CHALLENGES FACED BY TRUCK ENGINEERS IN THE MID-1990s

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ABSTRACT

This paper provides a brief overview of how truck engineers and designers are turning to highly sophisticated technology for assistance in meeting increased market and regulatory demands for vehicle improvements.

INTRODUCTION

While working on the December 1995 issue of *Roads & Bridges Magazine*, a review of what happened on the truck scene during the year seemed appropriate. The review was published under the headline: "The Year of the Engine Engineer." It went over fairly well. At least, no transmission engineers called to complain. The 1995 headline serves as a point of departure for this talk. Early on, it was determined that the time frame for the talk should be adjusted to look forward to what is happening this year. With brakes that feature electronic antilock controls being fine tuned this year for mandatory installation in all big trucks from next year through 1999, a headline such as "The Era of the Electronics Engineer" suggested itself. Since some recent technical changes in trucks, notably fuel economy moves, have their roots in advances first noted before 1995, it was decided that this talk be widened to survey all the mid-1990s. After a look back to the year of the engine engineer in 1995 and a brief glimpse back to earlier developments, we will close with an up-to-the-moment look at what truck technical people are doing this year.

As noted, 1995 has gone into the truck history books as "The Year of the Engine Engineer." While it must be said that powerplant people made most 1995 headlines, it should be added that governmental regulators were out there vying for a share of the spotlight. For high drama, it is difficult to top the 1995 work of the engineers at the diesel engine manufacturers. Three lines closed out last year with new engines that were their strongest-ever truck diesels, the 500-horsepower unit from Detroit Diesel, a 525-horse offering from Cummins and a 550-horsepower Caterpillar product. With high fuel prices showing no signs of going away, the high horsepower engines were justified as the makers' response to customer requests for added strength to get difficult jobs done efficiently. Engine engineers were doing far more than "building them stronger" in 1995. Developing variations of existing engines that operate on alternative (nonpetroleum) fuels as a way to reduce air pollution and curb dependence on foreign oil was a massive effort.

Work on "alt" fuels sent researchers off in many directions. While Mack people were studying compressed natural gas or CNG as the fuel for a test E7 diesel engine, Detroit Diesel researchers were working with Ford engineers on a test of a CNG-fueled Series 60 powerplant for bulk newspaper delivery in the Los Angeles area. High costs are one of the problems with many alt fuels. As one engineering executive explained, a difficulty can be estimating the cost of auxiliary parts, such as fuel tanks, which have not yet been produced in volume for engines using the unusual fuels. At one extreme, alt fuel plans can be as obvious as one by Cummins people. Reacting to operators' requests for added power, they moved up the top horsepower ratings of the firm's L10 natural gas engines to more robust 280 and 300 numbers.

More complex was the effort of the truck producer, Navistar, and the oil firm, Amoco, working with two European companies in a program that delivered "a new, ultra-low emissions alternative fuel for use in diesel engines." The product was said to be "predominantly dimethyl ether or DME which is converted from natural gas or coal and other feedstocks." Those who worked on the new fuel said "DME can eliminate exhaust smoke and greatly reduce other exhaust pollutants while reducing engine noise." The alt fuel was said to be able to meet California's demanding 1998 emissions requirement "without the use of exhaust after treatment or catalytic converters." While California's 1998 exhaust rule, as is frequently the case, is more strict than those for the rest of the nation, preparing for a further tightening of emission limits for the rest of the nation in 1998 was another reason why truck engine engineers were busier than usual in 1995. The pressure is on to cut oxide of nitrogen emissions by 20 percent to meet the 1998 national standard. No one is saying exactly what will be done but confidence in meeting the standard is widely expressed.

Last year, both Caterpillar and Navistar were working with Hydraulic Electronic Unit Injection fuel injection systems for trucks just a cut below the strongest. Cat offered the system in its new 3116 diesel which has ratings of 170 to 275 horsepower. At Navistar, a similar system was used on the line's first electronic diesel which develops 250 to 300 horsepower. The beauty of these advanced systems is that they do an acceptable job of curbing emissions without aid of catalytic converters or other exhaust after treatment.

Volvo's latest offering in the diesel field is the electronic VE D12 which turns out 310 to 415 horsepower. Other important engine programs have had Detroit Diesel cooperating with Navistar on powerplant development and with Mercedes-Benz of Germany in designing diesels for the Mercedes subsidiary here—Freightliner.

Improved fuel economy, a need spawned by the oil crises of the Seventies dominated technical changes in trucks in the Eighties and early Nineties. On-off engine fans that operate only when needed for cooling, powerplants with reduced operating speeds, more efficient gearing as well as aerodynamic streamlining to curb wind drag were the most noticeable developments. There was a time about 1985 when the "experts" said that aerodynamic changes had gone about as far as they could in cutting fuel consumption. Every couple of years since, at least one truck maker has unveiled a restyled model with better aerodynamics that cut fuel bills even more. By introducing two very aerodynamic big truck lines, Louisville vocational units and AeroMax 9500 over-the-road tractors, Ford dominated the 1995 new model scene in the heavy truck field and proved that further aerodynamic gains are possible.

No one introduces a new model heavy truck these days without pointing out how the designers have thoroughly consulted with those all-important drivers on how the vehicle should be built. Ford made a novel point about its new models unveiled in 1995, noting that designs for most recent truck models were based on measurements of average drivers obtained in studies conducted during the World War II era, Ford said it measured current drivers and based its latest designs on those figures. Increased seat travel and more "belly" room were the big changes.

Turning now to what is going on in truck development this year, the big headline maker can be traced to a 1995 decision by the National Highway Traffic Safety Administration, requiring installation of brakes with electronic antilock capability on all new big trucks and trailers at varying dates between next year and 1999. Bendix, Midland and Rockwell WABCO have been gearing up to supply the hardware. In a recent move, Eaton and Bosch have decided to set up a joint effort to supply antilock brakes to the North American market. Antilock systems got a blackeye as they were found wanting when required in 1975. This time they are being mandated only after extensive federal testing. The current hardware has drawn few complaints so far, although there are those who have their doubts about how antilock systems in tractors and trailers should be linked. Most 1995 objections to the systems were aimed at antilocks installed in light trucks and cars. Many have been dismissed with observations that vehicle operators have not taken the time to learn how to use antilock systems properly.

Systems engineering is a major trend in truck development today. It is playing a key role in putting the finishing touches on big truck antilock systems. In a few words, it calls for designing parts that will be used together at the same time that other parts which will be used in the system are developed. Ideally, all parts that go into the system are preassembled as a system before going on the truck. The plan is designed to guard against mistakes as system parts are put into the truck. It makes sense when all of the wires, sensors, tone wheels and other antilock parts needed in an axle are put in the axle before the axle is shipped to the truck assembly plant. Errors in assembly were blamed for some of the antilock problems of the Seventies.

Computer-like systems which enable major truck components to diagnose their own malfunctions have been built into many components introduced in recent years. That trend has relieved the concerns of those who wondered how mechanics could be trained to troubleshoot the new electronic marvels which have come to dominate truck products in recent years.

For those who want to see something farther out than "automated diagnostics," truck industry technical experts are working on "prognostics." This involves using computerized "artificial intelligence" to project how a truck component will fail and when. The rubber industry has taken computerization of trucks a step further by burying computer chips in tire treads. It is a great way to pick up information from the point where the rubber meets the road. Futurists in the truck industry have been fascinated with radar since it proved most useful during World War II. Could not its ability to "see" through the night and storms be used to head off traffic accidents, they asked. Radar-activated braking is not here yet but Eaton Corporation and Delco Electronics have started moving toward that goal. Already they have reported progress in overcoming one of the admitted problems of truck operation—the inability of the driver to see what is going on in certain "blind spots" around the vehicle. In other safety efforts, the Volvo truck operation in North Carolina and its parent company in Sweden have been installing daytime running lights on trucks and researching the potential benefits of electronically actuated air bags in heavy trucks.