Lead Industries Association, Inc.

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SUBJECT: AUTOMOBILE EMISSIONS CONTROLS

TO THE MEMBERS OF THE LEAD INDUSTRIES ASSOCIATION, INC.:

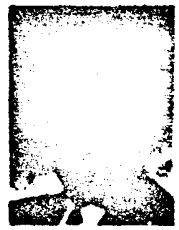
The attached copy of an address by Charles M. Heinen of the Chrysler Corporation is an excellent summary of the state of the art regarding auto emission controls and the compulsion to meet Federal emmissions standards for 1975.

Very truly yours,

Jerome F. Smith

Jerome F. Smith
Secretary & General Manager

JFS:lm
Attachment



Charles M. Heinen, Chrysler's executive engineer-materials engineering, tells in detail why the auto industry isn't ready and can't be. This is the text of his talk to an ESD sales engineering luncheon October 13.

Emissions 1975: Not ready!

I will not keep you in suspense, gentlemen. The answer to the question "Are we ready for the 1975 emission standards?" is a resounding NO.

I am sure this does not come as a great surprise to you. Today I thought we might want to review what has been done and what remains to be done.

I believe the public and particularly public officials and the environmentalists are yet to find out the *magnitude* of the task that remains. It involves not only the automotive industry, but also the petroleum industry, the makers of gasoline pumps, the various agencies at all levels of government and our various service industries, before the 1975 standards are a practical reality.

Please remember my emphasis on the words *a practical reality*. They may become a legislative reality before we are ready and this would be a needless economic tragedy.

First of all, what are the 1975 emission standards? The 1975 emission standards call for a 97% reduction in hydrocarbons from the values of an uncontrolled car. They call for better than 96% reduction of carbon monoxide and for no change, interestingly enough, in oxides of nitrogen which are now controlled to 50%. These are the 3 components of the automobile exhaust that are regulated.

A disparity between lab and highway

Achieving these numbers in the laboratory with new emission control devices has been an almost routine but always a short-lived accomplishment in the automotive industry.

Unfortunately, the 1975 emission standards call for meeting them at all times during a period of 50,000 miles, and there is the rub. The penalties for not meeting are so substantial that the automobile industry would be in constant jeopardy during the entire life of the car. It would be possible, for example, to request a recall and fix-up campaign on all cars at any time during the 50,000 miles. Needless to say, owners of 1975 cars would be less than enthusiastic to have their motoring habits disrupted to such a degree.

To add to the interest of the 1975 standards is the fact that while the federal government does not call for reductions in oxides of nitrogen, the California standards do. They ask a reduction from the present 50% control to 75% control. One of the key problems is that when you control oxides of nitrogen, you do so by burning *less efficiently*. When you control carbon monoxide and hydrocarbons, you do so by burning *more efficiently*. This is the technical dilemma that is facing us.

What are the tools available to us? If you are thinking turbines, Wankels, stratified charge engines, or any of the other engines of the future—forget it. There just is not enough time to take any of these more exotic engines and convert them from their present laboratory stage to a mass-production reality by 1975 or 1976—even if any of them had the capabilities of meeting the standards, which they do not.

A 2nd approach available to us in the case of hydrocarbons and carbon monoxide is to burn the materials in a post-engine oven known as an afterburner. This has generally taken the shape of a burner where the exhaust manifold is currently located. The problem with an afterburner is that if it burns efficiently for all conditions, there will some conditions under which the temperatures of the available materials will be exceeded.

In my chamber of horrors, there is a skid box collection of various afterburners that have failed from differential expansion, from extreme oxidation, from melting, and just about all of the other possible forms of failure resulting from high temperatures.

In spite of what I have said, an afterburner has a place in the picture, but it cannot be efficient enough to guarantee all of the necessary combustion required for the standards and certainly not for the standards in 1976 which are considerably more rigid than the ones in 1975.

Catalysts: A whole other can of worms

The 3rd tool available to us is the catalyst. What is a catalyst? It is a material, according to classic definition, which changes the rate or the temperature at which a particular chemical reaction takes place without participating in the reaction. This is the classic definition of a catalyst. Ah, that this were the actual case.

Catalysts, like little boys and girls, come in many types and sizes. For today's discussion, we will be interested in 2 shapes: Catalysts deposited on ceramic pellets, and catalysts deposited on a ceramic structure closely resembling a honeycomb.

In addition, we will be interested in whether the catalysts themselves consist of precious metal salts, such as platinum and palladium, or whether they include the more common materials so-called base metals, such as nickel, copper, manganese, etc.

Regardless of the type of catalyst, it must have large surface area. The ratio of real to apparent area is of the order of 100,000 to one. If this large surface area is destroyed, the catalyst rapidly loses effectiveness. For the case of high-temperature catalysts such as those which are used in connection with the exhaust, a form of aluminum oxide known as gamma alumina is used as the base. Gamma alumina is a remarkable material in that it can be spread out in such a form as to provide large surface area. Unfortunately, it has a limitation of about 1600°F. After that, it loses surface area. Recently some success has been achieved in raising or stabilizing the gamma alumina temperature to a somewhat higher level, but in any event, 1600° to 1800° will begin to have substantial effects on it.

It is not generally known that temperatures in the exhaust reach high levels. For example, between 70 and 90 miles-an-hour at road load, temperatures at 1600° easily can be achieved. These would be increased, of course, if an extra

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Emissions 1975: Problems with catalyst supply

heavy weight is being carried or towed at that speed.

If in addition to this you add such operations as a stuck choke or a partially plugged air cleaner or a sparkplug failure or any of the number of other things that can happen to an automobile under normal operation, the temperatures immediately increase because you increase the amount to be burned. One % carbon monoxide, for example, will add 200° to the temperature that is reached from the exhaust alone.

The method of failure, when it is the result of high temperatures alone, is to lose catalyst effectiveness. Most of this loss, interestingly enough, shows up at low temperatures of operation first. We can fail a federal test cycle under low temperature operating conditions—a situation created by high temperature effects on surface area.

And if the catalyst doesn't work?

Actually, there are conditions of deep winter operation when the exhaust never reaches the necessary temperature to activate the catalyst located under the seat or further back. Winter exhaust temperatures at low speed can average under 600°F. A new catalyst—a good new catalyst—usually starts working at about 400-450°F. Since catalysts do deteriorate, the temperature at which catalysts start acting increases to above 600°F. It doesn't take much deterioration to reach the point where it never starts to run or where it runs for only a short percentage of the time at low temperatures.

A 3rd type of deterioration occurs from the so-called poisoning effects. These can come about as a result of direct chemical reaction of the catalyst agent with some material in the exhaust gas, such as phosphorus or sulfur. The more likely form of poisoning is with a material such as the lead which is used in the exhaust to increase octane rating. This material literally covers the pores of the catalyst coating and as a result there is no activity.

Finally, catalysts can deteriorate from thermal or mechanical shock. The exhaust from the automobile varies widely in temperature within short periods of time. Sometime when you want to amuse yourself while you are driving, check up on the number of times that you go from idle to idle. Even during normal driving, not necessarily bumper-to-bumper driving, you will find to your surprise—or it was at least to mine—that you have gone from idle to idle once every 47 seconds on the average. This means that you have gone through a temperature range at the catalyst of at least 500° and probably more. This constant thermal change results in thermal shock to the catalyst.

The mechanical shock results from merely bouncing around in the case of pellets, or from stresses which occur at some point in the honeycomb. Perhaps it will occur from a backfire. In any event, we see this sort of thing happening quite often.

So we find that the catalysts are sensitive to temperature, that they are sensitive to thermal and mechanical shock, and finally, that they are sensitive to poisoning. All 3 of these can occur during normal driving conditions. Now you would presume that the federal certification test would take into consideration what would happen under extremes of thermal stress or thermal shock or from poisoning. Not so.

The important portion of the federal test for establishing durability is a cycle which produces a comfortable average temperature of 1100—and a maximum temperature of 1300—even at the exhaust manifold. Of course, the temperatures become lower as you go farther back from the engine. This test, an extremely difficult one for current engines, is designed to stress the types of emission control systems we have at the present time. Unfortunately, it is not a test to truly stress catalysts.

The real possibility, therefore, exists that the full government test can be passed successfully and that the catalyst will, nevertheless, fail in the hands of customers in the field. To serve the best interests of the public, it is obvious that the environmental protection agency needs to do some homework to come up with a "customer" type test to stress catalysts for emission levels and durability.

Federal tests can be run on smooth roads or indeed even on a chassis dynamometer for mileage accumulation. These tests don't make much sense when you are talking about a catalyst that will have to survive on all types of roads subject to adverse mechanical shocks. These tests should also include the ability to withstand backfires, since this has been a not infrequent form of failure in catalyst tests.

Actually, by carefully running a catalyst, we and others have achieved 50,000 miles of operations more or less within the limits of the federal specification. But when we expose these same catalysts even to what we at Chrysler call our general endurance cycle, they don't average much over 10,000 miles.

Again I must emphasize that despite the way the legislation is written, the federal government should address itself immediately to developing a meaningful test for catalysts. It's pure fiction to handle catalysts with a test and mileage accumulation that was developed primarily for another type of system.

Where do we get the catalysts?

Assuming that the question of the testing was satisfactorily resolved, what other problems do we have that should be taken care of before 1975? Well, first of all, regardless of what we prove in the laboratory, we will have to have catalysts to be used on 10 million cars. This is a whale of a lot of catalysts.

The pebbles for the pebble-type catalysts are generally available because they are used extensively in petroleum refinery and other chemical applications. Unfortunately, pebble-type catalysts have severe limitations on where they can be mounted in the vehicle, primarily because they have to remain relatively horizontal and because the cans to house them are inherently larger than those for the monoliths. As a result there will be many vehicles that just simply cannot be adapted to the use of pebble-type catalysts in time.

Let us assume that 50% of the production comes under that general heading. I believe this is a reasonably fair estimate since I have been spending a good deal of time looking underneath the various automobiles. That means that we also have to produce a second type of catalysts with monolith structures or substructures for the rest of the vehicles. Considering that at the present time there is nothing more than a pilot line for these materials, someone has to do an awful lot of work in a hurry.

Various catalyst manufacturers have estimated that it will take 6 months following brick and mortar to come out with a production product. 6 months from this day—plus the 18 months normally allotable to brick and mortar—brings us to October 1974, roughly 3 months after production is to start.

There are a number of people working on various plant designs, but to the best of our knowledge, no ground has been broken.

durability, testing; fuels, aftermarket—a nightmare ahead

After considerable testing, maneuvering, and a large number of investigations on various claimed catalysts, it does not appear that any of the catalysts that have any chance of meeting 1975 standards will be entirely devoid of precious metals. The precious metal situation is an interesting one. What it boils down to is that the major portion—indeed almost all of the precious metal capacity—is in the hands of the Russians and the South Africans, neither of which are the favorite trading partners of many groups in this country.

Where do we get precious metals?

If we were to use all of the precious metals available in the world, it is also worthwhile to know that the aboveground supply is just enough to keep us going in catalysts for about 2 years. Any additional supplies have to be obtained by starting new mines, mostly in South Africa. The mines also have an 18-month lead-time requirement so supply sourcing will be a rather interesting undertaking.

Let's assume that this, too, can be solved and consider another interesting aspect of this situation. I have indicated above that on the average the catalyst will last 10,000 miles. This means that we have to develop a large aftermarket operation for replacing the catalyst every year or less and, incidentally, for maintaining the operating conditions of the vehicle in such a fashion that it will not unduly stress the catalyst.

In view of the fact that the manufacturer has to be responsible for the catalysts during their 50,000 miles of operation, this could mean that he has to have control of both the vehicle maintenance and the catalyst replacements. This control would pose some challenging legal problems.

Even forgetting about the legalities of the problem, the sheer magnitude of developing a marketing organization thoroughly trained in the replacement of catalysts within a period of a year is quite staggering, particularly since to the best of my knowledge no one has started to do anything about it. Of course, the replacement catalysts will have to come out of the same precious metal supply and out of the same plants for monoliths and pebbles mentioned previously.

It would seem to me that there ought to be at least a few available at the outset for each aftermarket outlet in case of early failures. So we have another problem that should be well on its way to solution before catalysts are turned loose on the unwary public, and another problem on which there has not been much progress.

As I mentioned earlier, catalyst life may average 10,000 to 15,000 miles. But how about the variation from average? As you would assume, it is broad. On individual tests we have had failures as low as a couple of thousand miles and running under special conditions as high as 50,000 miles or close to it.

It is entirely possible that a failed catalyst would result in higher emission levels of both hydrocarbons and carbon monoxide than we have on our current cars. Therefore, it seems necessary that some provisions be made for inspection of the exhaust at regular intervals to be certain that there are not a number of vehicles running around with worthless catalysts and, therefore, emitting to a higher degree.

You would think that one of the first things that would have been done for '75 by the government would be to develop a method for evaluating catalysts in the field. This is not the case.

The federal government has not yet developed a test for field evaluation even for the existing systems. The closest approach to this is an idle test being run by the state of New Jersey and which is somewhat meaningful in connection with present systems. This test, however, would have absolutely no meaning as far as catalysts are concerned. I do not have a ready answer to the type of field test which might be used. Nevertheless, in view of the known variable life of the catalyst, it seems that this should be a requirement before the country goes catalysts by the millions.

The 2nd part of the problem is that the federal government claims it has no legal responsibility or even authority to conduct field testing. That function belongs to the states. However, none of the states, with one or 2 exceptions, have taken the necessary and expensive step of setting up adequate field stations to evaluate catalysts once a year. Legislation will be needed to require a catalyst to be changed periodically, if the inspection station concepts have not been worked out. There is no legislation in the works to do this.

The cost of a suitable field test lane for a once-a-year evaluation is about $50,000. It has been estimated that one test station per every 48,000 cars would be required assuming that a 3-minute test can be developed. This adds up to 2,000 test stations and $100,000,000.

What's in a 3-minute test?

Of course, we haven't developed a meaningful 3-minute test as yet. All of these stations, of course, would have to be equipped with instrumentation. This volume of instrumentation may cause instrument makers' mouths to water, but the simple fact is that at present we do not have the capacity to make enough of these instruments for much more than laboratory purposes and the likelihood of having them in time for 1975 in 50 states is essentially zero.

A 4th question which arises is that of fuel supply. We have heard a great deal of talk about the use of lead-free fuel and even some statements to the effect that it could be generally available any time that it was needed.

Well, suppose the time were 1975. According to a number of studies, the problem of making 91-octane fuel available for 10% or more of the cars by 1975 would require a substantial increase in production refinery capacity. As a matter of fact, according to one widely quoted study, this would require $366,000,000 worth of additional refinery hardware.

In spite of this and in spite of the fact that at the present time little lead-free 91-octane fuel is available, each of the last 3 years has shown a decrease rather than an increase in the amount of money spent for refining capacity. You do not make lead-free fuel with words. You have to make it with various forms of refinery equipment, and it generally agreed that this type of equipment also requires 18 months' lead time.

This does not correlate with the 1975 date. But it isn't just the production of 91-octane lead-free fuel that has to be stepped up. It also has to be made available to the customer. This means that an entire transportation system desegregated from the leaded fuel must be developed. This means that something of the order of 175,000 station pumps and tanks have to be added for those stations that only have two-fuel capacity.

Considering the job to be done, it is going to be rather difficult to find the lead-free fuel unless something dramatic is done about increasing the ability to make and install pumps, to build tank cars which can be used for lead-free

Emissions 1975: Why hurry?

fuel exclusively; and to install pipelines and storage tanks that can be used for lead-free fuel.

Finally, there will always be the temptation on the part of a station attendant who doesn't have lead-free fuel to use his leaded fuel supply, particularly if he can sell his premium gas for a few cents extra. So it has been generally agreed that something has to be done about the pump and tank interface. The idea of having a fuel pump nozzle that will only fit a distinctive opening to the vehicle tank has been discussed for some time.

An attempt was made to get the automobile and petroleum industries together to discuss this and to agree on a common opening. Unfortunately, this ran afoul of some of our antitrust fears and again nothing has been done.

Considering that the vehicles for 1974 are already well along toward production deadlines, this apparently simple nozzle design decision must be made shortly, particularly if suitable nozzles are to be manufactured, distributed and installed in the service stations across the country.

The law is ready—if nothing else

As we turn in almost any direction, we find that about the only thing that is ready for a 1975 introduction of catalysts is the law that says it must be done. Neither the government nor the various industries involved have done those necessary jobs which must precede a general installation of a brand new untested piece of equipment which is known to have major faults.

A natural question is: What's the rush? Why must it be 1975, particularly since it looks like nothing but a technical catastrophe can result from such early introduction?

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As Bob Brattain, chairman of California's technical advisory committee, points out, no one really knows what the levels should be at the present time. So, the urgency is certainly not from the point of view of any health crisis. It certainly does not seem to be an urgent situation except perhaps from a political point of view. Since I am not a politician except by necessity, I am not going to comment on the importance of that particular consideration.

I have restricted my discussion to 1975 because for 1976, in spite of some of the widely publicized claims to the contrary, we have nothing that even comes close to what we have for 1975. The problems are all the same except multiplied.

If there were nothing more involved in continuing on our present course other than embarrassment for some federal officials and some embarrassment for some automobile company engineers or executives, then we might say, "All right, let's go ahead; what the hell, we can always have some arguing back and forth and maybe something will be accomplished as a result." But this is not all.

It has been estimated by Russell Train, chairman of the president's council on environmental quality, that the cost of devices starting in 1977 will be something of the order of 9 billion dollars a year. This includes fuel penalties which could range anywhere from 10 to 30%. This expenditure is something that should not be considered unless there is a good degree of certainty that the problem is one of immediate crisis (actually this is not the case because of the measures already taken), and we know exactly what we are going to get for the additional moves to be taken.

Neither of these 2 conditions is met at the present time.

For these reasons, I say that we are not ready for 1975. There is no real possibility of being completely ready for 1975. You and I as citizens, who are going to have to pay the bill and who are going to have to live with the effects of any failures which might occur as a result of either overkill or overanxiousness, should start asking some questions. One is, "Is 1975 necessary in 1975 or at any other time?"