taken to ensure that there was no repetition in later production machines put up for sale. That process has, in fact, been continued with selected vehicles from the real production line in the New Assembly Hall as a "belt and braces" defence against failures in service that cost both the factory and the operator a great deal of money.

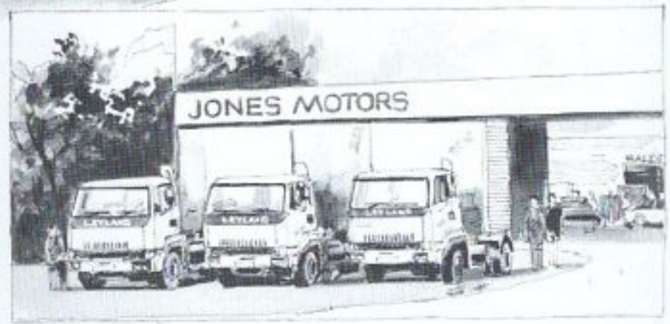
That process acts as a back-up to the advanced quality-control and production-audit schemes set up at the new factory to ensure that every T45 complies with its laid down specification of performance. The engine test facility gives written information on every engine's output and condition, and a series of smaller scale quality checks record everything from the thickness of the paint to the function of the electrical system; from the operation of the air circuits to the performance of the brakes.

Before any truck is released it undergoes a highly detailed test run on a dynamometer rig, where its tractive effort, running characteristics, exhaust content and every other mechanical function, are not only tested but recorded automatically. That process is much more detailed than the traditional on-road test run, and the data is more accurately logged, and furthermore able to be recalled for any subsequent purpose. Only when the truck reaches the required standard in every single function is it allowed to go out to the Distributor. Even then, he is required to carry out a detailed 56 point pre-delivery check before the customer sees his truck.

Reinforcing those quality control checks, are a series of support systems aimed at keeping the truck working and earning. The "Co-Driver" package of service support, comprising running data analysis systems, new parts supply systems, a one-number emergency aid scheme, and a charge-card system for away-from-base attention, all speed the truck back to work in the event of a probler In support of that is a fast trouble shooting procedure tha reports back on each and every service problem so that pattern, if any, can be quickly seen and appropriate acti taken on production trucks.

The end is not only a truck with high performance, high earning ability, low running costs and low down-time factors, but a truck with every modern aid behind its service support system. That truck in fact meets all the requirements laid down for it in the original concept all those years ago. At that time, the operating criteria were criticised by many as being unduly pessimistic. The penalty of lost working time, the cost of every man-hour c work required, and the level of utilisation that would be demanded in the '80's in order to support a profitable transport operation, were all questioned in 1974 as being far too severe.

In T45 the result is remarkably accurate, and the truck that was produced from that forecast is not only the first truck specifically built for the difficult economic situation that faces all of us in the '80's, but represents the finest standard of engineering and production available today.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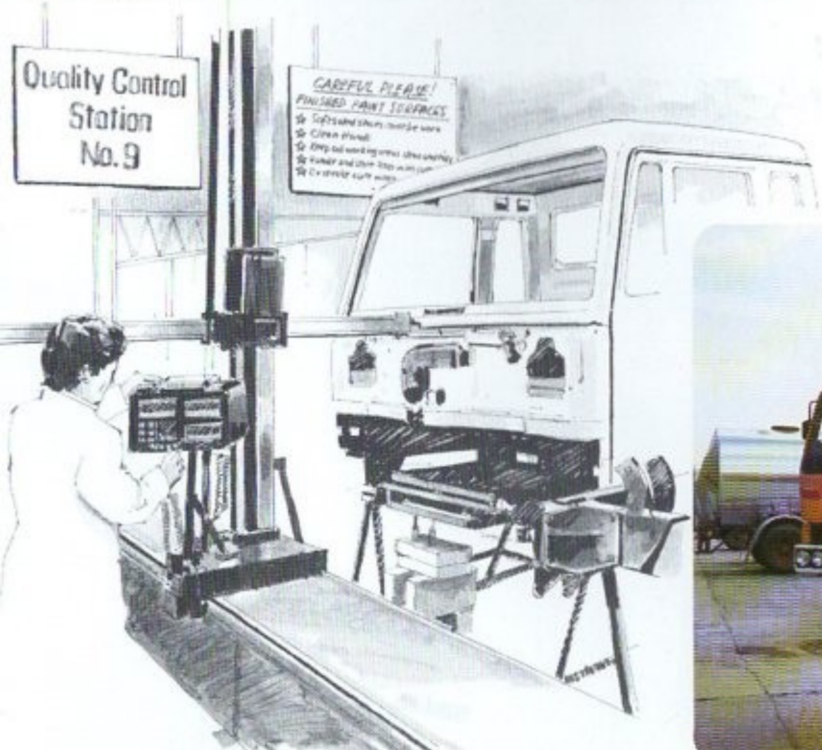
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