April 21, 1934

Dr. R. R. Sayers
Bureau of Mines
Dept. of Commerce
Washington, D.C.

Dear Dr. Sayers:

I have had a conversation with Dr. Edgar in which he passed on to me your request that I give you my opinion with regard to the possibilities for danger associated with the distribution and handling of gasoline, containing up to 4.5 cc. of tetraethyl lead per gallon, with the understanding that such gasoline is to be limited to aeronautical usage. I am glad to state my point of view and to present the evidence on which it is based.

The possibilities for danger may be classified under the following headings;

(1) those associated with exposure to the prepared gasoline, including skin contact, inhalation of vapors of gasoline under all the conditions of use and spillage; and

(2) those associated with exposure to exhaust gases containing finely divided lead, on the part of pilots, passengers and the general public. It seems quite clear to me that we need not concern ourselves with the question suggested under the second heading since the opportunities for exposure to insufficiently diluted exhaust gases in confined or unventilated areas will be insignificant in the case of aeroplanes as compared to those which have been afforded by automobiles without evidence of human lead accumulation. Therefore there remains only the question of exposure to gasoline containing concentrations of tetraethyl lead up to 1 part in 840 of gasoline.

It is apparent that the vapors rising from tanks or open containers will show slightly increasing amounts of lead, with increasing concentrations of lead in the gasoline. The vaporized lead in the atmosphere as the result of spillage will also be greater for a given amount of gasoline, with every increase in the concentration of lead in the gasoline. However, the amounts of lead which will be present in vapors above tanks are too small to be

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of practical importance, at the specified concentrations. Moreover, the problem of spillage, with complete evaporation of gasoline and lead is not likely to be of consequence, since the gross amounts of gasoline handled at one place will be relatively small, and since spillage must be guarded against in any case because of fire hazards. In view of the complete lack of evidence that lead absorption has occurred from the inhalation of vapors of automobile gasoline under the conditions which exist in garages and filling stations, I cannot conceive of difficulty from a slight increase in the lead concentration of the small fraction of gasoline which is handled under the conditions which exist at air ports.

The one factor which must be considered seriously is the influence of lead concentration in gasoline upon the rate of lead absorption through the skin of exposed persons. It has been observed that lead is absorbed rapidly out of gasoline through the skin of animals when it is present to the extent of 10 % by volume in gasoline. Absorption is very much retarded when the concentration of lead is 1% in gasoline, and it fails to occur when the concentration is 0.1%. The available data do not justify the plotting of a curve from which the zero point of absorption might be predicted, but the magnitude of the change in absorption which results from the drop from 10% to 1% concentration makes for the probability that absorption ceases at concentrations well above 0.1%. It does not appear that it would be hazardous, therefore, from the point of view of skin absorption to handle gasoline containing lead in concentrations approximating 1 part in 840 parts of gasoline.

Evidence obtained from the periodic examinations of several men at Wright Field who handled gasoline containing 6 cc. of $Pb(Et)_4$ per gallon tends to substantiate the foregoing conclusion. An interpretation of the variation in the analytical results on these men cannot be made with accuracy because they were exposed to Ethyl Fluid in the preparation of the gasolines which were being used for experimental purposes. Suffice it to say, therefore, that the examinations of five men from time to time over a period of three years, during which they were regularly exposed (by inhalation) to Ethyl Fluid, and to gasoline containing 6 cc. of $Pb(Et)_4$ per gallon did not result in any symptoms or signs of lead intoxication or evidences of lead absorption. On the last examination of their excreta (1932) after three years exposure, the following results were obtained.

| Subject | Pb in Faeces Mgs/Gm.Ash | Pb in Urine Mgs/Liter |
|---|---|---|
| M.F.C. | 0.05 | 0.08 |
| T.N.L. | 0.05 | 0.08 |
| H.Z. | 0.04 | 0.05 |
| P.S. | 0.10 | 0.09 |
| F.K. | 0.08 | 0.05 |
| E.R.L. | 0.04 | 0.07 |

The above figures do not demonstrate the occurrence of significant lead absorption.

Taking into account the information now available on the whole subject of lead exposure in relation to leaded gasoline, together with the foregoing observations, which are admittedly meager, I am convinced that the use of lead in aviation field up to 4.5 cc. per gallon will not be attended by an increased hazard to any group of individuals.

Very truly yours,

RAK:IS

Robert A. Kehoe, M.D.