

## AIR TECHNICAL SERVICE COMMAND IN EUROPE

DIRECTOR OF TECHNICAL SERVICES

APO 633

28 March 1945

Subject: Grade 100/150 (1½ T) Fuel

To : Commanding General, Army Air Forces, Washington, D. C., Attn: Col. D. C. Doubleday, Chief, Engr. Br., Materiel Div., Office AS/AS, M &amp; S

1. Reference is made to your WARK 59004 regarding information on circumstances surrounding decision covered in reference message B 394 dated 22 March 1945.
2. Due to excessive maintenance of the V-1650 engines, the Eighth Air Force have decided to discontinue use of the grade 100/150 (1½ T) fuel and return to the 100/150 (1 T) fuel in their fighter aircraft. The change will be accomplished by dumping future deliveries of 1 T fuel into storage tanks containing the 1½ T fuel thus diluting the amount of ethylene dibromide as replacement stock is delivered.
3. Use of 1½ T fuel was adopted to remedy excessive lead fouling of spark plugs encountered with the grade 100/150 products. This lead fouling was caused by the high percentage of TEL (6 mm TEL/U.S. gallon) as it was determined the fouling condition which required cleaning or replacement of plugs after fifteen hours engine operation could be greatly reduced by increasing the amount of ethylene dibromide content in the fuel. The normal grade 100/150 fuel contains a theoretical amount of ethylene dibromide required to dissolve or absorb the lead in TEL and prevent formation of lead oxide through reaction to form lead bromides which are discharged through the exhaust in the form of an extremely fine powdery substance. However, due to maldistribution of the mixture, design of induction systems, and effect of supercharger operation it developed that the amount of ethylene dibromide was not sufficient to overcome the plug fouling condition and therefore an additional one-half of the theoretical amount required was added to the fuel, making a total of 1½ T to insure adequate mixing with the TEL.
4. This additional amount of ethylene dibromide eliminated the plug fouling condition and increased cleaning and replacement to fifty hours; however, subsequent inspection revealed a strong corrosion effect on the exhaust valve seats through the formation of hydro bromic acid. The valve seat material on the V-1650 engine is a silichrome material which is highly susceptible to the corrosive effect of hydro bromic acid, and it was found that the valve seats were being corroded to effect a loss of .010 to .015 inches at approximately 25 to 30 hours engine operation. Since the total exhaust valve adjustment tolerance on this engine is .060" this rapid rate of corrosion would necessitate engine changes at from 125 to 150 hours operation. General Doolittle's decision to revert to the normal 100/150 fuel was based on the fact it would be easier to change plugs instead of engines.

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5. The corrosive action was not observed on P-47M aircraft with the R-2800-57 engine as the exhaust valve seat inserts are of stellite which apparently is not affected by the hydro bromic acid in the concentrations encountered.

6. Prior to the use of grade 100/150 (1½ T) fuel, increased maintenance and deleterious effects from the use of the normal 100/150 fuel required certain modifications on all fighter aircraft. These were chiefly in the following categories:

- a. Replacement of certain rubber seals and tubing due to deteriorating effect on rubber materials.
- b. Intake and exhaust systems required reinforcement of connections and fittings to withstand increased pressures and temperatures due to increase in power.
- c. Fuel systems required adjustment to increase pump capacity or use of booster pump to maintain fuel flow at high powers.
- d. Superchargers required resetting to operate at increased back pressures and adjustment to compensate for change at critical altitudes.
- e. Manifold pressure regulators required more frequent inspection and cleaning periods due to tendency of MM or xylidine to increase sludging of engine oil.

7. The Rolls-Royce Company have made a preliminary report to the effect experimental work on a reduction of the resistance in the high tension ignition circuit appears to be a solution towards eliminating plug fouling with the 100/150 grade fuel. Work is progressing on replacing the presently used resistors, 1500 to 2500 ohms capacity with 500 ohm resistors which will give a much hotter plug. This apparently tends to prevent the settling out and deposition of lead oxide on the electrodes. However, it is reported that this change reduces the overall life of the plug from 100 to approximately 50 hours, or 50%.

8. The Eighth Air Force are giving consideration to employing both the grade 100/130 and grade 100/150 fuel in their fighter aircraft by using the 100/130 grade in wing and belly tanks and putting the 100/150 grade in the auxiliary and main fuel tanks. This would give a happy medium and enable aircraft to utilize the 100/130 fuel for long range low output cruise conditions on the outgoing escort flights and change over to the 100/150 fuel for combat and return flight. It is considered this arrangement can be developed satisfactorily in view of the fact all fighter stations now carry a stock of the 100/130 grade fuel for transient aircraft; however, the stock, storage and supply facilities would be the governing factors.

For the Commanding General:

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