No. 283/O.E.E.C.

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

MASSEY-FERGUSON MODEL FE-35 DIESEL TRACTOR

WITH 3.A. 152 3-CYLINDER ENGINE

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



Date of Tests: March/May 1960
Test No.: R.60045/OEEC

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

Date of Approval: 16th June 1961 *Serial No.:* 008

The British Society for Research in Agricultural Engineering
NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING
WREST PARK SILSOE BEDFORDSHIRE

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

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PART I

SPECIFICATION OF TRACTOR

Tractor:

Make:	Massey-Ferguson
Model:	FE-35
Type:	3.A.152, 3-cylinder diesel
No.:	Serial No. SNF.175006

Engine:

Make:	F. Perkins Ltd.; type 3.A.152, indirect injection diesel, Serial No. CL.1800396
Cylinders:	3 cylinders, vertical, in-line, 3·6 in. (91·4 mm) bore × 5 in. (127·0 mm) stroke, compression ratio 17·5:1, replaceable chromium plated steel dry liners, overhead valves
Rated speeds:	2000 rev/min, governor setting—no load engine speed 2175 ± 25 rev/min
Minimum speed:	(For full load work) Not specified
Fuel system:	Fuel—Diesel oil C.A.V. type D.P.A. 3232038 injection pump; C.A.V. type BDL.110S6133 injector nozzles. Manufacturer's production setting for injection pump: 11·76 pt/h (6·68 l/h) to 12·25 pt/h (6·96 l/h) at 1400 rev/min engine 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 governor incorporated in injection pump. Governed range of engine speed 450 rev/min to 2200 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 gear type pump and metal strainer in sump. Multi-purpose S.A.E. 20W/30 oil. A.C. full flow replaceable cartridge element oil filter. Recommended oil change period, 120 h. Oil capacity, engine sump 9·8 pt (5·6 l)
Cooling system:	Pressurised 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:	Laycock 11 in. (279 mm) dia, single plate, dry, foot-pedal operated. Auburn dual clutch optional
Gearbox:	Own make, sliding gear type, 6 forward speeds and 2 reverse
Differential:	Final drive with crown wheel and pinion and differential. No differential lock fitted. Total transmission oil capacity 53 pt (30·1 l)

Gear No.	*Number of engine revolutions for one revolution of driving wheel*	*Theoretical travelling speed for 2000 rev/min rated speed of engine, mile/h (km/h)*
1	205·5	1·33 (2·14)
2	137·0	1·99 (3·20)
3	74·7	3·65 (5·87)
4	51·4	5·30 (8·53)
5	34·2	7·96 (12·81)
6	18·7	14·59 (23·48)
R. Low	153·8	1·80 (2·90)
R. High	38·5	7·22 (11·62)

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: 1065 lb (483 kg) at 36 lb/sq. in. (2·5 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: 2560 lb (1161 kg) at 20 lb/sq. in. (1·4 kp/sq. cm)
Wheelbase:	6 ft 0 in. (1829 mm)

Belt pulley:

Location:	At rear of tractor in three alternative positions, p.t.o. driven, heavy duty unit
Diameter × width:	9 in. (229 mm) × 6½ in. (165 mm)
Speeds (at 2000 rev/min rated engine speed):	1337 rev/min giving 3150 ft/min linear speed (16·0 m/s)
Direction of rotation:	Optional, related to position of unit

Power take-off:

Main:	Manually engaged proportional engine speed or proportional ground speed, 6-spline, 1⅜ in. (34·9 mm) dia, at rear of tractor
Height above ground:	19 in. (483 mm)
Proportional engine speed:	Speed, at 2000 rev/min rated engine speed: 720 rev/min at 1500 rev/min engine speed: 540 rev/min
Direction of rotation:	Clockwise viewed from tractor rear
Proportional ground speed:	1 revolution of p.t.o. for approx 20 in. (508 mm) of travel
Direction of rotation:	Clockwise rotation viewed from tractor rear in forward gear

Power lift: Own make 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 (depending on flow through relief valve) to single acting ram cylinder and 3 external tappings. Category I 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 figure: 3000 lb (1361 kp) at 2500 lb/sq. in. (176 kp/sq. cm) oil pressure with lower links horizontal. Oil delivery at 2000 rev/min rated engine speed: 3·1 gal/min (13·6 l/min) at 2000 lb/sq. in. (140·6 kp/sq. cm) with oil temperature corresponding to viscosity of 250 S.U.S. (54 Centistokes)
Live hydraulics given by optional dual clutch

Drawbar: Fixed on hydraulically controlled implement linkage with central hole and 4 holes 2⅛ in. (54 mm) apart either side of centre line, vertical adjustment from 11 in. (279 mm) to 24 in. (610 mm), changed by adjustable stay links
Distance from rear axle: 29½ in. (749 mm) as tested

Hitch: Optional (not fitted)
Height above ground: 13⅛ in. (333 mm)
Distance from rear axle: 7⅞ in. (200 mm)

Electrical equipment:

Voltage:	12
Generator:	Lucas type C.39P2
Battery:	Lucas type HV.15A/8 lead-acid, capacity 90 amp h
Starting device:	Lucas 12 V type 45GRF15 solenoid engaged starter motor. C.A.V. inlet manifold flame type cold starting aid

Overall dimensions:

Overall length:	9 ft 9 in. (2·97 m) as tested
Overall width:	5 ft 4 in. (1·63 m) at 52 in. (1321 mm) track, no ballast weights 6 ft 9⅜ in. (2·07 m) at 52 in. (1321 mm) track, to outside of wheelweights, 10 per wheel
Overall height:	5 ft 3 in. (1·60 m) to top of pre-cleaner 4 ft 6 in. (1·37 m) to top of steering wheel
Minimum ground clearance:	12⅝ in. (321 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	1349 (612)	2088 (947)
On rear wheels	1861 (844)	5006 (2271)
Total	3210 (1456)	7094 (3218)

Special remarks: None

PART II

LABORATORY TESTS

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

Date and location of tests: 28th March 1960; N.I.A.E., Silsoe, Beds.
Type of dynamometer: Water brake, Heenan and Froude
Fuel: Diesel oil, density 0·840 at 60°F (15·6°C), Cetane No. 51
Oil: Multi-purpose S.A.E. 20W/30

(1) *Sustained power tests:*

Duration of test, h	*Horse-power (Metric h.p.)*	*Engine speed, rev/min*	*Torque, lb ft (kpm)*	*Specific fuel consumption, lb/h.p. h (g/metric h.p. h)*	*Fuel temp, °F (°C)*	*Oil temp, °F (°C)*	*Coolant temp, °F (°C)*	*Air temp, °F (°C)*	*Atmos. pressure, in. Hg (mm Hg)*	*Remarks*
2	38·3 (38·8)	2100	95·8 (13·2)	0·437 (195)	95 (35)	201 (94)	176 (80)	63 (17)	29·49 (749)	Max. power
1	23·0 (23·3)	1100	109·8 (15·2)	0·413 (185)	94 (34)	170 (77)	184 (84)	61 (16)	29·49 (749)	Speed less than at max. torque

(2) *Varying speed tests:*

Horse-power (Metric h.p.)	Engine speed, rev/min	Fuel consumption: UK gal/h (l/h)	Fuel consumption: H.p. h/UKgal (metric h.p. h/l)	Fuel consumption: Lb/h.p.h (g/metric h.p. h)	Temperature: Oil, °F (°C)	Temperature: Coolant, °F (°C)	Temperature: Fuel, °F (°C)	Atmos. conditions: Temp, °F (°C)	Atmos. conditions: Pressure, in. Hg (mm Hg)	Remarks
37·1 (37·6)	2000	1·95 (8·9)	19·0 (4·24)	0·435 (195)	192 (89)	186 (86)	90 (32)	64 (18)	29·49 (749)	Rated engine speed
30·5 (30·9)	1500	1·53 (6·96)	20·0 (4·46)	0·415 (186)	177 (81)	180 (82)	85 (29)	62 (17)	29·49 (749)	P.t.o. speed 540 rev/min
0	2178	0·60 (2·7)	—	—	170 (77)	150 (66)	75 (24)	55 (13)	29·49 (749)	No load

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

Date and location of tests: 7th April 1960; N.I.A.E., Silsoe, Beds.

Type of dynamometer: Water brake, Heenan and Froude

Fuel: Diesel oil, density 0·840 at 60°F (15·6 °C), Cetane No. 51

Oil: Multi-purpose S.A.E. 20W/30

(1) *Sustained power tests:*

Duration of test, h	Horse-power (Metric h.p.)	Engine speed, rev/min	Torque, lb ft (kpm)	Specific fuel consumption, lb/h.p. h (g/metric h.p. h)	Fuel temp, °F (°C)	Oil temp, °F (°C)	Coolant temp, °F (°C)	Air temp, °F (°C)	Atmos. pressure, in. Hg (mm Hg)	Remarks
2	39·5 (40·1)	2100	98·7 (13·7)	0·422 (189)	93 (34)	210 (99)	185 (85)	68 (20)	29·70 (754)	Max. power
1	23·7 (24·0)	1100	113·1 (15·6)	0·411 (184)	98 (37)	179 (82)	191 (88)	71 (22)	29·70 (754)	Speed less than at max. torque

(2) *Varying speed tests:*

Horse-power (Metric h.p.)	Engine speed, rev/min	Fuel consumption: UK gal/h (l/h)	Fuel consumption: H.p. h/UKgal (metric h.p. h/l)	Fuel consumption: Lb/h.p.h (g/metric h.p. h)	Temperature: Oil, °F (°C)	Temperature: Coolant, °F (°C)	Temperature: Fuel, °F (°C)	Atmos. conditions: Temp, °F (°C)	Atmos. conditions: Pressure, in. Hg (mm Hg)	Remarks
38·4 (38·9)	2000	1·96 (8·9)	19·6 (4·37)	0·420 (188)	208 (98)	188 (87)	103 (39)	76 (24)	29·70 (754)	Rated engine speed
31·8 (32·2)	1500	1·55 (7·0)	20·5 (4·57)	0·402 (180)	193 (89)	189 (87)	100 (38)	72 (22)	29·70 (754)	P.t.o. speed 540 rev/min
0	2180	0·61 (2·8)	—	—	150 (66)	153 (67)	77 (25)	68 (20)	29·70 (754)	No load

3. **Supplementary tests:** Belt test
Date and location of tests: 29th March 1960; N.I.A.E., Silsoe, Beds.
Type of dynamometer: Electrical swinging frame
Fuel: Diesel oil, density 0·840 at 60 °F (15·6 °C), Cetane No. 51
Oil: Multi-purpose S.A.E. 20W/30

(1) *Sustained power tests:*

Duration of test, h	*Horse-power (Metric h.p.)*	*Engine speed, rev/min*	*Torque, lb ft (kpm)*	*Specific fuel consumption, lb/h.p. h (g/metric h.p. h)*	*Fuel temp, °F (°C)*	*Oil temp, °F (°C)*	*Coolant temp, °F (°C)*	*Air temp, °F (°C)*	*Atmos. pressure, in. Hg (mm Hg)*	*Remarks*
2	37·1 (37·6)	2094	92·9 (12·8)	0·452 (202)	97 (36)	199 (93)	177 (81)	64 (18)	29·48 (749)	Max. power
1	22·5 (22·8)	1100	107·3 (14·8)	0·421 (188)	94 (34)	171 (77)	185 (85)	65 (18)	29·48 (749)	Speed less than at max. torque

(2) *Varying speed tests:*

Horse-power (Metric h.p.)	*Engine speed, rev/min*	*Fuel consumption*			*Temperature*			*Atmos. conditions*		*Remarks*
		UK gal/h (l/h)	*H.p. h/UKgal (metric h.p. h/l)*	*Lb/h.p. h (g/metric h.p. h)*	*Oil, °F (°C)*	*Coolant, °F (°C)*	*Fuel, °F (°C)*	*Temp, °F (°C)*	*Pressure, in. Hg (mm Hg)*	
36·2 (36·7)	2000	1·96 (8·9)	18·5 (4·13)	0·448 (200)	198 (92)	175 (79)	95 (35)	63 (17)	29·48 (749)	Rated engine speed
35·8 (36·3)	1968	1·93 (8·8)	18·6 (4·15)	0·445 (199)	199 (93)	180 (82)	98 (37)	63 (17)	29·48 (749)	Belt linear speed 3100 ft/min (15·7 m/s)
0·4 (0·4)	2169	0·62 (2·8)	—	—	180 (82)	149 (65)	86 (30)	67 (19)	29·48 (749)	Lowest recorded

PART III

DRAWBAR TESTS ON ARTIFICIAL TRACK

Date of tests: 23rd-25th May 1960
Type of track: Tarmacadam
Position of governor control lever: Fully open giving no load engine speed of 2175 $\pm$ 25 rev/min and maximum power engine speed of approx. 2100 rev/min
Type of tyre: Rear—Goodyear, straight bar open centre, 11-28, 6-ply pneumatic
Front—Goodyear, Super rib, 6·00–16, 6-ply pneumatic
Fuel: Diesel oil, density 0·840 at 60 °F (15·6 °C), Cetane No. 51
Oil: Multi-purpose S.A.E. 20W/30 (engine and transmission)

A. Tests with maximum additional weight

Weight of tractor; without driver:

Weight without ballast:	Front—1349 lb (612 kg), rear—1861 lb (844 kg)
Ballast: front	Weights, 3 per wheel—600 lb (272 kg) Water—139 lb (63 kg)
rear	Weights, 10 per wheel—2500 lb (1134 kg) Water—645 lb (293 kg)
Weight with full ballast:	Front—2088 lb (947 kg), rear—5006 lb (2271 kg) Total—7094 lb (3218 kg)
Tyre pressure:	Front—36 lb/sq. in. (2·5 kp/sq. cm) Rear—20 lb/sq. in. (1·4 kp/sq. cm)
Height of drawbar above ground:	17½ in. (445 mm)

(1) *Maximum powers and pulls:*

Gear No.	*Maximum powers*					*Air temp, °F (°C)*	*Atmos. press., in. Hg (mm Hg)*	*Maximum pulls*	
	Horse-power (Metric h.p.)	*Corres-ponding pull, lb (kp)*	*Wheel slip, %*	*Speed, mile/h (km/h)*	*Engine temp, °F (°C)*			*Pull, lb (kp)*	*Reason for stall*
1	19·2 (19·5)	6150 (2790)	18·5	1·17 (1·88)	170 (77)	65 (18)	29·70 (754)	6700 (3039)	Wheelspin and bouncing
2	28·5 (28·9)	6100 (2767)	17·9	1·75 (2·82)	176 (80)	66 (19)	29·70 (754)	6700 (3039)	Wheelspin and bouncing
3	33·2 (33·7)	3500 (1588)	6·0	3·56 (5·73)	175 (79)	62 (17)	29·70 (754)	4100 (1860)	Engine stall
4	34·5 (35·0)	2450 (1111)	3·7	5·28 (8·50)	173 (78)	64 (18)	29·70 (754)	2850 (1293)	Engine stall
5	34·1 (34·6)	1600 (726)	2·4	7·99 (12·86)	170 (77)	64 (18)	29·70 (754)	1875 (851)	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/h.p. h. (g/metric h.p. h)	*Drawbar h.p. h/UKgal (drawbar metric) h.p. h/l)*	*Corresponding pull, lb (kp)*	
1	0·633 (283)	13·2 (2·94)	5800 (2631)	3650 —> 6400 (1656) (2903)
2	0·566 (253)	14·7 (3·28)	4850 (2200)	3150 — 6300 (1429) (2858)
3	0·517 (231)	16·1 (3·59)	3500 (1588)	2150 — 4100 (M.S.P.) (975) (1860)
4	0·490 (219)	17·0 (3·79)	2450 (1111)	1550 — 2850 (M.S.P.) (703) (1293)
5	0·482 (216)	17·3 (3·86)	1600 (726)	1100 — 1875 (M.S.P.) (499) (851)

B. **Tests without ballast:**

Weight of tractor, without driver:

Weight without ballast: Front—1349 lb (612 kg), rear—1861 lb (844 kg)
Total—3210 lb (1456 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 22½ in. (572 mm)

(1) *Maximum powers and pulls:*

Gear No.	*Maximum powers*					*Air temp., °F (°C)*	*Atmos. press., in. Hg (mm Hg)*	*Maximum pulls*	
	Horse-power (Metric h.p.)	*Corresponding pull, lb (kp)*	*Wheel slip, %*	*Speed, mile/h (km/h)*	*Engine temp., °F (°C)*			*Pull, lb (kp)*	*Reason for stall*
3	25·7 (26·1)	2900 (1315)	13·8	3·32 (5·34)	170 (77)	65 (18)	30·10 (765)	3200 (1452)	Wheelspin
4	33·4 (33·9)	2450 (1111)	8·1	5·11 (8·22)	175 (79)	67 (19)	30·10 (765)	2875 (1304)	Engine stall
5	34·3 (34·8)	1630 (739)	3·3	7·89 (12·70)	175 (79)	66 (19)	30·10 (765)	1900 (862)	Engine stall
The following results were obtained with a drawbar height of 22½ in. (572 mm)									
3	30·0 (30·4)	3500 (1588)	16·2	3·21 (5·16)	176 (80)	69 (21)	30·10 (765)	3750 (1701)	Wheelspin

PART IV

1. **Location of centre of gravity:**

	Test A, ballasted	*Test B, unballasted*
Height above ground	24¼ in. (616 mm)	24¾ in. (629 mm)
Distance forward from the vertical plane containing the axis of the rear wheels	20¾ in. (527 mm)	28⅞ in. (733 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)

Results	*With brakes*		*Without brakes*	
	Right-hand	*Left-hand*	*Right-hand*	*Left-hand*
Radius of turning space	8 ft 10 in. (2·7 m)	8 ft 8½ in. (2·7 m)	9 ft 10½ in. (3·0 m)	9 ft 10½ in. (3·0 m)
Turning radius	8 ft 6 in. (2·6 m)	8 ft 4 in. (2·5 m)	9 ft 6 in. (2·9 m)	9 ft 6 in. (2·9 m)

PART V

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

2. **Remarks:**
   None

Test Engineer: M. W. JESSON
Officer in charge: T. C. D. MANBY
Head of Mechanical Engineering Department: H. J. HAMBLIN
Date: 1st May 1961

APPENDIX

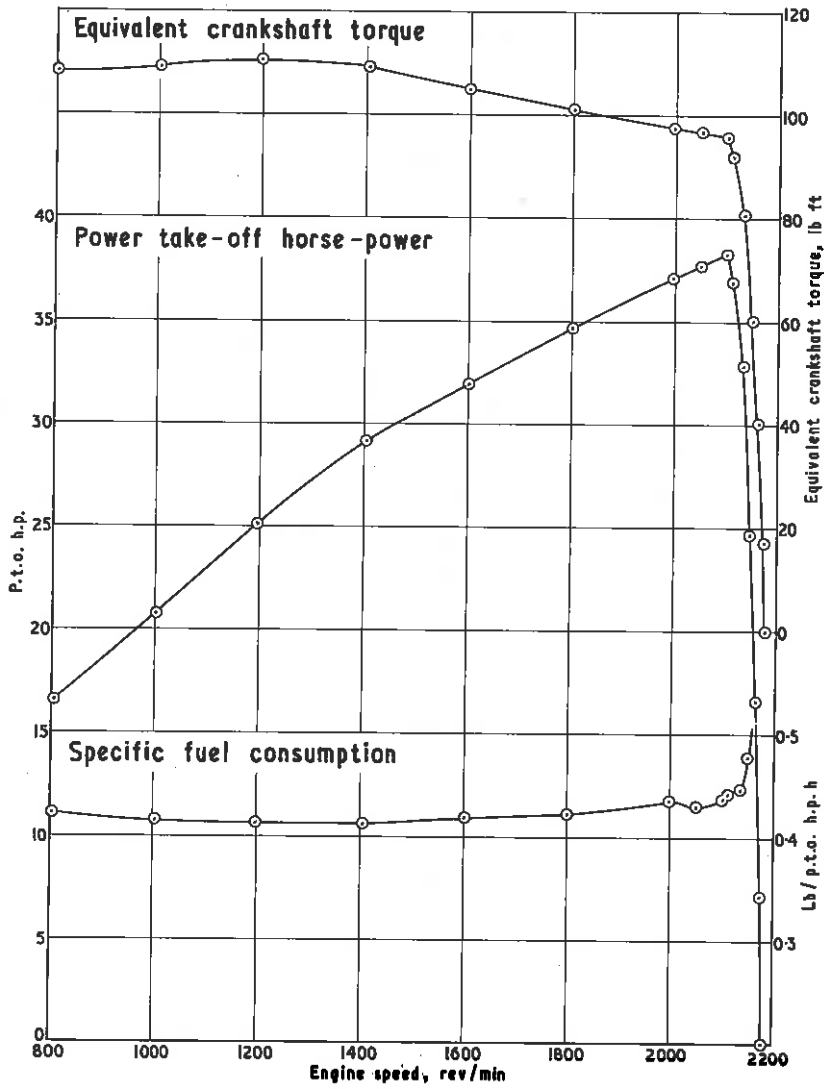


FIG. 1. Power take-off test

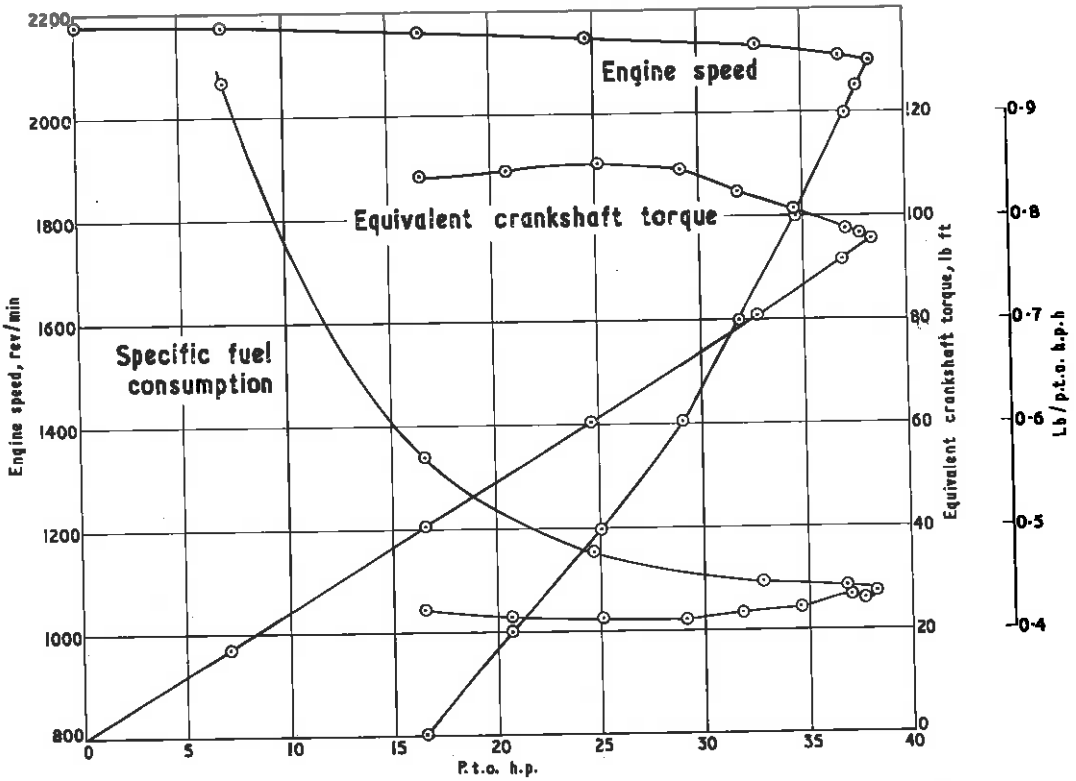


FIG. 2. Power take-off test

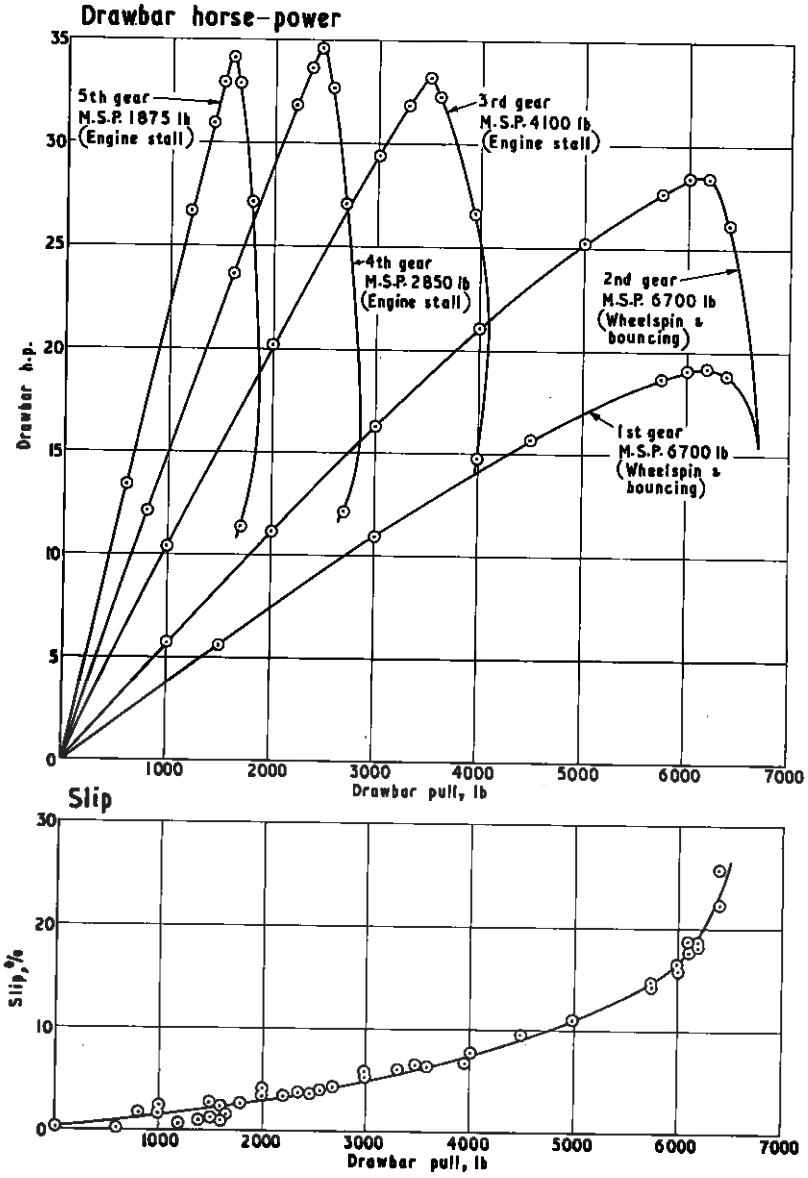


FIG. 3. Drawbar test on tarmacadam, with ballast

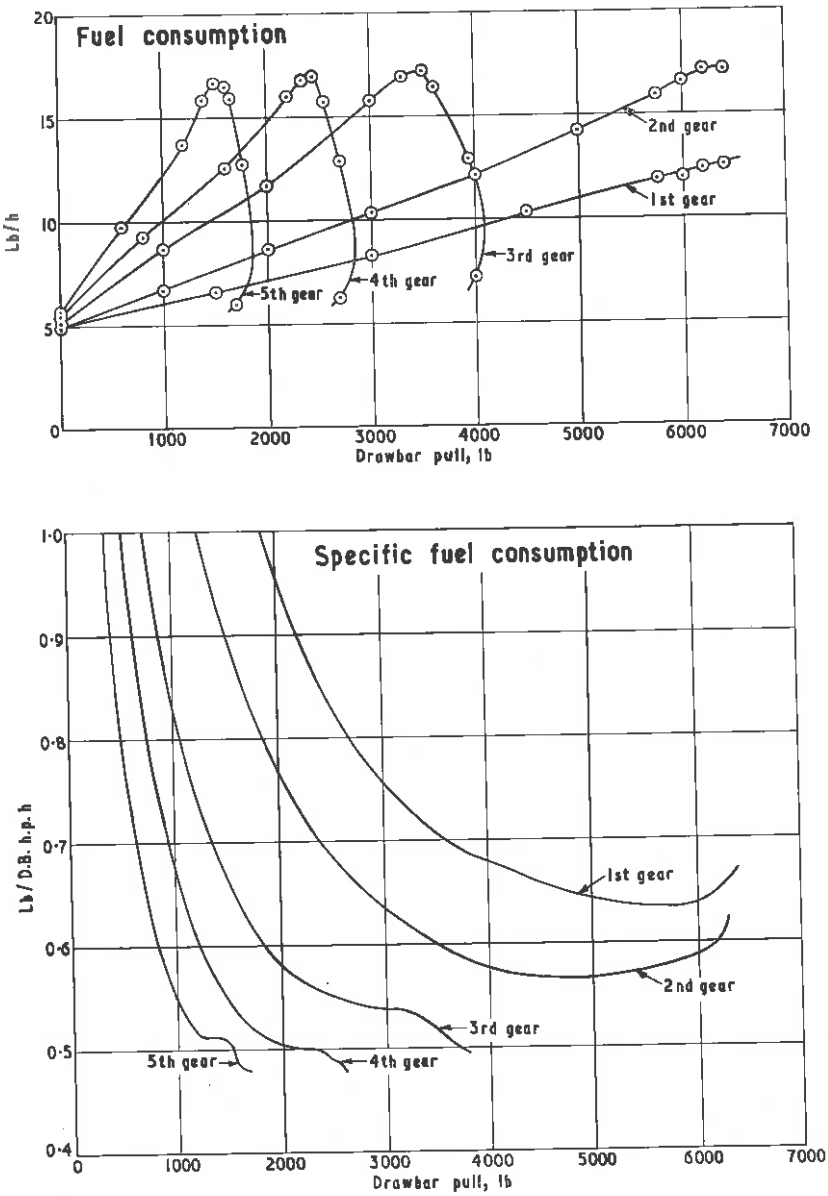


FIG. 4. Drawbar test on tarmacadam, with ballast

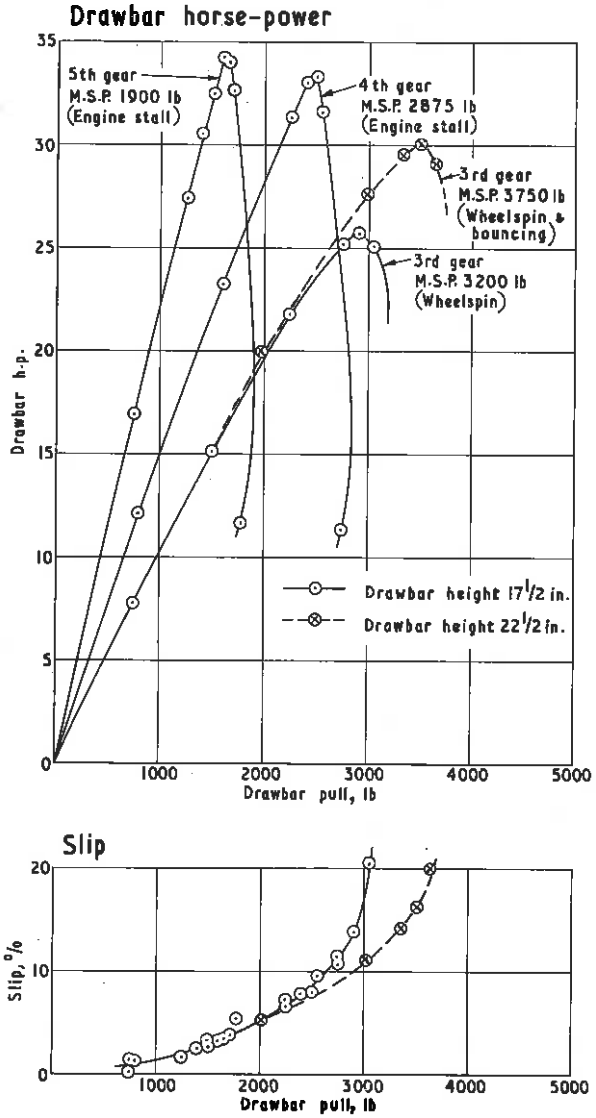


FIG. 5. Drawbar test on tarmacadam, without ballast

Henry Burt & Son Ltd, Mill Street, Bedford