REPORT No. 392/O.E.C.D.

REPORT ON TEST IN ACCORDANCE WITH O.E.C.D. TEST CODE FOR AGRICULTURAL TRACTORS

MASSEY-FERGUSON FE 35X DIESEL TRACTOR

MODEL: MULTI-POWER

Manufactured by: Massey-Ferguson (Manufacturing) Limited, Banner Lane, Coventry

Date of Tests: September/October 1963
Test No.: R.64011/O.E.C.D.

This report has been approved by the O.E.C.D. Coordinating Centre (C.N.E.E.M.A., France) as being in accordance with the O.E.C.D. Tractor Test Code

Date of Approval: 24th May 1964 *Serial No.:* 051

NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING
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This Bulletin is based on engineering tests in accordance with the O.E.C.D. Tractor Code. It does not contain an evaluation of the performance of the tractor on practical farm work

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NOTE TO SUBSCRIBERS TO USERS TEST SCHEME

The N.I.A.E. is continuing to publish some reports which express performance in engineering rather than agricultural terms.

Their value lies in the use of standard test conditions and procedure, and the results obtained are strictly comparable between different tractors. This report is one of these and gives results of a test made in accordance with the agricultural tractor test code of the Organisation for Economic Co-operation and Development. The object of this scheme is to enable a comparison to be made between tractors tested in Britain or in any other European country.

PART I

SPECIFICATION OF TRACTOR

Tractor:

Make:	Massey-Ferguson
Model:	FE 35X Diesel Multi-Power
Type:	A.3. 152 3-cylinder diesel
No.:	Serial No. SNMYW 326474

Engine:

Make:	F. Perkins Ltd, type A.3. 152, indirect injection diesel, Serial No. 1944943 C
Cylinders:	3 cylinders, vertical, in-line, 3·6 in. (91·4 mm) bore × 5 in. (127·0 mm) stroke, compression ratio 17·4:1, replaceable cast iron dry cylinder liners, overhead valves
Rated speeds:	2250 rev/min, governor setting—no load engine speed 2375 ± 25 rev/min
Fuel system:	Fuel—Diesel oil C.A.V. type D.P.A. 3232788A injection pump, Serial No. R.16905 XD; C.A.V. type BDL 110S6267 injector nozzles. Manufacturer's production setting for injection pump: 0·125 pt (71·0 ml) delivery for 402–420 pump revolutions at 700 rev/min pump speed (bench test figures); injection pressure 120–135 atm (124–140 kp/sq. cm). A.C. type YE fuel feed pump, sediment bowl on feed pump, one Purolator and one C.A.V. paper filter in series. Capacity of fuel tank 8½ UKgal (38·6 l)
Governor:	C.A.V. mechanical, incorporated in injection pump. Governed range of engine speed 500 rev/min to 2400 rev/min.
Air cleaner:	A.C. oil bath with centrifugal pre-cleaner outside hood. Oil capacity 0·77 pt (0·44 l)
Oiling system:	Forced feed from eccentric rotor type pump with metal strainer in sump. Multi-purpose 20W/30 oil. A.C. full flow replaceable cartridge element oil filter. Recommended oil change period, 120 h. Oil capacity (engine sump) 9·0 pt (5·1 l)
Cooling system;	Pressurized water cooled, 7 lb/sq. in. (0·49 kp/sq. cm), impeller assisted with 16 in. (406 mm) dia 2-blade belt driven fan, thermostat for temperature control. Cooling water capacity 2 UKgal (9·1 l)

Transmission:

Clutch:	Auburn Laycock dual, two plates 9 in. (229 mm) dia and 11 in. (279 mm) dia for p.t.o. shaft and gearbox drive respectively, dry, foot-pedal operated
Gearbox:	Own make transmission with 12 forward speeds and 4 reverse, with finger switch selected low-high input constant mesh gears hydraulically operated for gear changing under load, a sliding mesh 3-speed gearbox and a dual range epicyclic reduction gear at the output end of the main gearbox
Differential:	Final drive with crown wheel and pinion and differential. Foot pedal operated differential lock fitted. Total transmission oil capacity 53 pt (30·1 l)

Gear	*Number of engine revolutions for one revolution of driving wheel*	*Theoretical travelling speed for 2250 rev/min rated speed of engine, mile/h (km/h)*
Forward		
1st low	203·0	1·51 (2·43)
1st high	155·4	1·98 (3·19)
2nd low	135·5	2·26 (3·64)
2nd high	103·7	2·95 (4·75)
3rd low	73·9	4·15 (6·68)
3rd high	56·5	5·42 (8·72)
4th low	50·7	6·03 (9·70)
4th high	38·8	7·89 (12·70)
5th low	33·9	9·04 (14·55)
5th high	25·9	11·82 (19·02)
6th low	18·5	16·60 (26·71)
6th high	14·1	21·70 (34·92)
Reverse		
1st low	149·3	2·05 (3·30)
1st high	114·3	2·68 (4·31)
2nd low	37·3	8·22 (13·23)
2nd high	28·6	10·74 (17·28)

Steering device: Recirculating ball type with double drop arms and drag links

Brakes: Hand brake—not fitted
Foot brakes—internal expanding type on differential half shafts, independent or combined foot-pedal operated, ratchet on pedals for parking

Wheels:

Steering wheels: Two at front. Tyres, 6·00–16, 6 ply pneumatic. Track 48 in. (1219 mm) by 4 in. (102 mm) steps to 80 in. (2032 mm), changed by extending front axle and reversing wheels. Maximum permissible weight on each tyre 1260 lb (572 kg) at 48 lb/sq. in. (3·37 kp/sq. cm), 1065 lb (483 kg) at 36 lb/sq. in. (2·53 kp/sq. cm)

Driving wheels: Two at rear. Tyres, 11–28, 6-ply pneumatic. Track 48 in. (1219 mm) by 4 in. (102 mm) steps to 76 in. (1930 mm), changed by reversing wheel centres and offset lugs on rims. Maximum permissible weight on each tyre 2685 lb (1218 kg) at 22 lb/sq. in. (1·55 kp/sq. cm)

Wheelbase: 6 ft 0 in. (1829 mm) at 48 in. (1219 mm) front wheel track

Belt pulley:

Location: At rear of tractor with three alternative positions, p.t.o. driven, heavy duty unit

Diameter/width: 9 in. (229 mm) × $6\frac{1}{2}$ in. (165 mm)

Speeds: 1322 rev/min giving 3114 ft/min (15·8 m/s) linear speed at 2250 rev/min rated engine speed

Direction of rotation: Optional, related to position of unit

Power take-off

Main: Manually engaged proportional engine speed or proportional ground speed, 6-spline, $1\frac{3}{8}$ in. (34·9 mm) dia, at rear of tractor

Height above ground: 19 in. (483 mm)

Proportional engine speed: 712 rev/min at 2250 rev/min rated engine speed
540 rev/min at 1706 rev/min engine speed
Independent of main clutch

Direction of rotation: Clockwise viewed from tractor rear

Proportional ground speed: 1 revolution of p.t.o. for approximately 20 in. (508 mm) of travel

Direction of rotation: Clockwise viewed from tractor rear in forward gear

Power lift: Own make, live hydraulic with 4-cylinder piston type pump supplying oil (from transmission) pressure at 2350 lb/sq. in. (165 kp/sq. cm) minimum —2800 lb/sq. in. (197 kp/sq. cm) maximum pressure (depending on flow through relief valve) to single acting ram cylinder and 3 external tappings. Category 1 implement linkage with controls for draught, response and position, with overload release. Maximum load at end of lower links—manufacturer's recommended figures: 2600 lb (1179 kp) for field work, 1800 lb (816 kp) for road work—test figures: 2720 lb (1234 kp) at 2700 lb/sq. in. (190 kp/sq. cm) to 2100 lb/sq. in. (148 kp/sq. cm) oil pressure with links in lowest and highest positions respectively. Oil delivery at 2250 rev/min engine speed, test figures: 2·9 gal/min (13·2 l/min) at 2000 lb/sq. in. (141 kp/sq. cm), oil temperature 129 °F (54 °C).

Drawbar: Fixed on hydraulically controlled implement linkage with central hole and 4 holes $2\frac{1}{8}$ in. (54 mm) apart either side of centre line, vertical adjustment from $12\frac{1}{2}$ in. (318 mm) to $25\frac{3}{4}$ in. (654 mm) changed by adjustable stay links. Distance from rear axle $29\frac{1}{2}$ in. (749 mm) as tested. Swinging drawbar also available but not fitted

Hitch: Optional (not fitted)
Height above ground $13\frac{1}{8}$ in. (333 mm)
Distance from rear axle $7\frac{7}{8}$ in. (200 mm)

Electrical equipment:

Voltage: 12

Generator: Lucas type C39P2

Battery: Lucas type HV17A/8 lead-acid, capacity 96 amp h.

Starting device: Lucas 12V type 45 GRF 15 solenoid engaged starter motor, C.A.V. inlet manifold flame type cold starting aid.

Overall dimensions:

Overall length: 9 ft $8\frac{1}{4}$ in. (2·95 m) as tested

Overall width: 5 ft 4 in. (1·63 m) at 52 in. (1321 mm) track, no ballast weights. 7 ft $0\frac{7}{8}$ in. (2·16 m) at 52 in. (1321 mm) track to outside of wheel weights, 11 per wheel

Overall height: 6 ft $7\frac{1}{2}$ in. (2·02 m) to top of exhaust pipe
4 ft 6 in. (1·37 m) to top of steering wheel

Minimum ground clearance: $12\frac{3}{4}$ in. (324 mm) to bottom of gearbox

Weights: With full fuel tank, oil, cooling water, no driver

	Without additional weight, lb (kg)	*With maximum additional weight, lb (kg)*
On front wheels	1394 (632)	2085 (946)
On rear wheels	1908 (865)	5195 (2356)
Total	3302 (1497)	7280 (3302)

Special remarks: None

PART II

LABORATORY TESTS

1. **Compulsory tests:** Power take-off test

Date and location of tests: 18th September 1963, N.I.A.E., Silsoe, Bedford, U.K.

Type of dynamometer: Water brake, Heenan and Froude

Fuel: Diesel oil, density 0·830 at 60 °F (15·6 °C), Cetane No. 56

Engine oil: Multi-purpose 20W/30

Transmission oil: Multi-purpose 20W/30

Horse-power (Metric h.p.)	*Speeds, rev/min*		*Equivalent crankshaft torque, lb ft (k.p.m.)*	*Fuel consumption*			*Temperature*			*Atmos. conditions*	
	Engine	*P.t.o.*		*UKgal/h (l/h)*	*Lb/h.p. h. (g/metric h.p. h.)*	*H.p. h/ UKgal (Metric h.p. h/l)*	*Coolant °F (°C)*	*Oil °F (°C)*	*Fuel °F (°C)*	*Air temp. °F (°C)*	*Atmos. press. in. Hg (mm Hg)*
A. Maximum power											
41·0 (41·6)	2297	727	93·8 (12·97)	2·29 (10·41)	0·464 (208)	17·9 (3·99)	190 (88)	228 (109)	90 (32)	64 (18)	29·98 (761)
B. Power at standard p.t.o. speed (540 rev/min)											
34·7 (35·2)	1706	540	106·8 (14·77)	1·78 (8·09)	0·426 (191)	19·5 (4·35)	193 (89)	219 (104)	95 (35)	64 (18)	29·98 (761)
C. Power at maximum torque											
26·0 (26·4)	1190	377	114·6 (15·85)	1·28 (5·81)	0·410 (183)	20·2 (4·51)	194 (90)	204 (96)	96 (36)	64 (18)	29·98 (761)
D. Power at rated speed											
40·8 (41·4)	2250	712	95·2 (13·17)	2·26 (10·27)	0·460 (206)	18·1 (4·04)	191 (88)	230 (110)	92 (33)	64 (18)	29·98 (761)

No load, maximum engine speed: 2376 rev/min

2. **Supplementary tests:** Engine test (in installed condition)

Date and location of tests: 13th September 1963; N.I.A.E., Silsoe, Bedford, U.K.

Type of dynamometer: Water brake, Heenan and Froude

Fuel: Diesel oil, density 0·830 at 60 °F (15·6 °C), Cetane No. 56

Engine oil: Multi-purpose 20W/30

Horse-power (Metric h.p.)	Speed, rev/min	Crankshaft torque, lb ft (k.p.m.)	Fuel consumption			Temperature			Atmos. conditions	
			UK gal/h (l/h)	Lb/h.p. h (g/metric h.p. h.)	H.p. h/ UKgal (Metric h.p. h./l)	Coolant °F (°C)	Oil °F (°C)	Fuel °F (°C)	Air temp, °F (°C)	Atmos. press. in. Hg (mm Hg)
A. Maximum power										
42·2 (42·8)	2300	96·3 (13·32)	2·28 (10·36)	0·448 (200)	18·5 (4·13)	191 (88)	235 (113)	97 (36)	70 (21)	30·19 (767)
B. Power at standard p.t.o. speed (540 rev/min)										
36·2 (36·7)	1706	111·4 (15·41)	1·79 (8·14)	0·410 (183)	20·3 (4·53)	197 (92)	218 (103)	105 (41)	72 (22)	30·19 (767)
C. Power at maximum torque										
28·9 (29·3)	1290	117·5 (16·25)	1·39 (6·32)	0·400 (179)	20·8 (4·64)	198 (92)	203 (95)	104 (40)	71 (22)	30·19 (767)
D. Power at rated speed										
41·9 (42·5)	2250	97·8 (13·53)	2·24 (10·18)	0·444 (199)	18·7 (4·17)	194 (90)	235 (113)	100 (38)	70 (21)	30·19 (767)
No load, maximum engine speed: 2395 rev/min										

3. **Supplementary tests:** Belt test

Date and location of tests: 19th September 1963; N.I.A.E., Silsoe, Bedford, U.K.

Type of dynamometer: Electrical, swinging frame

Fuel: Diesel oil, density 0·830 at 60 °F (15·6 °C), Cetane No. 56

Engine oil: Multi-purpose 20W/30

Transmission oil: Multi-purpose 20W/30

Horse-power (Metric h.p.)	Speeds		Equivalent crankshaft torque, lb ft (k.p.m.)	Fuel consumption			Temperature			Atmos. conditions	
	Engine, rev/min	Belt, ft/min (m/s)		UKgal/h (l/h)	Lb/h.p. h (g/metric h.p. h)	H.p. h/ UKgal (Metric h.p. h/l)	Coolant °F (°C)	Oil °F (°C)	Fuel °F (°C)	Air temp. °F (°C)	Atmos. press. in. Hg (mm Hg)
A. Maximum power											
39·1 (39·6)	2298	3180 (16·15)	89·4 (12·36)	2·29 (10·41)	0·486 (217)	17·1 (3·82)	194 (90)	233 (112)	90 (32)	70 (21)	30·04 (763)
B. Power at standard belt speed (3100 ft/min [15·75 m/s])											
38·6 (39·1)	2240	3100 (15·75)	90·5 (12·52)	2·24 (10·18)	0·482 (216)	17·2 (3·84)	194 (90)	232 (111)	90 (32)	72 (22)	30·04 (763)
C. Power at maximum torque											
26·2 (26·6)	1230	1702 (8·65)	111·7 (15·45)	1·33 (6·05)	0·420 (188)	19·8 (4·42)	196 (91)	204 (96)	91 (33)	70 (21)	30·04 (763)
D. Power at rated speed											
38·7 (39·2)	2250	3114 (15·82)	90·3 (12·49)	2·25 (10·23)	0·483 (216)	17·2 (3·84)	194 (90)	232 (111)	90 (32)	72 (22)	30·04 (763)
No load, maximum engine speed: 2366 rev/min											

PART III

DRAWBAR TESTS ON ARTIFICIAL TRACK

Date of tests:	9th–21st October 1963
Type of track:	Tarmacadam
Position of governor control lever:	Fully open, giving no load engine speed of 2375 ± 25 rev/min.
Type of tyre:	Rear—Goodyear Sure Grip, straight bar open centre, 11–28, 6-ply pneumatic Front—Goodyear Super Rib, 6·00–16, 6-ply pneumatic
Fuel:	Diesel oil, density 0·830 at 60 °F (15·6 °C), Cetane No. 56
Engine oil:	Multi-purpose 20W/30
Transmission oil:	Multi-purpose 20W/30

A. Tests with maximum additional weight

Weight of tractor, without driver:

Weight without ballast:	Front—1394 lb (632 kg), rear 1908 lb (865 kg)
Ballast: front	Weights, 3 per wheel—579 lb (263 kg)
water	112 lb (51 kg)
rear	Weights, 11 per wheel—2611 lb (1184 kg) Water—676 lb (307 kg)
Weight with full ballast:	Front 2085 lb (946 kg), rear 5195 lb (2356 kg) Total—7280 lb (3302 kg)
Tyre pressure:	Front—36 lb/sq. in. (2·5 kp/sq. cm) Rear—22 lb/sq. in. (1·5 kp/sq. cm)
Height of drawbar above ground:	17½ in. (445 cm)

(1) *Maximum powers and pulls*

	Maximum powers								*Maximum pulls*	
Gear No.	*Horse-power (Metric h.p.)*	*Corres-ponding pull, lb (kp)*	*Wheel slip, %*	*Engine speed, rev/min*	*Speed, mile/h (km/h)*	*Engine coolant temp, °F (°C)*	*Air temp, °F (°C)*	*Atmos. press, in. Hg (mm Hg)*	*Pull, lb (kp)*	*Reason for stall*
1 Low	21·2 (21·5)	6100 (2767)	17·2	2339	1·30 (2·09)	163 (73)	56 (13)	30·08 (764)	6750 (3062)	Wheelspin and bouncing
1 High	27·6 (28·0)	6100 (2767)	17·2	2319	1·70 (2·74)	172 (78)	56 (13)	30·08 (764)	6750 (3062)	Wheelspin and bouncing
2 Low	31·0 (31·4)	6000 (2722)	16·0	2301	1·94 (3·12)	178 (81)	64 (18)	30·16 (766)	6750 (3062)	Wheelspin and bouncing
2 High	34·1 (34·6)	4650 (2109)	8·9	2280	2·75 (4·42)	174 (79)	59 (15)	30·16 (766)	5800 (2631)	Engine stall
3 Low	35·7 (36·2)	3400 (1542)	6·0	2261	3·94 (6·34)	180 (82)	59 (15)	30·24 (768)	4150 (1882)	Engine stall
3 High	34·8 (35·3)	2450 (1111)	3·9	2281	5·33 (8·58)	180 (82)	63 (17)	30·17 (766)	3025 (1372)	Engine stall
4 Low	36·5 (37·0)	2300 (1043)	3·6	2283	5·95 (9·57)	174 (79)	55 (13)	30·24 (768)	2825 (1281)	Engine stall
4 High	35·4 (35·9)	1725 (782)	2·5	2240	7·70 (12·39)	177 (81)	59 (15)	30·24 (768)	2175 (987)	Engine stall
5 Low	36·1 (36·6)	1500 (680)	2·2	2287	9·03 (14·53)	184 (84)	63 (17)	30·17 (766)	1875 (851)	Engine stall
5 High	34·3 (34·8)	1100 (499)	1·8	2222	11·69 (18·81)	180 (82)	62 (17)	30·17 (766)	1400 (635)	Engine stall

(2) *Fuel consumption*

Gear No.	*Optimum fuel consumption**			*Range of pull, lb (kp) over which specific fuel consumption does not exceed optimum consumption by more than 10%*
	Specific fuel consumption, lb/drawbar h.p. h. (g/metric D.B. h.p. h.)	*Drawbar h.p. h/UKgal (drawbar metric h.p. h/l)*	*Corresponding pull, lb (kp)*	
1 Low	0·664 (297)	12·5 (2·79)	6000 (2722)	3925 – > 6300 (1780) (2858)
1 High	0·614 (275)	13·5 (3·01)	5700 (2586)	3600 – > 6300 (1633) (2858)
2 Low	0·582 (260)	14·3 (3·19)	5200 (2359)	3400 – > 6100 (1542) (2767)
2 High	0·557 (249)	14·9 (3·32)	4900 (2223)	3160 – > 5300 (1433) (2404)
3 Low	0·540 (242)	15·4 (3·44)	3400 (1542)	2350 – > 3800 (1066) (1724)
3 High	0·535 (239)	15·5 (3·46)	2800 (1270)	1830 – 3025 (M.S.P.) (830) (1372)
4 Low	0·518 (232)	16·0 (3·57)	2600 (1179)	1640 – 2825 (M.S.P.) (744) (1281)
4 High	0·540 (242)	15·4 (3·44)	1725 (782)	1300 – 2175 (M.S.P.) (590) (987)
5 Low	0·532 (238)	15·6 (3·48)	1500 (680)	1170 – 1875 (M.S.P.) (531) (851)
5 High	0·549 (246)	15·1 (3·37)	1100 (499)	1000 – 1400 (M.S.P.) (454) (635)

*The drawbar specific fuel consumption curves in H4, L5 and H5 gears had no clearly marked minima and the values shown for optimum fuel consumption in these gears are those corresponding to maximum drawbar horsepower.

B. Tests without ballast

Weight of tractor without driver:

Weight without ballast: Front—1394 lb (632 kg)
Rear—1908 lb (865 kg)
Total—3302 lb (1497 kg)

Tyre pressure: Front—20 lb/sq. in. (1·4 kp/sq. cm)
Rear—12 lb/sq. in. (0·8 kp/sq. cm)

Height of drawbar above ground: 17½ in. (445 mm) and 21 in. (533 mm)

(1) *Maximum powers and pulls*

Gear No.	Maximum powers: Horse-power (Metric h.p.)	Corresponding pull, lb (kp)	Wheel slip, %	Engine speed, rev/min	Speed, mile/h (km/h)	Engine coolant temp, °F (°C)	Air temp, °F (°C)	Atmos. press, in. Hg (mm Hg)	Maximum pulls: Pull, lb (kp)	Reason for stall
3 Low	29·8 (30·2)	2950 (1338)	12·5	2324	3·79 (6·10)	184 (84)	61 (16)	29·93 (760)	3200 (1452)	Wheelspin
3 High	**35·4 (35·9)**	**2650 (1202)**	**8·4**	**2261**	**5·01 (8·06)**	**175 (79)**	**64 (18)**	**29·93 (760)**	**3125 (1418)**	Wheelspin and engine stall
4 Low	36·9 (37·4)	2440 (1107)	7·5	2260	5·67 (9·12)	178 (81)	64 (18)	29·93 (760)	2970 (1347)	Engine stall
4 High	36·9 (37·4)	1850 (839)	5·2	2280	7·48 (12·04)	182 (83)	60 (16)	29·93 (760)	2230 (1012)	Engine stall
5 Low	37·5 (38·0)	1600 (726)	4·2	2279	8·79 (14·14)	184 (84)	62 (17)	29·93 (760)	1960 (889)	Engine stall
5 High	35·8 (36·3)	1150 (522)	2·9	2277	11·67 (18·78)	180 (82)	56 (13)	30·08 (764)	1460 (662)	Engine stall
The following results were obtained with a drawbar height of 21½ in. (546 mm)										
3 Low	32·6 (33·1)	3300 (1497)	13·8	2302	3·70 (5·95)	180 (82)	60 (16)	29·93 (760)	3550 (1610)	Wheelspin and bouncing

PART IV

1. Location of centre of gravity

	Test A, ballasted	*Test B, unballasted*
Height above ground	23·7 in. (602 mm)	26·0 in. (660 mm)
Distance forward from the vertical plane containing the axis of the rear wheels	20·2 in. (513 mm)	29·0 in. (737 mm)
Distance from the median plane parallel to the longitudinal axis of the tractor bisecting the track	0	0

2. Turning space and turning radius

Wheel equipment: As for drawbar tests without ballast

Wheel track: Front 48 in. (1219 mm), rear 52 in. (1321 mm)

	With brakes		*Without brakes*	
	Right-hand	*Left-hand*	*Right-hand*	*Left-hand*
Radius of turning space	9 ft 5 in. (2·9 m)	9 ft 2 in. (2·8 m)	10 ft 1 in. (3·1 m)	9 ft 11 in. (3·0 m)
Turning radius	9 ft 1 in. (2·8 m)	8 ft 10 in. (2·7 m)	9 ft 9 in. (3·0 m)	9 ft 7 in. (2·9 m)

PART V

1. **Repairs and adjustments during tests:** None
2. **Remarks:** None

Test Engineer: M. W. JESSON
Head of Tractor Performance Department: T. C. D. MANBY
Date: 26th March 1964

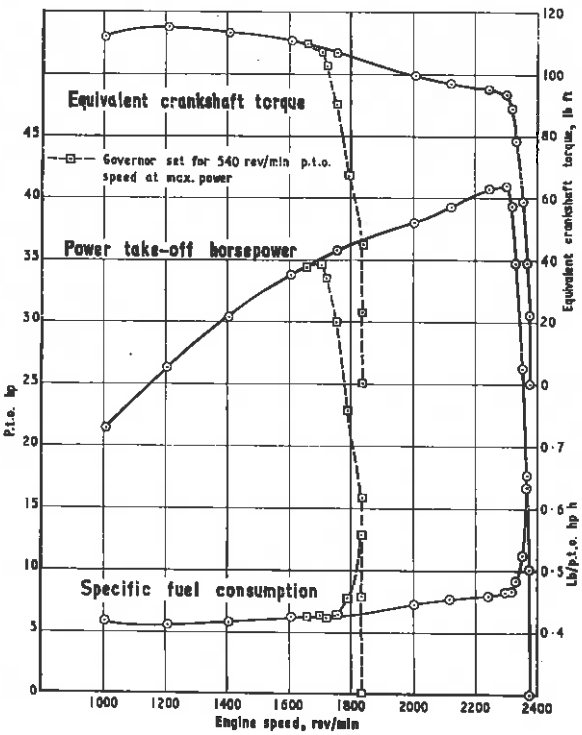

FIG. 1. Power take-off test

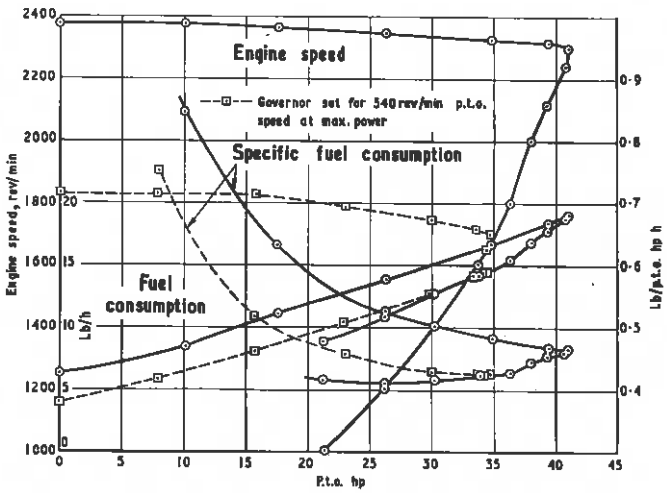

FIG. 2. Power take-off test

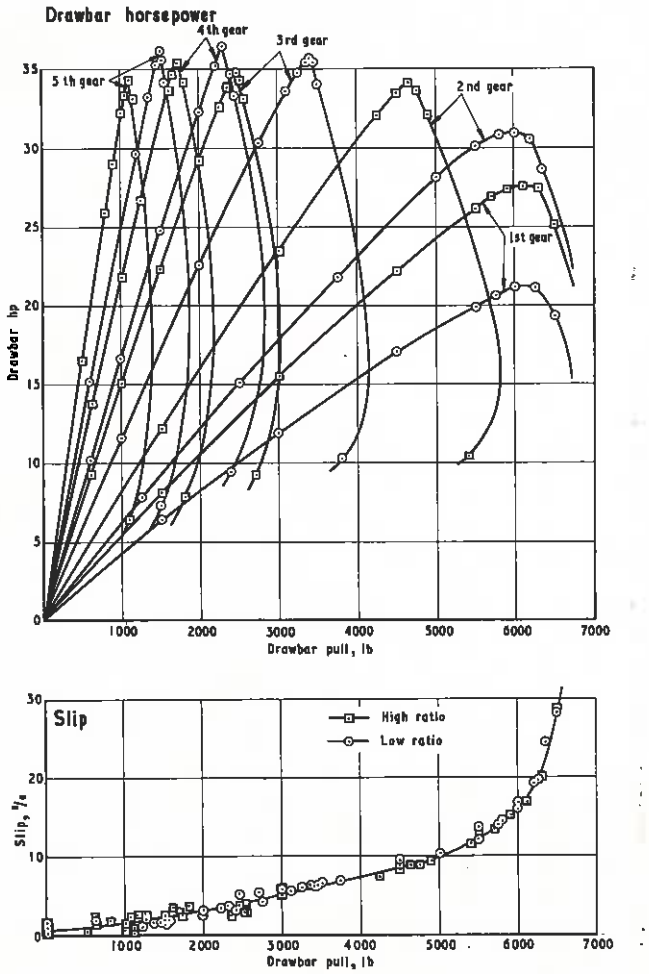

FIG. 3. Drawbar test on tarmacadam, with ballast

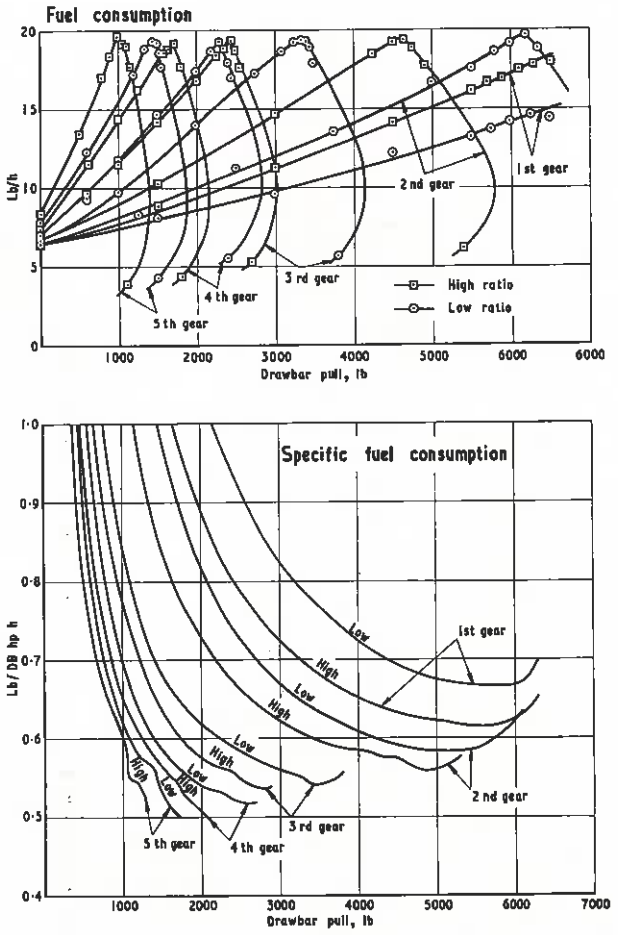

FIG. 4. Drawbar test on tarmacadam, with ballast

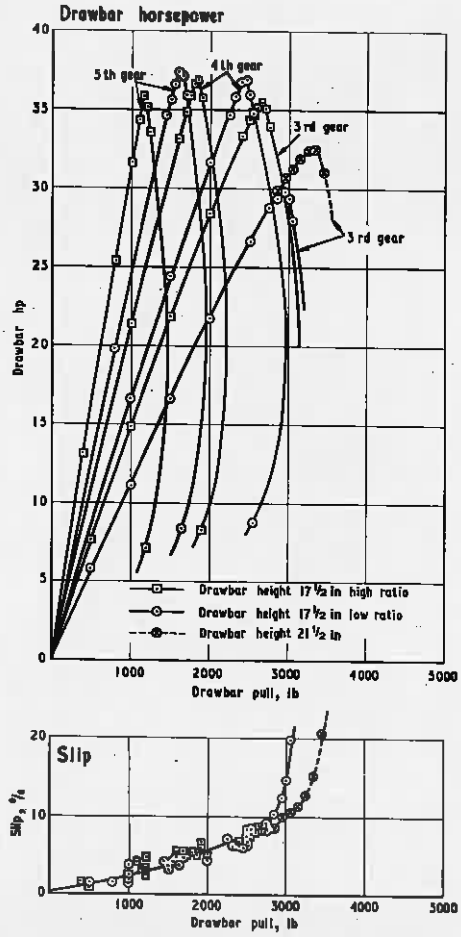

FIG. 5. Drawbar test on tarmacadam, without ballast

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