December 16, 1947

Mr. Henry A. Geisler
Project Engineer
South Wind Division
Stewart-Warner Corp.
1514 Drover St.
Indianapolis 7, Ind.

Dear Sir:

Your letter of November 14, 1947 to Dr. Calingaert has been referred to me for reply. The delay has been due to awaiting results of a test we are currently conducting on several gasoline burners including one of your own.

For your information the South Wind Car Heater (Model 781) which we are testing has accumulated 150 hours of quite satisfactory operation on a somewhat intermittant schedule burning a standard motor fuel containing 3.0 ml. tetraethyllead per gallon. A visual inspection of as much of the unit as possible without complete disassembly has indicated only moderate deposit formation. From the appearance, reasons for an early failure are not evident and a considerably longer run is anticipated. It may be well to point out that our criterion of satisfactory operation is fuel flow rate; efficacy of heat transfer is not taken into consideration.

With regard to the information requested in your letter, the following may be of interest and assistance. During the war several branches of the Armed Forces requested that the Ethyl Corporation develop means for the removal of tetraethyllead (TEL) from gasoline prior to burning. To accomplish this several different procedures, which fall into two classifications, were developed. First were procedures which removed the TEL in a unit completely apart from that in which the gasoline was actually burned. Such procedures involved (1) a chemical decomposition of the TEL with subsequent separation of the decomposition products by filtration, (2) adsorption by activated clay (Filtrol), and (3) a thermal decomposition of the TEL to metallic lead and subsequent removal.

Second were those procedures wherein the TEL removal, or "deleading" as it is generally referred to, was accomplished within the unit in which the fuel was used. Two approaches were made along this line, namely, a thermal decomposition followed by filtration, and a hot clay adsorption.

Since the first group are probably of little direct interest to you no further discussion of the procedures will be included. However the second group may have potential value to you.

The thermal deleading unit as developed for the Army kitchen stove, consists of an expanded generator tube packed with steel wool. The steel wool actually serves a dual prupose in that it provides (1) a hot mass through which the leaded fuel passes and is vaporized with the TEL being decomposed due to the high temperature (at least 650°F), and (2) a filter for the removal of the metallic lead resulting from the decomposition. The unit, as developed for the Army, consisted of a steel tube 1.6-in. I.D. by 14-in. in length packed with 7.5 oz. of No. 1 steel wool. The size of the tube is rather flexible, with even larger units being desirable for the deleading operation, although slower starting of the burner due to the expanded generator volume offers a handicap if the burner is of the type requiring vaporization before starting. The packing density, 0.22 oz. of steel wool /cu. in. appeared to be the optimum.

In the Army unit a satisfactory service life of 300 hours was accomplished during which time about 125 gallons of gasoline containing 3.0 ml. TEL/gal. was burned. This corresponds to a capacity of 4.8 gal. (containing 3.0 ml. TEL/gal.) /cu. in. of packed tube. With a fuel containing 4.5 to 4.6 ml./gal. (as in Grade 115/145 Aviation Fuel) the ratio would become 3.2 gal./cu. in. However there was some indication that with an increased flow rate in the above unit, lead removal was not nearly as satisfactory. In other words, some experimental work would be involved in the development of a unit for deleading fuel for the flow rate of 16 lbs/hr. which you mention.

The second method of deleading which was adapted to an Army stove utilized a cannister 18" x 8" x 4" with interior baffles. These cannisters were packed with activated clay (Filtrol). The adsorbent capacity of the Filtrol is dependent to a large extent on the operating temperature, as well as on size and design of the cannister - particularly the baffling -, and the flow rate. Therefore the cannisters were located directly under the burner and temperatures in the cannister were in the range of 250 to 300°F. As an example of the type of result obtainable with this arrangement, a 640 hour run using 282 gal. of fuel containing 3.0 ml. TEL/gal. was made. An 85% TEL removal was effected by 9.9 lbs of adsorbent. With a different cannister design a 450 hr. run with 193 gal. of fuel containing 3.0 ml.

TEL/gal. was made and essentially complete removal of the TEL was accomplished with an 11.6 lb. charge of adsorbent. Generally the adsorbent was not completely spent at the end of a run. Thus it may be seen that about one-half gal. of fuel per cu. in. of overall cannister volume is effectively deleaded.

Although we do have one of your South-Wind car heaters and have familiarized ourselves with its construction, we, of course, have no idea of the various features, limitations, etc. of the plane heater. Perhaps this lack of specific information tends to make us more optimistic about the possibility of satisfactorily adapting one of these deleading methods to your unit. From the health and safety viewpoint we definitely favor the use of an easily replaced and disposable cartridge, cannister, or tube over a routine disassembly and removal of lead deposits by mechanical or other means. It seems quite likely that a fully satisfactory deleading unit could be developed, and several hundred hours of operation between replacements coule be obtained if you wished to go into that type of installation. The possibility of replacing units does not appear to us to offer a serious disadvantage in view of the rigid inspection and maintenance practices of the airlines.

Regarding the removal of lead deposits, the location of deposits, of course, is the governing factor. A hot 20% ammonium acetate solution is an effective and non-corrosive agent for use as an aid to mechanical cleaning. A number of commercial materials (such as Oakite) are used here in this Laboratory for loosening deposits from engine parts. These solvents are apt to be corrosive to certain non-ferrous alloys, however. Dilute acids are used here when quantitative recovery is required and a non-metallic surface is involved. Electrolytic cleaning might be adapted to simply shaped pieces although the heat-exchanger in your unit could probably not be cleaned this way. Disassembly of the heaters and removal of deposits by means of a wire brush used with ordinary detergents will probably be one of the most satisfactory means of cleaning.

It is hoped that the above information will prove to be of assistance to you. Should you wish to go into any phase of this work more fully it is suggested that you let us hear from you. A visit by yourself or others of the staff to our Laboratory might be quite advantageous. If it should appear more desirable to have someone from this Laboratory visit your plant I am sure that too could be arranged.

ccshepherd

C. C. Shepherd

CCS:h
cc: Dr. R. A, Kehoe