

March 21, 1927.

Spears & Riddle Company,
"heeling, West Virginia.

Dear Sirs:

Enclosed is copy of a letter dated the 17th from Dr. Bricker which is self-explanatory.

I believe it would be a good plan for us to prepare a large number of copies of the "Rules and Regulations", which are now attached to the jobber contracts, as referred to in my letter to Dr. Bricker, for distribution to the dealers who sell Ethyl Gasoline to the public.

I think I can prepare a letter to accompany the "Rules and Regulations" to each dealer after he has been signed up for Ethyl Gasoline by our jobbers, which will not act as any sales resistance whatever to these dealers. However, in a matter of this kind, we should not be too timid on the question of sales resistance, in my way of looking at things. It is the long haul we are after with ETHYL. If Ethyl Gasoline was only a temporary expedient, one would be naturally inclined to shrink from taking any action which would create some sales resistance. However, I vision Ethyl Gasoline with tremendous future possibilities and, for that reason, we should not allow ourselves to be annoyed too much by a dealer here and there who won't use ETHYL because of the precautions to be observed in handling it. Let us get dealers who are willing to observe the rules and who do not become frightened by our explaining to them what they have to do in selling ETHYL.

I think we have simply got to "take the bull by the horns" and let the dealer know once and for all that if he sells Ethyl Gasoline three things are essential:

1. That the proper notice is on the pump.
2. The maintenance of the standard.
3. The sale of it through equipment which will reflect credit on ETHYL and the carrying on hand of a supply of caution folders to be handed out when called for and, in that connection, the delivery to him, if he does desire to sell it, of the "Rules and Regulations" of which he acknowledges receipt and a copy of which he is to deliver to each of his men employed in handling Ethyl Gasoline.

I think this can be arranged and handled in a way which will not excite much, if any resistance or antagonism to our product. There is nothing like starting right on an educational campaign of this character. If we proceed fearlessly and at the same time, adroitly, I figure that we will get our message over in such good shape that in a couple of years from now it won't be necessary to tell a man that Ethyl Gasoline is to be used only as a motor fuel--the public generally will recognize the fact and most of them will observe it.

KE 0001123

Spears & Riddle Company

3/21/27

You will recall that there were all sorts of dire predictions about sales resistance in connection with the putting of a notice on the pump that it contained tetraethyl lead, but I do not believe anyone would say today that such notice has created any substantial resistance and if our picture of the future is correct as to the greater importance to be attached to Ethyl Gasoline, I think such notice and precautionary measures will have less significance from the standpoint of resistance to sales.

We would be very glad indeed to get any suggestions from you relative to this subject.

Yours very truly,

EWV/GMC

KE 0001124

March 17, 1927.

Re: Precautions to be Observed
in the Handling of Ethyl
Gasoline.

Mr. E. W. Webb,
President, Ethyl Gasoline Corporation,
25 Broadway,
New York, N.Y.

My dear Mr. Webb:

This is in reply to your letter of March 15 stating that you are planning to undertake a method of instructing all dealers in ethyl gasoline concerning the precautions to be used in its handling.

When this type of gasoline was first sold in Pennsylvania our Department found, on several occasions, that despite the fact that station attendants had available, booklets calling attention to the precautions to be used, they were entirely ignorant of the contents of the booklets. Rather than take drastic action, the Atlantic Refining Company (this situation was found especially in connection with that company's distributors) was asked to devise a plan by which they would be assured that the persons handling ethyl gasoline were familiar with the method in which it should be handled, and at the same time this Department would have definite knowledge that such information had been given to these employees.

Since that company inaugurated its plan, all other companies in Pennsylvania mixing ethyl gasoline have adopted similar procedures. Inasmuch as the Spears and Riddle Company is the only large seller of ethyl gasoline in this State, outside of the companies mixing in this State, I have asked them to adopt some such method also. After the splendid cooperation we had had with the Atlantic Refining Company, I preferred to ask the Spears and Riddle Company to devise their own methods, and it was with this object in view that I took up with them the proposition.

I believe that your suggestion that all sellers of ethyl gasoline receive their instruction direct from you in a most admirable one, and I shall be glad to learn what plans you are making for this purpose. If I, or any one else in this Department can be of help to you in perfecting your plans for your Pennsylvania dealers, we shall be very glad to have you advise us.

Your calling attention to the fact that no authentic case of injury to any person from the use of this material has been brought to light, leads me to say that this situation should make you feel that your efforts in exacting care in its handling have been well worth while.

KE 0001125

Mr. E. W. Webb

3/17/27

I note that you expect to see Dr. Kehoe within the next ten days and I shall therefore not look for any advice from you until after the expiration of that time.

I appreciate very much the cooperation which you have uniformly given this Department, and it is because of that cooperation that we prefer to have you develop your own method of procedure rather than attempt to impose upon you one devised by us.

Yours very truly,
Elizabeth B. Bricker, M.D.
Chief, Hygiene and Sanitation Section

EB/S

KE 0001126

March 15, 1927.

E. W. Webb.

Re; Instructions and Precautions for
the Handling of Ethyl Gasoline.

Dr. Elizabeth B. Bricker,
Chief, Hygiene and Sanitation Section,
Department of Labor and Industry,
Harrisburg, Pa.

Dear Dr. Bricker,

Spears & Riddle Company of Wheeling, W. Va., have just brought to our attention the correspondence relative to the above subject, as applicable to the distributors of Fleetwing Ethyl Gasoline in your state.

They were the second concern to sell Ethyl Gasoline in this country, and I feel that we know them sufficiently well to state that they are as anxious as any concern could be to handle our product in a way which will meet with the approval of your department, as well as ourselves. We have always found them wholly responsive to any merited suggestions and particularly those that might have reference to health matters.

They have brought this matter to my attention with the idea of seeing if some satisfactory arrangement could not be made with your office which would be of the nature of standardization; by that I mean, that it might be well for all distributors to be advised as nearly alike as possible.

With each jobber's contract, we attach what we term "Rules and Regulations for Sale and Distribution of Ethyl Gasoline", copy of which is enclosed, and we also explicitly instruct such jobbers to advise their re-sellers in accordance with those rules. Furthermore, it is necessary for anybody who sells Ethyl Gasoline to the public, to have "Caution" folders available for issue in the event they should be asked for by the public. It is understood with our direct customers that the contents of these folders will be brought to the attention of each dealer, so that all who handle it will be aware of the precautions which we recommend for use, as well as those of the Surgeon General.

I think that you and other health authorities will subscribe to the point that for a product that has been on the market for four years, during which time there has never been an authentic case of anyone being injured in its use, we have set out some very strict rules in connection with its distribution.

I think we can devise a plan to have copies of the enclosed rules placed in the hands of each dealer who handled or sells Ethyl Gasoline to the public.

KE 0001127

Dr. Elizabeth B. Bricker

3/15/27

I hope you will bear with us so that we might be privileged to work out a satisfactory arrangement for you in the event, after you hear more about our plans, you should feel that further action is absolutely necessary.

We are sending the enclosed booklet out to each automobile dealer in the United States; to the owners of fleets of trucks having in operation more than five automobiles, these two classes constituting about 75,000; to the editors of oil and automobile trade journals; to all automobile manufacturers and engineers. We are having this booklet reprinted in smaller type on a four-page insert which will appear in the oil and automobile trade journals, commencing the latter part of this month and running through next month.

In addition to this, our customers will probably send out thousands of these booklets, all in an educational campaign, setting forth what we consider of importance in connection with its use in automobiles, the precautions to be used in its handling, etc.

Naturally, in writing a booklet of this kind with the hope of having it read by different types and classes of people, it will probably not be found entirely satisfactory to anybody; however, it is our best effort.

I believe the public will soon appreciate the fact that Ethyl Gasoline is sold solely as a motor fuel and is not to be used for any other purpose and that it will be treated accordingly.

However, I will go into the subject with Dr. Kehoe within the next ten days and pending the consideration of the above matter on your part, may I ask you not to expect any particular action relative to same to be taken by the Fleetwing people.

Kindly let me know if this is satisfactory to you.

Yours very truly,

SWW/B

KE 0001128

RULES AND REGULATIONS

The Surgeon General of the United States Public Health Service has issued the following regulations for distribution of Ethyl Gasoline (no matter under what name it may be sold):-

1. Each filling station shall have prominently displayed at the pump the following warning:

" _____ Ethyl Gasoline containing tetraethyl lead, to be used as a motor fuel only, and not for cleaning, washing or any other purpose."

2. Suitable leaflets shall be available at all filling stations where _____ Ethyl Gasoline is sold, for distribution on request. These leaflets shall describe the possible dangers and precautions to be taken in the use of _____ Ethyl Gasoline.

3. Containers of _____ Ethyl Gasoline sold to the general public shall be labeled:

" _____ Ethyl Gasoline containing tetraethyl lead. To be used for motor fuel only and not for cleaning, washing or any other purpose."

In addition to the above the Ethyl Gasoline Corporation has prepared and issued the following comment and suggestions:-

Motorists are reminded that there is danger involved in handling all kinds of motor fuel. When breathed as vapor, or when absorbed through the skin in sufficient quantity, any kind of gasoline will produce serious results; and when allowed to remain in contact with the skin it frequently produces irritation and blistering.

THE FOLLOWING PRECAUTIONS SHOULD BE TAKEN IN HANDLING GASOLINE CONTAINING TETRAETHYL LEAD (ETHYL GASOLINE):

1. Do not use it in lamps or stoves, or for cooking purposes of any kind.
2. Never use it for cleaning tools, machinery, clothing or hands.
3. Do not carelessly spill it on the floor of the garage.
4. Avoid spilling it on your clothing or skin.
5. Men who load it or handle it at filling stations or otherwise, should avoid spilling it as much as possible and avoid any unnecessary contact of it with their skin or clothing.
6. In operations where skin contact is unavoidable, such as removing valves from cars for drainage of residual gasoline, it is recommended that soap and water be immediately used to wash the hands and arms wherever practicable. The use of waste or other absorbent material for the removal of gasoline from the skin is suggested as a second possibility.

FULL REPORT ON ETHYL GASES

FIRST OF "DAILY MAIL" TESTS

LEAD DISCHARGES INTO THE AIR

WORSE IN TRAFFIC BLOCK

An important stage has been reached in the comprehensive test of ethyl petrol -- the new and much-discussed motor fuel containing lead tetra-ethyl -- which the DAILY MAIL is carrying out in the interests of hundreds of thousands of motorists.

We print below a full report on tests relating to the exhaust gases from motor-car engines in which the spirit has been used. The investigations have been carried out for this newspaper by the Research Association of British Motor and Allied Manufacturers, a body founded under the auspices of the Government Department of Scientific and Industrial Research.

According to the report, the tests showed that as an engine became warmed up, and as the load increased, the lead content in the exhaust gases rose from 1.76 per cent. of the lead supplied in the petrol to 60.2 per cent. It is pointed out that:

The engine stores lead during idling periods. . . In the racing away after a traffic stop, heavier discharges of lead may be expected.

It is important that users of ethyl petrol should ensure that the joints of the exhaust manifold and silencer are thoroughly tight.

The results of the other DAILY MAIL tests -- the effect of inhaling the gases and the effect of the spirit on the car engine -- will be published in due course.

LORD BUCKMASTER

Simultaneously with the issue of the Motor Research Association's report, it was announced in the House of Lords yesterday that the Government is to hold an inquiry into the possible dangers arising from the use of ethyl

KE 0001130

Lord Buckmaster, in asking for the appointment of a committee, declared, as reported in Page 13:

During the war the use of tetra-ethyl of lead as a poison gas was considered, and experts regarded it as a means of disseminating more certain death than any other poison they had got.

LEAD STORED UP IN ENGINE
RATE OF DISCHARGE FROM EXHAUST
SOMETIMES "DISQUIETING"

The report of the Research Association of British Motor and Allied Manufacturers on exhaust gases from Ethyl petrol is as follows. (The headlines and cross-headings have been inserted by THE DAILY MAIL):

Every motorist is familiar with the ordinary two-gallon petrol can -- the can in the street, as it may be termed. When such a canful of petrol is consumed in a petrol engine, 7,250 canfuls of air are inhaled by the engine. That is the first fact.

The number 7,250 is a fair average. Some thrifty motorists may use as much as 9,000 canfuls of air with each canful of petrol; others very wastefully may consume only 6,000 canfuls of air. In the ordinary run 7,250 canfuls of air to the canful of petrol is a fair average:

PROPORTIONS OF EXHAUST GASES

Taking this average value of 7,250 cans of air per can of petrol, we find that 8,200 canfuls of gases are discharged from the exhaust pipe. These gases are in the following proportions (for simplicity round numbers are given):-

	Canfuls
Nitrogen	5,650
Carbon dioxide	710
Carbon monoxide	450
Hydrogen	160
Argon	70
Steam or Water Vapour	1,160
Total	8,200

Rare gases, such as helium, neon, and others are ignored because they occur in very minute quantities. It is interesting to note that the 1,160 canfuls of steam, if condensed, as happens in cold weather or when starting, would almost fill a can.

We have, therefore, an easily remembered fact — namely, that a petrol engine emits very nearly as much water as it consumes of petrol.

The foregoing statements rest on the assumption that the engine is running properly. When an engine is misfiring, on account of faulty ignition or carburation, the fuel and air are emitted at the exhaust pipe in varying proportions and conditions.

Sometimes the unburnt fuel collects in the silencer and exhaust pipe where it may be ignited by hot gases from working cylinders, so that an explosion occurs in the silencer system. Such an explosion often blows out the accumulated carbon and other particles in a dense black cloud, as many motorists must have observed.

To get a clear picture of the exhaust gas problem we may consider a medium-powered car, such as is being used in the DAILY MAIL tests. Such a car runs about 23 miles on a gallon or 46 miles on a two-gallon can.

By simple arithmetic, since 8,200 canfuls of gas are emitted in 46 miles, we find that one canful of exhaust gas is discharged every 10 yards. A large lorry doing 4.6 miles to the gallon would emit a canful of exhaust gas every two yards, which explains the unpleasantness of following a big vehicle in a narrow badly ventilated lane.

So far, we have been discussing ordinary petrol. We may now consider

KE 0001132

Ethyl petrol. This fuel consists of No. 1 petrol with the addition of about one teaspoonful of Ethyl fluid per gallon of petrol (one gallon equals 1,280 teaspoonfuls). Ethyl fluid consists of:

	Per cent
Tetra Ethyl Lead	54.54
Ethylene dibromide	36.36
Halowax	9.09
Red Dye (No. 4 Sudan)	0.01
	<u>100.00</u>

The functions of the various ingredients need not be discussed here.

We are concerned mainly with the quantity of lead present, for it is on account of the poisonous properties of lead that these investigations have been made.

Briefly, then, it may be stated that Ethyl petrol is ordinary No. 1 petrol containing lead equivalent in weight to slightly more than a sixpenny-piece per gallon, or slightly more than a shilling-piece in a two-gallon can.

Since this lead is admittedly in the petrol, it must either remain in the engine, as a deposit on the various surfaces, or in the lubricating oil, or it must be blown into the exhaust and breather gases, or a combination of all these may occur.

LEAD IN THE ENGINE

The amount of lead in the exhaust gases is important in connection with air pollution and poisoning by inhalation, and the quantity of lead deposited on engine surfaces or in lubricating oil is of interest in relation to the health of those who are to handle engine parts during repair and overhaul.

To put the facts very briefly, we may state that in every two-gallon can of Ethyl petrol there are about seven grams of lead, and, since each can of petrol produces 8,200 cans of exhaust gas, we have available about 7/8ths of a milligram for each canful of exhaust gas, or nearly three (2.67) milligrams of lead for each cubic foot of exhaust gas, or 94 milligrams per cubic metre.

These figures give the lead that would be in the exhaust gas if none

KE 0001133

remained in the engine.

Before proceeding to the results of the experiments it is right to emphasise that the exhaust gases from ordinary petrol contain a deadly poison, namely, carbon monoxide.

This is present in the proportion of 450 camfuls in 8,200, or one part in eighteen. This is an average value. Some exhaust gases contain more and some less than one part of carbon monoxide in eighteen of exhaust gas.

It is safe to say that if the exhaust gases from any petrol engine were inhaled for a few minutes even with a slight dilution of air, the results would be fatal. It has been computed that ten minutes' running of a car engine in a small closed garage is enough to cause death to a person in that garage.

Various experiments have been made to determine the amount of lead in exhaust gases from Ethyl petrol. The experiments were made on two motor-car engines and also by burning the fuel under a cowl and chimney.

The engines used were a twin-cylinder water-cooled unit of 972c.c. capacity (R.A.C. rating, 8.34-h.p.), and a six-cylinder water-cooled engine of 2,665c.c. capacity (R.A.C. rating, 20.7-h.p.).

From these engines samples of from 20 to 50 cubic feet of exhaust gas were led through various absorbents and the absorbents were then analysed. The petrol and air consumption were measured during the sampling operation, and the engine conditions, such as speed and load, and rate of sampling were varied.

In those experiments where the Ethyl petrol was burnt under a cowl and chimney the gases were not analysed; the deposits on the cowl and chimney were analysed, so that these burning tests are, in a sense, a converse of the engine tests.

The flat twin-cylinder engine used in this work had been specially

KE 0001134

cleaned and conditioned before the tests began, and the opportunity was taken to examine the oil in the crankcase and the deposits on the pistons and cylinder heads.

A DEFINITE CONCLUSION

The results are given in the form of an appendix. They should be of special interest when compared with those obtained from the three vehicles now on the road.

The results of these tests lead to one definite conclusion, namely, that it is impossible to state the amount of lead emitted in exhaust gases as a definite fixed percentage of the lead introduced with the petrol. The amount of lead discharged into the atmosphere depends on the condition of the engine and on the manner of its operation.

In general, it may be stated that a clean engine or a cold engine emits very little lead in exhaust gas, because the lead is deposited on the clean or cool surfaces in contact with the gas on its way out.

In a hot engine, however, deposition on the surfaces is greatly reduced and more lead appears in the exhaust gases. If an engine, using Ethyl petrol, has been running light and cool for some time the pistons and cylinder heads become coated with a thick greyish-yellow deposit.

THIN REDDISH DEPOSIT

If the engine is now run under load, the thick yellow deposit vanishes, and in its place is formed a thin reddish deposit on a somewhat excoriated surface.

This process of deposition under cool conditions and disappearance under hot conditions is of fundamental importance, as will be seen later.

The facts imply that when an engine is running light or cold, lead may be stored up. And then, if the engine is speeded up, under load, this stored

lead may be discharged into the atmosphere.

KE 0001135

ceivably be even greater than the rate of supply. This fact is not only interesting but under certain conditions disquieting.

LAMP EXPERIMENTS

79 PER CENT. OF THE LEAD

LOST IN BURNT GASES

Although the lead emission from engines are the primary object of consideration, there are advantages in eliminating all the various complexities incident to engine operations. Therefore we may begin with the simple burning experiments.

In the first place a special Primus type of burner was used. This had been expressly designed for use in a calorimeter where complete combustion is necessary .

This special burner was placed under a clean steel cowl from which two lengths of glass tube emerged. The idea in using two lengths of glass tube was to split the analysis and see where most deposition occurred.

This experiment, although satisfactory, gave much trouble because the fine jet choked very frequently and needed laborious attention. Such choking had not occurred previously with ordinary petrols.

The repeat experiment was carried out with a petrol blowlamp, with a variable jet, such as is used by plumbers and painters. This blowlamp did not choke but it gave a slightly sooty deposit.

These two experiments are, so far as can be seen, very typical. The Primus burner represents complete combustion such as is seldom realised in an engine, the blowlamp, though less perfect, is probably better, in regard to combustion, than most engines.

These tests showed:

(a) WITH THE PRIMUS BURNER.

	Per cent.
Lead deposited on cowl	4.18
Lead deposited on chimney...	16.78
Total	20.96

79 P.C. OF THE LEAD LOST

Thus, 79 per cent. of the lead supplied was lost in the burnt gases. It should be noted that of the 16.78 per cent. deposited on the chimney 13.95 per cent. was found on the lower half nearest to the burner. This agrees with general observations on engines, where the chief deposits occur in the exhaust system near to the engine.

(b) WITH THE PETROL BLOWLAMP.

	Per cent.
Lead deposited on cowl	23.6
Lead deposited on chimney...	13.1
Total	36.7

Thus, 63.3 per cent. of the lead supplied was lost in the burnt gases. The bulk of the deposit in the glass chimney was at the lower end near the blow-lamp. It may be added that other experiments, using a steel tube as a chimney, were attempted and provisionally abandoned on account of gross contamination by iron oxide.

In some respects this is a matter for regret, because, apart from the closer resemblance to the steel exhaust pipe, it appears not unlikely that the lead compounds in the exhaust gases deposit more readily on steel or iron than on glass. On the other hand, the deposition in the glass tube could be watched as it proceeded.

LEAD DISCHARGES

MUCH LESS WHEN EXHAUST

PIPE IS COOLED

As already mentioned, the engine tests were carried out under a variety of conditions -- a few typical results may therefore be given. At

KE 0001137

the beginning of the tests, when the engine was clean and free from any lead deposits, samples of exhaust gas were taken.

The first set gave a lead content in the exhaust gas 1.76 per cent. of that supplied in the petrol. The second, under similar conditions except that the engine was warmer and less clean, gave 7.67 per cent. A later test gave 35.6 per cent. These three tests were all under light load at low speed.

A test was then carried out under heavy load after prolonged idling: the lead determined in the exhaust gas then rose to 60.2 per cent. of that supplied.

Tests were then made with a water-cooled exhaust pipe, a jacket being fitted through which a copious stream of cold water circulated. At once the lead found in the exhaust gas fell from 36.8 per cent. to 5.65 per cent. A subsequent test with the water-cooled exhaust pipe and heavier load gave 11.25 per cent.

In some respects, the capacity of the engine to store lead during idling periods is very fortunate, because in traffic and in garages, where the ventilation and dilution of the air is least efficient, the pollution of the air is less severe.

On the other hand, there are circumstances -- as, for example, in the racing away after a traffic stop -- where engines are fully loaded after idling, so that heavier discharges of lead may be expected.

Without a very prolonged investigation it is impossible to state with precision the nature and composition of the exhaust products from Ethyl petrol. And, having regard to the wide variations that occur in the conditions of engine operation, and in the cleanness of the various surfaces in different vehicles, it may be doubted whether such an investigation could be economically justified.

The main facts are that an engine running on Ethyl petrol emits lead compounds. These compounds vary in amount and kind as the conditions of running

KE 0001138

vary, and they are sufficiently soluble to be almost entirely dissolved in the exhaust water.

On account of the fact that the lead is introduced as a very small fraction of the petrol, which in turn is burnt in a very large volume of air, conditions are such that any lead carried in the exhaust gas to the atmosphere is likely to be in a finely divided state.

Under normal conditions of operation it appears that most lead is deposited on the first two or three feet of the exhaust system, and that in the neighbourhood of the exhaust valve the lead compounds are frequently in a volatile or gaseous state.

On this account it is important that users of Ethyl petrol should ensure that the joints of the exhaust manifold and silencer are thoroughly tight.

Such a precaution is desirable in all cases because of carbon monoxide, but with a second poison present the precaution is doubly necessary.

With regard to the gases discharged from the exhaust pipe, we have seen that, if all the lead in the petrol were emitted in the exhaust gases there would be, under average conditions, 94 milligrams of lead per cubic metre of exhaust gas. Assuming that 30 per cent. of the lead is emitted, which appears to be a reasonable average, this would mean 28 milligrams of lead per cubic metre of exhaust gas.

How far this would be diluted by the surrounding air would depend on the situation in respect of buildings and wind currents.

As an indication of dilution, carbon monoxide is fairly convenient, and it has been extensively studied. In a good commercial garage 4 parts of carbon monoxide in 10,000 of air may be assumed as a high but not unusual proportion. Assuming one part of carbon monoxide in 18 of exhaust gas, this implies a dilution of 139.

Applying this dilution to the 28 milligrams of lead above, we have a

lead content of 0.2 milligrams per cubic metre. In streets the dilution would be two or more times as great, and so the lead present per cubic metre would be 0.1 milligrams or less.

This engine was thoroughly cleaned for the test. After 28 gallons of Ethyl petrol had been consumed, the deposits on the pistons and cylinder heads were collected and analysed for lead. The total deposit from the two cylinders and pistons was 30.01 grams. The lead found was:

	Grams.
1st determination	8.55
2nd determination	8.61
Mean	8.58

Taking the lead content per gallon as 3.5 grams, the total lead supplied, would be 98 grams, so that the lead in the surface deposits amounts to 8.75 per cent. of that supplied in the petrol.

When the engine had consumed 36 gallons of petrol, the crankcase oil was drained out. This amounted to 1,325 quarts and had a density of 0.915 grams cc. Then the sludge in the crankcase was scooped out; of this 78 grams were obtained.

The crankcase was then washed out with petrol. The washings amounted to 1.5 quarts of density 0.758. Analysis of the three substances gave the following quantities of lead: --

		Grams.
Drained oil ...	1st determination ..	11.78
	2nd determination ..	11.55
	Mean	11.665
Sludge	1st determination ..	3.07
	2nd determination ..	3.02
	Mean	3.045
Washings	1st determination ..	0.05
	2nd determination ..	0.04
	Mean	0.045

Taking the lead content per gallon as 3.5 grams, the total lead supplied would be 126 grams, so that the lead found in the crankcase stated as a percentage of the lead supplied would be:

KE 0001140

	Per cent.
Drained oil	9.26
Sludge	2.42
Washings	<u>0.04</u>
Total	11.72

During this oil test the engine had run at various speeds and loads for 127 hours, during which time 3 quarts of oil had been consumed. This quantity, representing $1/48$ of the petrol consumption, is high, but not more than is often met in road service.

The lubrication was intentionally liberal, and this, in conjunction with the horizontal cylinder arrangement, would explain why the lead content is higher than that found in the medium-powered car. In the report on the latter the content per gallon was incorrectly taken as 2.5 grams instead of 3.5 grams. This correction makes the lead found as a percentage of that supplied 2.66 per cent.

A summary of all the results obtained will be given when the trials are concluded.

For the Research Association of British Motor and Allied Manufacturers.

(Signed) H.S. ROWELL, Director.

KE 0001141