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SUPER-CHARGE TESTING OF AVIATION FUELS UNDER FULL SIZE ENGINE CONDITIONS

In Germany, aviation fuels are tested in the DVL single cylinder super-charged engine according to BVM regulations, under the following conditions:-

Engine Speed	n = 1600/min.
Compression ratio	1: 6.5
Boost air temperature	130°C
Valve overlap	45°
Ignition	30° before top dead centre.

The knock limit curves and boost pressure or mean effective pressure are plotted as functions of the excess air ratio.

On the other hand, present-day water-cooled and air cooled aero-engines are operated at low altitudes under the following conditions *)

	Engine Speed	Boost pressure	Boost air temperature	Effective pressure	Air Ratio
Take off power	2700	1.42	75	14	0.75
Climb or combat power	2500	1.3	70	14	0.8
Maximum continuous power	2300	1.2	65	13	0.85
Economical Cruising power	2100	1.1	60	11	1.03

Compression ratio	1:7 to 1: 7.2
Valve overlap	about 80°

The single cylinder test procedure itself differs from the main engine operating conditions mainly in having a much lower engine speed and a relatively high boost air temperature of 130°. Also, the compression ratio and valve overlap are lower.

Since the knock limit curves obtained with a single cylinder test engine do not permit conclusions to be drawn about the knock resistance in a main engine, the fuels were tested under full scale conditions, in a water-cooled DB cylinder, and in a air-cooled BMW cylinder. The above main engine conditions were transferred to the single cylinder engine, except for the

*) These are average figures taken from data on various types of motors. The operating conditions are subject to variation at times.

engine speed of 2700 at take-off, which was lowered to 2500 because of the strain on the crank shaft of the single-cylinder test bed (BMW 132A).

Further engine data for the two test cylinders are:-

	DB Cylinder E	BMW 132 Cylinder
Compression ratio	1 : 8	1 : 6.5
Valve overlap	100°	45°
Ignition timing	38° before tdc.	30° before tdc.
Injection timing	50° after tdc. (suction stroke)	20° after tdc. (suction stroke)
Coolant temperature	30°C	-
Oil Temperature	80°C	80°C
Cooling air static pressure	-	300 mm water gauge.

The fuels investigated were a B.4 and a C_3, a DHD gasoline and ET 110. The test results are reproduced on TPFS plate No. 3252 Figs.1-4. The boost pressure and the mean effective pressure are plotted as functions of the air ratio. The results indicate that the higher knock rating of modern aero-engines is not being exploited to the full, and that a considerable gain in power is still possible. This applies to both the aromatic fuel C_3 and to ET 110, which is known to permit a much higher supercharge.

It is a striking fact that, while in the BMW cylinder the DHD gasoline is still superior to C_3, in the DB cylinder the C_3 fuel has a better rating; the reservation must be made that the DHD gasoline consisted of several different samples. On the engine side, an attempt should be made to develop aero-engines in such a way that the available high-power fuels can be utilized right up to the limit of superchargeability, with a certain reserve. It is also suggested that the same tests be carried out on existing modern types of main engines.

SUMMARY

Four fuels were tested for knock behaviour in a DB single cylinder and a BMW cylinder under full size engine operating conditions. The results show that apart from B4 they will permit a higher boost than is employed in modern aero-engines. There is thus plenty of scope for increasing power of the engines.