4885

WW/B/11

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 7 OF 1955.

PRELIMINARY REPORT ON PETROL TESTS.

BY: G. A. W. van DOORNUM.

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 7 OF 1955.

PRELIMINARY REPORT ON PETROL TESTS.

The following motor spirits were received and tested:-

1. Synthetic Petrol, blend No. 22.
2. Synthetic Petrol, blend No. 24.
3. Motor spirit of octane rating 82.
4. Motor spirit of octane rating 93.
5. Normal commercial motor spirit.

The main purpose of these tests was to establish whether any significant difference in operation in a normal motor-car engine might be expected.

As, however, the available amounts of the fuels (1) to (4) were quite small, road tests were entirely ruled out and only a very small number of runs on the test bed could be carried out. The results obtained so far thus only give a rough indication and can by no means be considered to lead to final conclusions.

It should also be noted that some of the tests had to be carried out before the test bed was fully completed and while the operators were not yet fully experienced. In so far as the limited quantities permitted, these tests were repeated later.

The following tests were carried out:-

1. Measurement of maximum torque and power at a few engine speeds. This figure gives a rough indication of the acceleration under actual operation.

2. Fuel/........

2. Fuel consumption tests carried out simultaneously with (1) above. These tests give an indication of engine efficiency under full throttle operation. As maximum power is not required in practice for any great length of time, these figures are more of theoretical than of practical interest.

They were therefore supplement with:

3. Fuel consumption tests at part load under conditions reflecting operation in practice at steady speed.

4. Heating up test. Provisionally this test was carried out by determining the rise in temperature of the engine-cooling-water when starting from the cold condition. This test was found to consume a fairly large quantity of fuel and could thus not be repeated.

During all these tests carburettor and timing were left as they had been set for operations on normal commercial motor spirit, drawn from the Institute's storage tank. This same fuel was used for comparative measurements.

Condensed test results are given in attached tables 1 to 4 and diagrams 1 to 3.

Table Nos. 1 and 2 refer to the earlier experiments. The full load power gives an indication of maximum acceleration, the associated efficiency figures which are proportional to the data for "work performed" are not of much practical importance, as continuous full load power at these low speeds is seldom required for any length of time. The data of tables 1 and 2 do, however, indicate that, with the carburettor adjustments as they were during the test, normal motor spirit gives a somewhat higher power but at the same time a slightly lower efficiency.

For practical/..........

For practical purposes, the economy of the engine is better judged by its performance at moderate speed and power. Thus tests at 2000 r.p.m. (corresponding to about 45 miles per hour car speed) were carried out at about 8 and 20 H.P., which would be roughly the extreme power requirements at this speed when driving in flat and hilly country.

Under these conditions there is hardly a significant difference between the various motor spirits tested. At part load, the engine's efficiency is poor but this applies equally to all fuels investigated and is quite normal.

The data of Table No. 3 apply to later tests, carried out on the nearly completed test bed and are seen to confirm the earlier figures. It should be noted that the figures for work performed in Table No. 1 refer to the work done when consuming 250 millilitre of fuel, those in all subsequent tables to work performed when consuming 200 grams of test fuel. As the density of the blends 22 and 24 was less than that of normal petrol, the performance figures of the blends on a volume basis should be higher, as compared with normal petrol. As motor spirit is sold on a volume basis, this fact is of some importance. Figure 3 shows the various densities in relation to the temperature.

The rate of heating of the engine was determined by measuring the temperature of the cooling water at 5 minute intervals, reckoned from the moment of starting the engine. As the initial and ambient temperatures could not be controlled, it was considered best to judge the rate of heating by the temperature rise during the first five minutes. This figure is almost the same for all petrols tested, and allowing for differences in temperature, no appreciable differences are shown by the complete heating curves (Figure 2).

Finally,/............

Finally, some high octane fuel (leaded commercial petrol of octane rating 93) and some medium octane (octane rating 82) motor spirit were tested and compared with normal petrol. Here again, carburettor and timing adjustments were made for the normal fuel and not altered during the tests. Table No. 4 shows the results obtained. The two special fuels were tested, one immediately after the other, while the run on normal petrol was carried out a few days later. During the first two test runs the barometric pressure was 25.3" Hg, the temperature 25°C, during the third test run 25.7" Hg and 20°C respectively. Derating the torque in the case of normal petrol in the ratio $\frac{25.3}{25.7} \times \frac{293}{298} = 0.97$, the slightly higher torque in the case of normal petrol is reduced to practically the same figures as for the octane rating 93 fuel.

This point may thus serve to illustrate that in cases like these, any difference in behaviour of two fuels, as experienced by the ordinary car user (and assuming that he would notice a 3 % difference at all) would be of little value in assessing the ralative merits of two types of petrol.

It also appears from these data that the difference between the octane rating 82 and octane rating 93 fuels is very small indeed. Some of these petrols have been reserved for actual acceleration tests with a car. For this reason no fuel consumption tests were carried out, but only the torque obtained, which in this connection is the more important figure.

(Sgd.) G. A. W. v. DOORNUM.

PRINCIPAL TECHNICAL OFFICER.

PRETORIA.

26th. April, 1955.

TABLE NO. 1.

		Full load					
Nominal speed	r.p.m.	900	1000	1500	2000	2000	2000
COMMERCIAL PETROL.							
Actual speed	r.p.m.	900	1000	1560	2080	1990	2040
Torque	mkg.	15.5	15.8	15.5	15.55	7.55	3.30
Power developed	H.P.	19.4	24.0	33.8	45.2	20.9	9.4
Work performed on 250 ml.	10^3 kgm	158.5	159.5	167	164.5	118.2	71
BLEND NO. 22.							
Actual speed	r.p.m.		1090	1550	2010	2040	2080
Torque	mkg.		15.6	14.1	15.95	7.55	3.4
Power developed	H.P.		23.6	30.4	44.6	21.4	9.9
Work performed on 250 ml.	10^3 kgm.		153	170	169	121	68.5
BLEND NO. 24.							
Actual speed.	r.p.m.		1020	1540	1850	2010	2046
Torque	mkg.		12.0	15.1	16.05	7.60	2.85
Power developed	H.P.		17.1	32.0	41.5	21.4	8.1
Work performed on 250 ml.	10^3 kgm		151	172.8	169	131.5	67.5

TABLE NO. 2.

				Full load		
COMMERCIAL PETROL.						
Actual speed.	r.p.m.	2040	2040	2015	2560	2510
Torque	mkg.	3.1	3.2	16.7	3.0	3.0
Power developed	H.P.	8.8	9.2	47.0	10.7	10.5
Work performed on 200 g.	10^3 kgm	72	75.5	190	65.6	68.5
BLEND NO. 22.						
Actual speed	r.p.m.	2060		1930	2520	
Torque	mkg.	3.0		16.5	2.8	
Power developed	H.P.	8.6		45.1	9.8	
Work performed on 200 g.	10^3 kgm.	75.6		214	68.6	
BLEND NO. 24.						
Actual speed	r.p.m.	1990	2070	1915	2540	2550
Torque	mkg.	3.0	3.0	17.0	2.8	3.0
Power developed	H.P.	8.3	8.65	45.5	9.9	10.7
Work performed on 200 g.	10^3 kgm.	68.7	75.5	191.5	70.1	74.4

TABLE NO. 3.

		All tests full load.				
Nominal speed	r.p.m.	1000	1500	2000	2500	3000
COMMERCIAL PETROL.						
Actual speed	r.p.m.	1005	1550	2090	2540	3060
Torque	mkg.	17.48	17.20	16.98	15.75	13.12
Power developed	H.P.	24.4	37.2	49.5	55.8	56.0
Work performed on 200 g.	10^3 kgm	198	199	198	191	171
Air/fuel ratio		11.7	12.4	12.9	12.6	12.9
BLEND NO. 22.						
Actual speed.	r.p.m.	1030	1530	2060		3065
Torque	mkg.	17.0	16.82	16.75		13.40
Power developed	H.P.	24.5	35.8	48.0		57.3
Work performed on 200 g.	10^3 kgm	196.5	198.7	195.7		159.7
Air/fuel ratio		13.[illegible]	12.6	12.7		14.1
BLEND NO. 24.						
Actual speed	r.p.m.	1020	1495	2025	2530	3045
Torque	mkg	17.44	17.0	16.92	15.78	13.45
Power developed	H.P.	24.8	35.5	47.7	55.7	57.0
Work performed on 200 g.	10^3 kgm.	202.8	195.5	197.5	192.5	173.0
Air/fuel ratio		12.3	12.6	13.3	13.9	14.1

TABLE NO. 4/.............

TABLE NO. 4.

Nominal speed	r.p.m.	1000	1250	1500	1750	2000	2250	2500	2750	3000
COMMERCIAL PETROL.										
Actual speed	r.p.m.	1060	1305	1560	1775	2065	2300	2535		3075
Torque	mkg.	17.36	16.95	17.08	17.5	17.28	16.95	16.3		13.75
Power developed	H.P.	25.6	30.4	37.2	43.3	49.7	54.4	57.5		58.9
LOW OCTANE (O.R. 82).										
Actual speed	r.p.m.	1020	1300	1540	1820	2040		2540	2800	3100
Torque	mkg.	16.75	16.48	16.35	16.35	16.47		15.62	14.85	13.6
Power developed	H.P.	24.8	29.8	35.1	41.5	46.7		55.4	58.0	58.7
HIGH OCTANE (O.R. 93)										
Actual speed	r.p.m.	1020	1260	1560	1820	2040	2300	2540	2820	3060
Torque	mkg.	17.42	16.85	16.72	17.0	16.72	16.52	15.74	15.22	13.95
Power developed	H.P.	24.8	29.6	36.4	43.2	47.5	53.1	55.9	59.7	59.5
COMMERCIAL PETROL. Torque and horse power corrected for same conditions as petrols O.R. 82 and 93.										
Torque	mkg.	16.8	16.35	16.55	17.0	16.75	16.45	15.8		13.35
Power developed.	H.P.	24.8	29.5	36.0	42.0	48.2	52.8	55.7		57.1

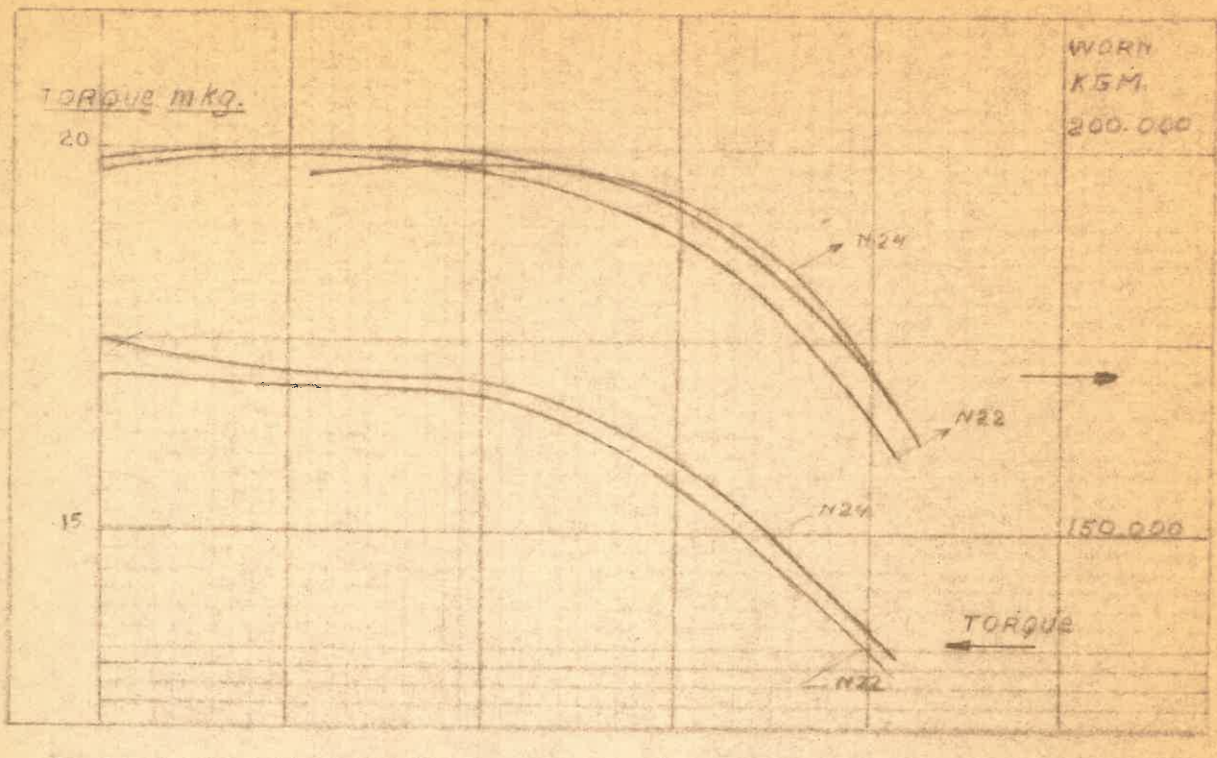

FIG. 1 ILLUSTRATING DATA OF TABLE № 3

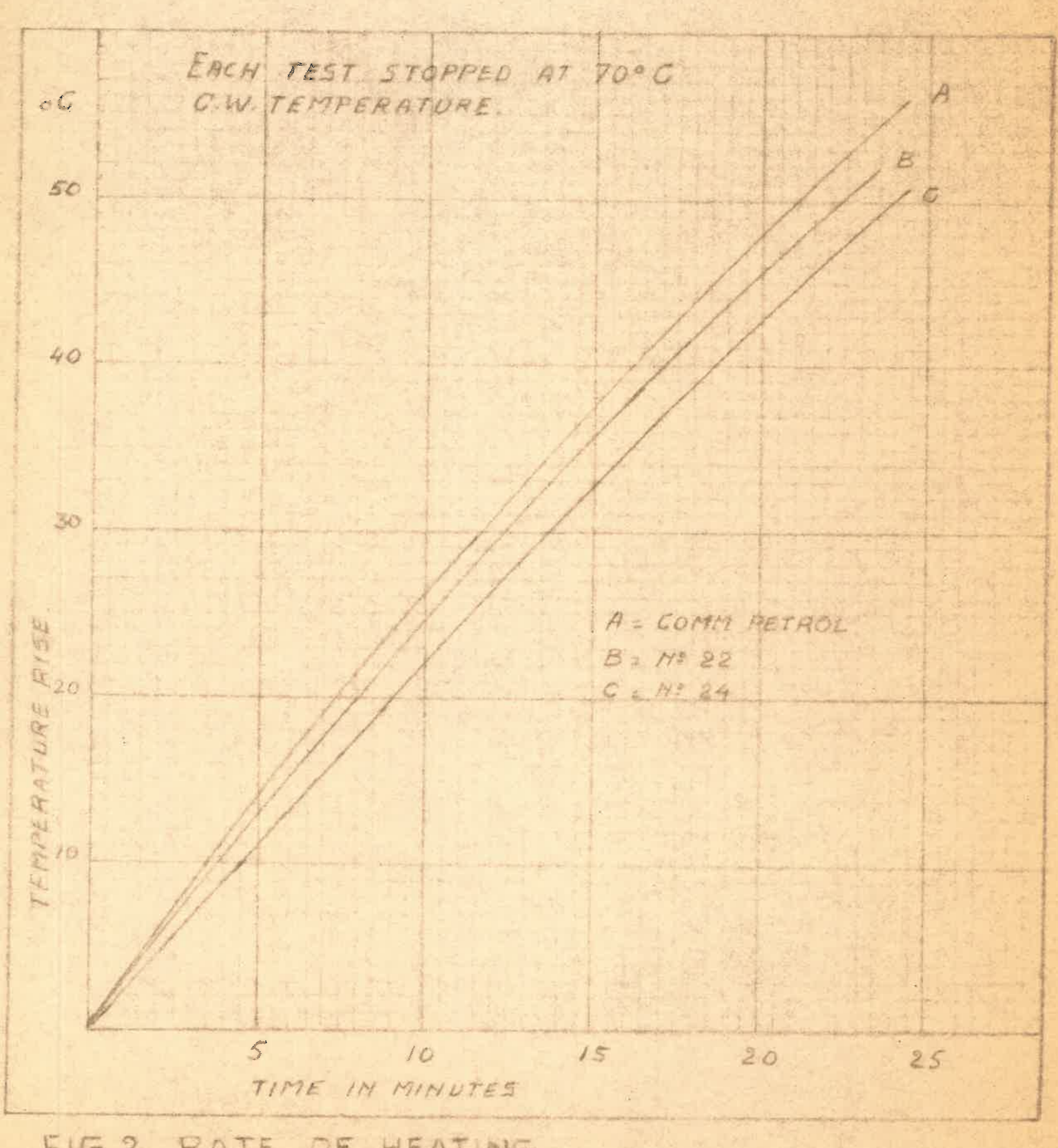

FIG 2 RATE OF HEATING

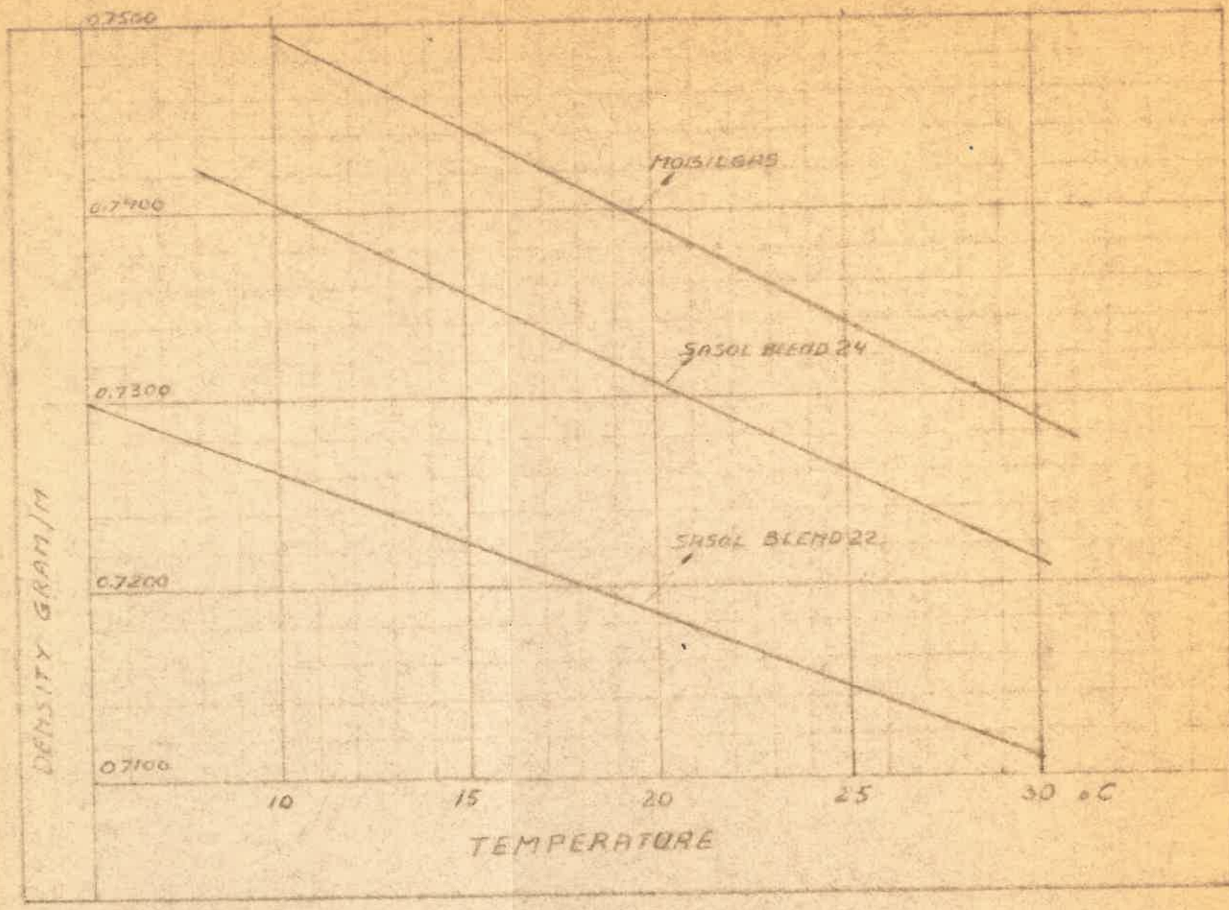

FIG. 3. DENSITY OF VARIOUS PETROLS.