COMITATO PER L'OMOLOGAZIONE
DELLE MACCHINE AGRICOLE

REPORT No. 546

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

MASSEY FERGUSON 1104 DIESEL TRACTOR

(this report covers both 2 W.D. and 4 W.D. models)



Manufactured by: MASSEY FERGUSON S.p.A.
Works of FABBRICO (Reggio Emilia) - Italy

Date of tests: March-December 1976

« This report has been approved by the Coordinating Center for the implementation of the O.E.C.D. Code for the official testing of agricultural tractors on the 27th of April 1977, under no. 546 ».

« The MASSEY FERGUSON 1104 tractor and the LANDINI R 9500 Special tractor being mechanically similar, the tests have not been repeated and the approval number is valid for both models of tractor ».

CONSIGLIO NAZIONALE DELLE RICERCHE
LABORATORIO PER LA MECCANIZZAZIONE AGRICOLA
TORINO - ITALY

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.

In this report all performance characteristics are given simultaneously according to the International System of Units and to the former used Technical System of Units (numbers enclosed in brackets).

The relation between the two systems is given by the following formulas:

Forces:	1 N	= 0.10197	kg	or 1	kg	= 9.80665	N
Powers:	1 kW	= 1.35962	metric hp	or 1	metric hp	= 0.73550	kW
Pressures:	1 bar	= 1.01972	kg/cm²	or 1	kg/cm²	= 0.980665	bar
Rotation speeds:	1 rd/s	= 9.54930	rev/min	or 1	rev/min	= 0.10472	rd/s
Torques:	1 mN	= 0.10197	mkg	or 1	mkg	= 9.80665	mN

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Manufacturer:	MASSEY FERGUSON S.p.A. Works of FABBRICO (Reggio Emilia) - Italy
Submitted for test by:	The Manufacturer
Selected by:	The Manufacturer with the agreement of the testing station
Place of running-in:	Works of FABBRICO (Reggio Emilia) - Italy
Duration of running-in:	60 hours

SPECIFICATION OF TRACTOR

Tractor

Make:	MASSEY FERGUSON
Model:	1104
Type:	TL 19 N/B - Four wheel rear wheel driven, unit construction
Serial No.:	1191764

Engine

Make:	PERKINS
Model:	A 6.3541
Type:	4-stroke, direct injection diesel
Serial No.:	354 UA 53426 L
Cylinders:	6 cylinders, vertical, in-line, 98.48 mm bore x 127 mm stroke, capacity 5800 cm^3, compression ratio 16 : 1, overhead in-line valves, replaceable cast-iron dry cylinder liners.
Fuel system:	Forced feed; DELCO diaphragm-type fuel pump; CAV paper filters, type 2 FAS 5845 B 510 replaceable cartridge element; capacity of fuel tank 92 litres; CAV model DPA 3263 F 621 injection pump, serial No. 26643 RS; manufacturer's production setting 21 to 21.5 l/h at 2199 rd/s (2100 rev/min) rated engine speed and 15 °C fuel temperature. CAV injector, model BDLL, serial No. 150 S 6472; Injector setting 166.7 ± 5 bar (170 ± 5 kg/cm^2).
Governor:	CAV mechanical type, incorporated in fuel injection pump; governed range of engine speed 57.6 to 237.7 rd/s (550 to 2270 rev/min); rated engine speed 219.9 rd/s (2100 rev/min).
Air cleaner:	DONALDSON main cleaner, model FWA 08-0052 dry type; DONALDSON pre-cleaner cap type, GAHOO.0161.S model.

Lubrication system:	Forced feed from gear-type pump; one screen type filter installed on pump suction and one, PERKINS 2654407 model, replaceable cartridge type filter installed on the pressure line to the engine; oil capacity 16 litres; recommended oil change period: 100 hours; cartridge change period: 200 hours; recommended oil: SHELL ROTELLA T, viscosity SAE 30.
Cooling system:	Water cooled from centrifugal pump 0.69 bar (0.7 kg/cm²) with thermostatic control; 480 mm diameter, 6 blade, belt-driven fan; cooling water capacity 22 litres. Temperature visual control with thermometer.
Starting system:	LUCAS make M 50 G model electric motor, 12 V; low temperature starting device (< 15 °C), CAV make, MK III C « thermostart » model.

Electrical system

Voltage:	12 V, negative earth.
Generator:	LUCAS make, 15 ACR model.
Battery:	SCAINI make, 610 11/6 FA8 model, lead acid type, capacity 110 Ah at 20 hours rating.

Transmission

Clutch:	VALEO make, independent dry dual disc clutch, 310 mm dia plates; driving part pedal operated; p.t.o. part hand lever operated.
Gearbox:	Own make, mechanical type with total 12 forward and 4 reverse speeds; the transmission consists of two forward speeds synchronized gear group (Low and High), in series with a three forward and one reverse speed partially synchronized gear group and a two speed sliding gear group (Reduced and Direct); each of three gear groups are operated by own lever.
Rear axle and final drive:	Own make, mechanical type with Gleason crown wheel and pinion; bevel gear type differential with pedal operated and self-disengaging lock; spur gear final drive.
Oil capacity:	Transmission 30 litres; final drives 2.5 litres each.
Oil change period:	1200 hours.
Recommended oil	Transmission and final drives MOBILUBE HD 90 EP, viscosity 14 °E at 50 °C.

Combination of 1st group	*Gear of 2nd group No.*	*Combination of 3rd group*	*Number of engine revolutions for one revolution of driving wheels*	*Travelling speed for 219.9 rd/s (2100 rev/min) at rated engine speed (*)*	
				km/h	*m/s*
Low	1	Reduced	332.88	1.84	0.511
High			260.59	2.35	0.653
Low	2		204.55	2.99	0.830
High			160.28	3.82	1.061
Low	3		126.24	4.85	1.347
High			99.00	6.19	1.719
Low	Reverse		219.47	2.79	0.775
High			171.81	3.56	0.989
Low	1	Direct	77.26	7.93	2.203
High			60.60	10.11	2.808
Low	2		47.40	12.92	3.589
High			37.19	16.47	4.575
Low	3		29.07	21.07	5.853
High			22.98	26.65	7.403
Low	Reverse		50.81	12.05	3.347
High			39.95	15.33	4.258

(*) Calculated with the rolling radius of the tyres 774 mm

Power take-off

Main p.t.o.:

Independent p.t.o. driven through the hand lever operated clutch disc; in centre line at rear of tractor; proportional engine speed or proportional ground speed preselectable by hand lever;

34.9 mm (1 3/8 in) dia according to ISO Standard, 6 spline; two angular speeds preselectable by hand lever: 56.5 rd/s (540 rev/min) and 104.7 rd/s (1000 rev/min) according to ISO Standard; height above ground 785 mm.

Proportional engine speeds:

62.8 rd/s (600 rev/min) and 116.3 rd/s (1111 rev/min) at 219.9 rd/s (2100 rev/min) rated engine speed;

56.5 rd/s (540 rev/min) and 104.7 rd/s (1000 rev/min) at 197.9 rd/s (1890 rev/min) engine speed.

Direction of rotation: clockwise viewed facing driving end.

Proportional ground speed:

1 revolution of p.t.o. for approximately 0.33 m and 0.17 m of travel.

Number of p.t.o. revolutions for one revolution of driving wheel: 14.91 and 28.10.
Direction of rotation: clockwise viewed facing driving end.

Auxiliary p.t.o.:

Independent p.t.o.; in centre line at rear of tractor above the main p.t.o. shaft; proportional ground speed; 34.9 mm (1 3/8 in) dia; 6 spline; height above ground 905 mm.

This auxiliary p.t.o. is driven by the same disc clutch and operated by the same hand levers of the main p.t.o.

Proportional engine speed:

219.9 rd/s (2100 rev/min) at 219.9 rd/s (2100 rev/min) rated engine speed.

Direction of rotation: anti-clockwise viewed facing driving end.

Proportional ground speed:

1 revolution of p.t.o. for approximately 0.09 m of travel. Number of p.t.o. revolutions for one revolution of driving wheel: 52.27.

Direction of rotation: anti-clockwise viewed facing driving end.

Belt pulley

Optional; not fitted on tractor tested.

Figures according to manufacturer's specification:

- location at rear tractor, fitted on the auxiliary p.t.o.; two positions: on right or on left side of auxiliary p.t.o.;
- diameter/width 240 mm/155 mm;
- speed 137.2 rd/s (1310 rev/min) at 219.9 rd/s (2100 rev/min) rated engine speed giving 16.45 m/s linear speed;
- engine speed 210.5 rd/s (2010 rev/min) at 15.75 m/s standard belt linear speed;
- direction of rotation: clockwise viewed from tractor right side with pulley connected to the right side of p.t.o.; opposite direction of rotation with pulley connected to the left side p.t.o.

Power lift

Own make hydraulic power lift, unit construction; draught control, position control, floating position; live gear pump directly driven by engine independently from the p.t.o. shaft; oil from independent reservoir supplied to single acting ram cylinder and up to 4 oil tappings for remote drive by supplementary control-valves.

One cartridge filter in the return line and a magnetic plug installed in the suction line.

Oil capacity 10 litres, 3 litres may be taken off by oil tappings; oil change period 1200 hours.

Recommended oil viscosity: 8.9-9.5 °E at 50 °C and 2-2.1 °E at 100 °C.

Three point linkage category 2 (ISO R 730).

Swinging drawbar

Own make; clevis type sliding on a drilled guide. Vertical height to centre of clevis: 2 positions 510 and 570 mm above ground; adjustments obtained by reversing the fitment of the drawbar; drawbar holes 28 mm dia; Distance from rear axle: 660 mm, position relative to p.t.o.: 365 mm to rear.

Lateral adjustments: 7 positions from 0 to 275 mm per each side.

Pivot position relative to rear wheel 120 mm.

Hitch

Height above ground 460 and 590 mm; changeable by reversing the hitch on the sector; hitch hole 28 mm dia; distance of hitch hole to rear axle center 370 mm; position relative to p.t.o. 75 mm to rear.

Steering

CALZONI make, mechanical type; hydraulically power assisted with independent circuit. Oil capacity 4.5 litres. Oil change period 1200 hours. Recommended oil viscosity 3.8 °E at 50 °C.

Brakes

GIRLING make, dual dry disc type on rear axle high speed shafts; independent or combined pedal operated, hand lever with ratchet operating both brakes for parking.

Wheels

Steering wheels: Two at front; PIRELLI « Tractor » 7.50-20, 6 ply rating; maximum permissible load on each tyre: 875 kg at 2.45 bar (2.50 kg/cm²); track width 1430 mm by 5 steps to 1830 mm obtained by extending front axle.

Driving wheels: Two at rear; PIRELLI « Tractor cinturato » 18.4/15-34, 6 ply rating; maximum permissible load on each tyre: 2400 kg at 1.08 bar (1.10 kg/cm²); W 14 L - 34 rim; track width 1600 mm by 6 steps to 1900 mm changed by reversing wheel centres and offset lugs on rims.

Wheelbase: 2420 mm.

Lighting Electrical 12 V, according to D.G.M. italian regulation.

	Height above ground of centre *cm*	*Dimensions* *cm*	*Distance from outside edge of tractor at 1600 mm rear track-width to centre* *cm*
Head lights	111.0	11.5 x 11.5	81.0
Side lights	170.5	11.5 x 3.5	28.5
Rear lights	163.5	5.5 x 6.0	31.5
Reflectors	122.5	4.5 x 5.5	31.0

Number of grease points (whole tractor): 15

CONDITIONS DURING TEST

Weights (Tractor weight without driver but with tank full and safety frame)

	Front *kg*	*Rear* *kg*	*Total* *kg*
Without ballast	1310	2200	3510
With ballast	1870	3050	4920

Ballast

	No. of weights	*Total weight kg (excluding water)*	*Water* *kg*
Front wheels	—	—	—
Front weight	10	420	—
Rear wheels	4	250	740

Track width during test: Front 1430 mm, rear 1600 mm

Overall dimensions

	Length *m*	*Width* *m*		*Height* *m*	
		max.	*min.*	*(1)*	*(2)*
With ballast	4.45	2.37	2.07	2.18	2.48
Without ballast	4.08	2.37	2.07	2.18	2.48

Remarks:
— length measured from ballast end to lower link end in horizontal position;
— (1) height measured at top of vertical exhaust;
— (2) height measured at top of the safety frame;
— ground clearance 0.49 m measured at the hitch support.

Seat

FRITZMEIER 3037 model; upholstered cushion and back rest; parallelogramm linkage with spring and air damper adjustable for driver's weight; longitudinal adjustment 100 mm

Safety frame

Own make; MFL « TS 2 » model; O.E.C.D. report no. CS 358, approved in date 14th February 1974.

FUEL AND LUBRICANTS USED IN TESTS

Laboratory and track tests

Fuel:	ESSO Diesel oil specific gravity 0.831 kg/l at 15 °C, cetane number not recorded.
Engine oil:	SHELL ROTELLA T, viscosity SAE 30.
Transmission oil:	MOBILUBE HD 90 EP, viscosity 14 °E at 50 °C.
Power lift oil:	ESSO ESSTIC 65, viscosity 8.9 ÷ 9.5 °E at 50 °C and 2.0 ÷ 2.1 °E at 100 °C.
Power steering oil:	AFT type A, viscosity 3.8 °E at 50 °C.

COMPULSORY TESTS

1. Power take-off performance

Date and location of test: 22nd March 1976 - L.M.A. TURIN - Italy
Type of dynamometer: Electrical, swinging frame.

Power	*Speed*		*Fuel consumption*			*Specific energy*
	Engine	*p.t.o.*	*Total*		*Specific*	
kW (metric hp)	*rd/s (rev/min)*	*rd/s (rev/min)*	*l/h*	*kg/h*	*g/kWh (g/metric hph)*	*kWh/l (metric hph/l)*
A - AT MAXIMUM POWER: 2 hour test						
66.5 (90.5)	219.9 (2100)	62.8 (600)	20.94	17.40	262 (192)	3.18 (4.32)
B - AT STANDARD p.t.o. SPEED - 56.5 rd/s (540 rev/min)						
62.6 (85.1)	197.9 (1890)	56.5 (540)	19.35	16.00	257 (189)	3.24 (4.41)
C - AT THE SPEED RECOMMENDED BY MANUFACTURER FOR DRAWBAR WORK						
66.5 (90.5)	219.9 (2100)	62.8 (600)	20.94	17.40	262 (192)	3.18 (4.32)
D - AT PART LOADS						
(i) 85% of the torque at maximum power						
58.1 (79.0)	225.8 (2156)	64.5 (616)	18.48	15.36	264 (194)	3.14 (4.27)
(ii) unloaded						
—	237.7 (2270)	67.9 (649)	6.06	5.04	—	—
(iii) 50% of the load defined in (i)						
29.8 (40.5)	231.6 (2212)	66.2 (632)	11.99	9.96	334 (246)	2.49 (3.38)
(iv) maximum power						
66.5 (90.5)	219.9 (2100)	62.8 (600)	20.94	17.40	262 (192)	3.18 (4.32)
(v) 25% of the load defined in (i)						
15.1 (20.5)	234.6 (2240)	67.0 (640)	8.95	7.44	493 (363)	1.69 (2.29)
(vi) 75% of the load defined in (i)						
44.0 (59.9)	228.3 (2180)	65.2 (623)	15.16	12.60	286 (210)	2.90 (3.95)

No load, maximum engine speed: 237.7 rd/s (2270 rev/min)

Equivalent crankshaft torque at maximum power: 302.6 mN (39.86 mkg)

Maximum equivalent chankshaft torque: 333.4 mN (34 mkg) at 146.6 rd/s (1400 rev/min)

Mean atmospheric conditions:
temperature 18 °C
pressure 987 mbar (740.0 mmHg)
relative humidity 75 %

Maximum temperature:
coolant 72 °C
engine oil 106 °C
fuel 22 °C
engine air intake 23 °C

2. Drawbar performance (Massey Ferguson 1104 Diesel Tractor)

Date of test: 13th - 14th and 15th July and 5th October 1976
Type of track: concrete
Height of drawbar above the ground: 570 mm
Tyre inflation pressure: 1.08 bar (1.1 kg/cm²) with ballast; 1.08 bar (1.1 kg/cm²) without ballast

Gear	Travelling speed		Power	Drawbar pull	Engine speed	Wheelslip	Fuel consumption		Temperature			Atmospheric conditions		
							Specific energy	Specific consumpt.	Fuel	Coolant	Engine oil	Temperature	Relative humidity	Pressure
No.	km/h	m/s	kW (metric hp)	N (kg)	rd/s (rev/min)	%	kWh/l (m.hph/l)	g/kWh (g/m.hph)	°C	°C	°C	°C	%	mbar (mmHg)
1 - MAXIMUM POWER (ballasted)														
1. L R	1.70	0.472	15.9 (21.6)	33625 (3430)	232.9 (2224)	15.0	—	—	—	78	90	27.5	56	988 (741)
1. H R	2.17	0.602	20.2 (27.5)	33550 (3420)	231.5 (2211)	14.7	—	—	—	78	94	27.8	55	988 (741)
2. L R	2.72	0.756	25.2 (34.3)	33350 (3400)	229.2 (2189)	15.0	2.08 (2.83)	400 (294)	30.0	80	100	27.1	65	988 (741)
2. H R	3.44	0.955	31.9 (43.4)	33450 (3410)	226.5 (2163)	14.9	2.26 (3.08)	367 (270)	30.0	80	100	26.9	67	988 (741)
3. L R	4.36	1.210	39.7 (54.0)	32800 (3345)	224.7 (2146)	14.5	2.44 (3.33)	340 (250)	30.0	80	100	26.4	67	988 (741)
3. H R	5.44	1.510	50.4 (68.5)	33350 (3400)	221.5 (2115)	14.9	2.53 (3.44)	328 (241)	30.0	80	100	27.5	61	988 (741)
1. L D	7.38	2.050	56.7 (77.0)	27650 (2820)	220.2 (2103)	8.2	2.71 (3.67)	307 (226)	30.0	82	100	24.0	69	988 (741)
1. H D	9.61	2.670	57.2 (77.8)	21425 (2185)	219.5 (2096)	5.5	2.71 (3.69)	307 (226)	30.0	84	107	24.5	67	988 (741)
2. L D	12.42	3.450	56.2 (76.4)	16275 (1660)	221.2 (2112)	4.7	2.70 (3.66)	308 (227)	30.0	85	108	27.5	58	988 (741)
2 - FIVE HOUR TEST AT 75% OF PULL AT MAXIMUM POWER														
3. H R	5.98	1.660	41.5 (56.5)	25000 (2550)	226.0 (2158)	6.7	2.50 (3.41)	332 (244)	30.0	88	105	25.5	58	993.3 (745)
3 - FIVE HOUR TEST AT PULL CORRESPONDING TO 15% WEELSLIP IN TEST (1)														
3. L R	—	—	—	33635 (3430)	223.8 (2137)	—	—	—	—	86	106	30.0	45	992.0 (744)
4 - MAXIMUM POWER (unballasted)														
3. H R	5.54	1.540	42.6 (57.9)	27650 (2820)	226.2 (2160)	15.0	2.44 (3.32)	340 (250)	30.0	72	95	24.5	49	997.0 (747.8)
1. L D	7.02	1.950	53.9 (73.3)	27650 (2820)	223.6 (2135)	14.9	2.71 (3.69)	306 (225)	30.0	74	97	24.5	49	997.0 (747.8)
1. H D	9.50	2.640	59.5 (80.9)	22550 (2300)	220.0 (2101)	6.7	2.81 (3.83)	295 (217)	30.0	80	100	24.5	49	997.0 (747.8)
2. L D	12.35	3.430	60.4 (82.1)	17600 (1795)	220.6 (2107)	5.3	2.88 (3.92)	288 (212)	30.0	80	106	24.8	47	995.7 (746.8)
2. H D	15.91	4.420	59.8 (81.3)	13525 (1380)	219.0 (2091)	3.3	2.83 (3.85)	294 (216)	30.0	80	105	24.8	46	995.4 (746.6)

Total oil consumption during ten hours duration of tests (2) and (3): 80 g/h
(1) Those figures not quoted are irrelevant due to the additional ballast.

3. Turning space and turning circle

Wheel equipment:	front 7.50-20 rear 18.4/15-34
Track of wheels:	front 1430 mm rear 1600 mm

	With brakes		*Without brakes*	
	Right-hand m	*Left-hand* m	*Right-hand* m	*Left-hand* m
Radius of turning space	4.06	4.01	4.41	4.36
Radius of turning circle	3.95	3.90	4.30	4.25

4. Location of centre of gravity

Height above ground	mm	868
Distance forward from the vertical plane containing the axis of the rear wheels	mm	866
Distance from the median plane of the tractor	mm	0

5. Braking

Date of test:	16th July 1976
Type of track:	concrete
Type of decelerometer:	MOTO METER, recording type
Weight of tractor with driver:	with ballast 4990 kg without ballast 3580 kg

Cold brakes

		With ballast	*Without ballast*
Travelling speed of tractor	km/h	25.0	25.0
Max. deceleration	m/s^2	4.2	4.0
Stopping distance	m	7.1	7.6
Force exerted on the brake pedal	N (kg)	430 (44)	370 (38)
Force exerted on the brake pedal to achieve a deceleration of 2.5 m/s^2	N (kg)	195 (20)	175 (18)

Brake fade characteristics (hot tests)

	with ballast	without ballast
[Maximum deceleration hot/maximum deceleration cold] x 100	95%	100%
[Stopping distance cold/stopping distance hot] x 100	90%	98%
[Force on pedal cold/force on pedal hot] x 100	100%	120%

Parking brake

Efficiency of handbrake on a slope of 16 per cent: with a 275 N (28 kg) pull on handbrake no wheel rotation occurs with tractor facing first up and then down the slope.

6. Measurement of ambient noise emitted by the tractor

Date of test:	16th December 1976
Type of sound level meter:	BRUEL & KJAER model 2209
Type of track:	concrete
Position of exhaust pipe:	vertical

Results of test

— gear:	3. H D
— travelling speed before acceleration:	21.6 km/h
— sound level:	93.5 dB (A)

7. Noise measurement at the driver's ear level

Date of test:	16th December 1976
Type of sound level meter and octave filter:	BRUEL & KJAER model 2209 and model 1613
Type of track:	concrete
Type of frequency analyzer:	octave type, with 10 bands from 31.5 to 16.000 Hz.

Results of test

Gear	*Travelling speed km/h (*)*	*Sound level*	
		dB (A)	*Sones*
1st L D	7.93	102	153
3rd H D	26.65	97.5	—

(*) The first gear tested corresponds to the travelling speed nearest to 7.25 km/h.

Remarks With frame fitted on tractor

8. Power lift and hydraulic pump performance

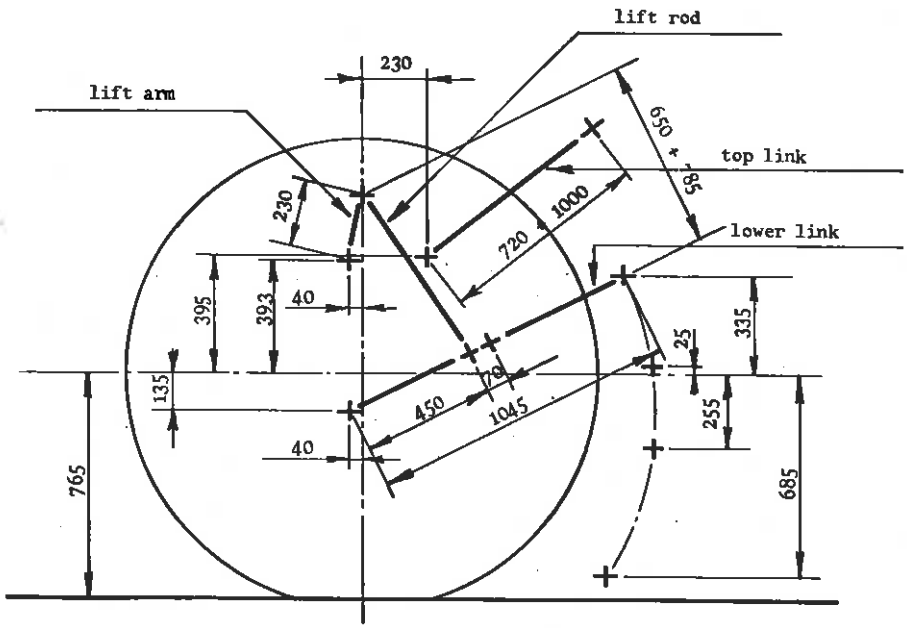
Date of test:	15th December 1976
Hydraulic fluid:	ESSO ESSTIC 65, viscosity 8.9÷9.5 °E at 50 °C
— type of linkage lock transport:	none on the tractor tested
— opening pressure of the cylinder over pressure relief valve:	205.9 bar (210 kg/cm²)

Pump characteristics

1 - opening pressure on the relief valve:	176.5 bar (180 kg/cm²)
- substained pressure by the open relief valve:	184.4 bar (188 kg/cm²)
2 - pump delivery rate at minimum pressure and rated engine speed:	35 l/min
3 - pump delivery rate:	33 l/min
- delivery pressure:	176.5 bar (180 kg/cm²)
- hydraulic power:	9.7 kW (13.2 metric hp)

Power lift

Dimensions of linkage geometry for the table on page 16



LINKAGE GEOMETRY WHEN CONNECTED TO THE STANDARD FRAME

	Maximum mechanical advantage	*Minimum mechanical advantage*
Projected length in side view:		
— lower links mm	1045	1045
— lift arms mm	230	230
— lift rods mm	785	650
— top link mm	765	770
Distance of lift rod connection point from pivot point of lower link mm	135	135

The following dimensions are given relative to the rear axle centre line 765 mm above the ground level

Lower link pivot point	40 mm before, 135 mm below	40 mm before, 135 mm below
Top link pivot point	230 mm behind, 395 mm above	230 mm behind, 395 mm above
Lift arm pivot point	40 mm before, 393 mm above	40 mm before, 393 mm above
Maximum and minimum height of lower link hitch points	25 mm above, 685 mm below	335 mm above, 255 mm below
Height of lower link hitch points when locked in transport position	no definite transport position	

LIFTING HEIGHTS IN RELATION TO A HORIZONTAL LINE THROUGH THE LOWER LINK PIVOT POINT

		cm	— 55	— 50	— 45	— 40	— 35	— 30	— 25	— 20	— 12	— 10	— 5	0	+ 5	+ 10	+ 15	+ 20	+ 25	+ 30	+ 35	+ 40	+ 45
Lifting force at hitch points	max. mech. advantage	N	—	—	—	—	—	—	—	—	25800	—	27450	28675	29925	30600	31375	31875	32550	33050	33450	34025	34325
		kg	—	—	—	—	—	—	—	—	(2630)	—	(2800)	(2925)	(3010)	(3120)	(3200)	(3200)	(3320)	(3370)	(3920)	(3470)	(3500)
	min. mech. advantage	N	21575	22450	23350	23925	24725	25700	26275	26875	—	28150	28725	29225	29800	30200	30400	—	—	—	—	—	—
		kg	(2200)	(2290)	(2380)	(2440)	(2520)	(2620)	(2680)	(2740)	—	(2870)	(2930)	(2890)	(3040)	(3080)	(3100)	—	—	—	—	—	—

Maximum force exerted through whole range: 25800 N (2630 kg)

Force at which front of tractor is calculated to lift with maximum allowable front ballast: — N (— kg)

Lifting force at the frame	max. mech. advantage	N	—	—	—	—	—	—	37275	35700	—	34125	33150	32950	32750	—	—	—	—	—	—	—	—
		kg	—	—	—	—	—	—	(3800)	(3640)	—	(3480)	(3380)	(3360)	(3340)	—	—	—	—	—	—	—	—
	min. mech. advantage	N	—	—	—	—	—	—	—	—	—	31375	32350	32850	33150	33350	33150	32350	31775	31575	31475	—	—
		kg	—	—	—	—	—	—	—	—	—	(3200)	(3300)	(3350)	(3380)	(3400)	(3380)	(3300)	(3240)	(3220)	(3210)	—	—

Maximum force exerted through whole range: 32750 N (3340 kg)

Force at which front of tractor is calculated to lift with maximum allowable front ballast: 27480 N (2802 kg)

All values of forces correspond to the pressure at maximum hydraulic power 176.5 bar (180 kg/cm²) calculated from measurements made at maximum oil pressure 184.4 bar (188 kg/cm²)

OPTIONAL TESTS

9. Engine tests

Date and location of tests: 10th March 1976 - L.M.A. TORINO - Italy
Type of dynamometer: Electrical, swinging frame

Power	*Engine speeds*	*Fuel consumption*			*Specific energy*
		Total		*Specific*	
kW (metric hp)	*rd/s (rev/min)*	*l/h*	*kg/h*	*g/kWh (g/metric hph)*	*kWh/l (metric hph/l)*
A - AT MAXIMUM POWER: 2 hour test					
69.9 (95.0)	219.9 (2100)	20.94	17.40	249 (183)	3.34 (4.54)
B - AT STANDARD p.t.o. SPEED - 56.5 rd/s (540 rev/min)					
65.4 (88.9)	197.9 (1890)	19.06	15.84	242 (178)	3.43 (4.66)
C - AT THE SPEED RECOMMENDED BY MANUFACTURER FOR DRAWBAR WORK					
69.9 (95.0)	219.9 (2100)	20.94	17.40	249 (183)	3.34 (4.54)
D - AT PART LOADS					
(i) 85% of the torque at maximum power					
61.0 (82.9)	225.9 (2157)	18.63	15.48	254 (187)	3.27 (4.45)
(ii) minimum load					
2.7 (3.6)	237.7 (2270)	6.35	5.20	1926 (1444)	0.43 (0.57)
(iii) 50% of the load defined in (i)					
31.4 (42.7)	232.8 (2223)	11.99	9.96	317 (233)	2.62 (3.56)
(iv) maximum power					
69.9 (95.0)	219.9 (2100)	20.94	17.40	249 (183)	3.34 (4.54)
(v) 25% of the load defined in (i)					
15.9 (21.6)	235.4 (2248)	8.81	7.32	460 (338)	1.80 (2.45)
(vi) 75% of the load defined in (i)					
46.2 (62.9)	228.3 (2180)	15.16	12.60	273 (200)	3.05 (4.15)

No load, maximum engine speed: 238.2 rd/s (2275 rev/min)

Crankshaft torque at max. power: 317.7 mN (32.40 mkg)

Maximum equivalent crankshaft torque: 346.7 mN (35.35 mkg) at 146.6 rd/s (1400 rev/min)

Mean atmospheric conditions:
temperature 21 °C
pressure 1001 mbar (751 mmHg)
relative humidity 37 %

Maximum temperature:
coolant 76 °C
engine oil 98 °C
fuel 21 °C
engine air intake 27 °C

ADDITIONAL TESTS OF THE TRACTOR EQUIPPED WITH FRONT DRIVING AXLE

MASSEY FERGUSON 1104-4 DIESEL TRACTOR

Characteristics that may vary due to the fitting of the front driving axle are only given hereunder.

Front axle and final drive

Own make, mechanical type with Gleason crown wheel and pinion, bevel gear type differential, epicyclic unit final drives.

Oil capacity:
- — Differential casing: 5.5 litres
- — Final drive units: 1.7 litres each
- — Oil change period: 1200 hours
- — Oil viscosity: SAE 90 EP

Combination of 1st group	*Gear of 2nd group No.*	*Combination of 3rd group*	*Number of engine revolutions for one revolution of driving wheels*	*Travelling speed for 219.9 rd/s (2100 rev/min) at rated engine speed (*)*	
				km/h	*m/s*
Low	1	Reduced	240.17	1.87	0.519
High			188.02	2.39	0.664
Low	2		147.58	3.05	0.847
High			115.64	3.89	1.081
Low	3		91.08	4.94	1.372
High			71.43	6.29	1.747
Low	Reverse		158.35	2.84	0.789
High			123.96	3.63	1.008
Low	1	Direct	55.74	8.06	2.239
High			43.72	10.28	2.856
Low	2		34.20	13.14	3.650
High			26.83	16.75	4.653
Low	3		20.97	21.44	5.955
High			16.58	27.11	7.530
Low	Reverse		36.66	12.26	3.405
High			28.82	15.60	4.333

(*) Calculated with the rolling radius of the tyres: 568 mm

Steering

DANFOSS-ORBITROL make, hydrostatic power steering with independent circuit.
Oil capacity: 4.5 litres
Oil change period: 1200 hours
Recommended oil viscosity: 3.8 °E at 50 °C

Wheels

Two front driving and steering wheels; Pirelli « Tractor cinturato » 13.6/12-24, 6 ply rating W 11-24 rim; maximum permissible load on each tyre 1435 kg at 1.47 bar (1.50 kg/cm²); track width 1650 mm.
Two rear driving wheels; Pirelli « Tractor cinturato » 18.4/15-34, 6 ply rating; maximum permissible load on each tyre 2400 kg at 1.08 bar (1.10 kg/cm²); W 14 L - 34 rim; track width 1600 mm by 6 steps to 1900 changed by reversing wheel centres and offset lugs on rims.

Wheelbase: 2570 mm

Lighting Electrical 12 V, according to D.G.M. italian regulations.

	Height above ground of centre *cm*	*Dimensions* *cm*	*Distance from outside edge of tractor at 1600 mm rear track-width to centre* *cm*
Head lights	110.0	11.5 x 11.5	81.0
Side lights	170.5	11.5 x 3.5	28.5
Rear lights	163.5	5.5 x 6.0	31.5
Reflectors	122.5	4.5 x 5.5	31.0

Weights (Tractor weight without driver but with full tank and safety frame)

	Front *kg*	*Rear* *kg*	*Total* *kg*
Without ballast	1580	2320	3900
With ballast	2360	3150	5510

Ballast

	No. of weights	*Total weight kg (excluding water)*	*Water* *kg*
Front wheels	—	—	260
Front weights	10	420	—
Rear wheels	4	250	680

Overall dimensions

	Length *m*	*Width* *m*		*Height* *m*	
		max.	*min.*	*(1)*	*(2)*
With ballast	4.45	2.37	2.07	2.14	2.48
Without ballast	4.18	2.37	2.07	2.14	2.48

Remarks:

— length measured from ballast end to lower link end in horizontal position

— (1) height measured at top of vertical exhaust

— (2) height measured at top of safety frame

— ground clearance 0.40 m measured at front differential casing

Turning space and turning circle

Wheel equipment: front 13.6/12-24
rear 18.4/15-34

Track of wheels: front 1650 mm
rear 1600 mm

	With brakes		*Without brakes*	
	Right-hand *m*	*Left-hand* *m*	*Right-hand* *m*	*Left-hand* *m*
Radius of turning space	4.32	4.29	6.11	6.06
Radius of turning circle	4.15	4.12	5.94	5.89

2. Drawbar performance on tractor equipped with front driving axle (Massey Ferguson 1104-4 Diesel Tractor)

Date of test: 7th - 8th and 15th September 1976
Type of track: concrete
Height of drawbar above the ground: 570 mm
Tyre inflation pressure: front wheels 1.47 bar (1.5 kg/cm²) with ballast; 1.47 bar (1.5 kg/cm²) without ballast
rear wheels 1.08 bar (1.1 kg/cm²) with ballast; 1.08 bar (1.5 kg/cm²) without ballast

Gear	Travelling speed		Power	Drawbar pull	Engine speed	Wheelslip	Fuel consumption		Temperature			Atmospheric conditions		
							Specific energy	Specific consumpt.	Fuel	Coolant	Engine oil	Temperature	Relative humidity	Pressure
No.	km/h	m/s	kW (metric hp)	N (kg)	rd/s (rev/min)	%	kWh/l (m.hph/l)	g/kWh (g/m.hph)	°C	°C	°C	°C	%	mbar (mmHg)
1. MAXIMUM POWER (ballasted)														
1. LR	1.67	0.464	21.0 (28.6)	45350 (4625)	230.5 (2201)	15.0	—	—	26	80	90	21.5	47	996.0 (747.0)
1. HR	2.12	0.590	26.5 (35.9)	44875 (4575)	228.5 (2182)	14.5	—	—	26	80	90	20.5	50	996.0 (747.5)
2. LR	2.69	0.746	33.2 (45.2)	44525 (4540)	226.3 (2161)	14.2	2.19 (2.98)	380 (279)	21	80	90	13.0	91	997.8 (748.4)
2. HR	3.42	0.950	42.1 (57.3)	44325 (4520)	224.9 (2148)	13.8	2.39 (3.25)	348 (256)	21	78	90	10.5	92	998.4 (748.8)
3. LR	4.28	1.189	52.0 (70.6)	43700 (4455)	220.6 (2107)	13.0	2.47 (3.35)	337 (248)	23	80	90	16.5	78	997.3 (748.0)
3. HR	5.80	1.611	55.9 (76.0)	34725 (3540)	221.1 (2111)	6.7	2.68 (3.65)	310 (228)	26	82	96	21.8	52	996.0 (747.0)
1. LD	7.52	2.089	59.8 (81.3)	28625 (2920)	220.4 (2105)	5.3	2.82 (3.83)	295 (217)	26	85	100	21.8	49	996.0 (747.0)
1. HD	9.76	2.711	60.2 (81.5)	22200 (2265)	220.3 (2104)	3.5	2.86 (3.88)	290 (214)	26	85	102	21.8	49	996.0 (747.0)
2. LD	12.50	3.472	59.2 (80.5)	17025 (1735)	221.2 (2112)	3.0	2.81 (3.82)	296 (218)	26	85	105	21.8	49	996.0 (747.0)
2. MAXIMUM POWER (unballasted)														
3. LR	4.39	1.219	42.8 (58.1)	35050 (3575)	224.0 (2139)	12.0	2.40 (3.25)	347 (256)	24	78	90	15.8	55	977.3 (733.0)
3. HR	5.54	1.539	53.9 (73.3)	35000 (3570)	221.0 (2110)	12.2	2.57 (3.49)	321 (236)	24	80	95	15.8	55	977.3 (733.0)
1. LD	7.49	2.080	60.0 (81.6)	28825 (2940)	220.2 (2103)	5.6	2.84 (3.86)	293 (215)	24	80	98	15.2	60	977.3 (733.0)
1. HD	9.76	2.711	60.6 (82.4)	22350 (2280)	220.0 (2101)	3.6	2.88 (3.92)	286 (212)	24	80	100	15.0	65	977.3 (733.0)
2. LD	12.56	3.489	59.2 (80.5)	16975 (1730)	220.4 (2105)	2.7	2.82 (3.83)	295 (217)	24	80	104	15.5	58	977.3 (733.0)

Maximum drawbar pull at 15% wheelslip: 35800 N (3650 kg)

OFFICER IN CHARGE
(R. Gioia)

HEAD OF L.M.A.
(L. Lisa)

Turi 13rd December 1976

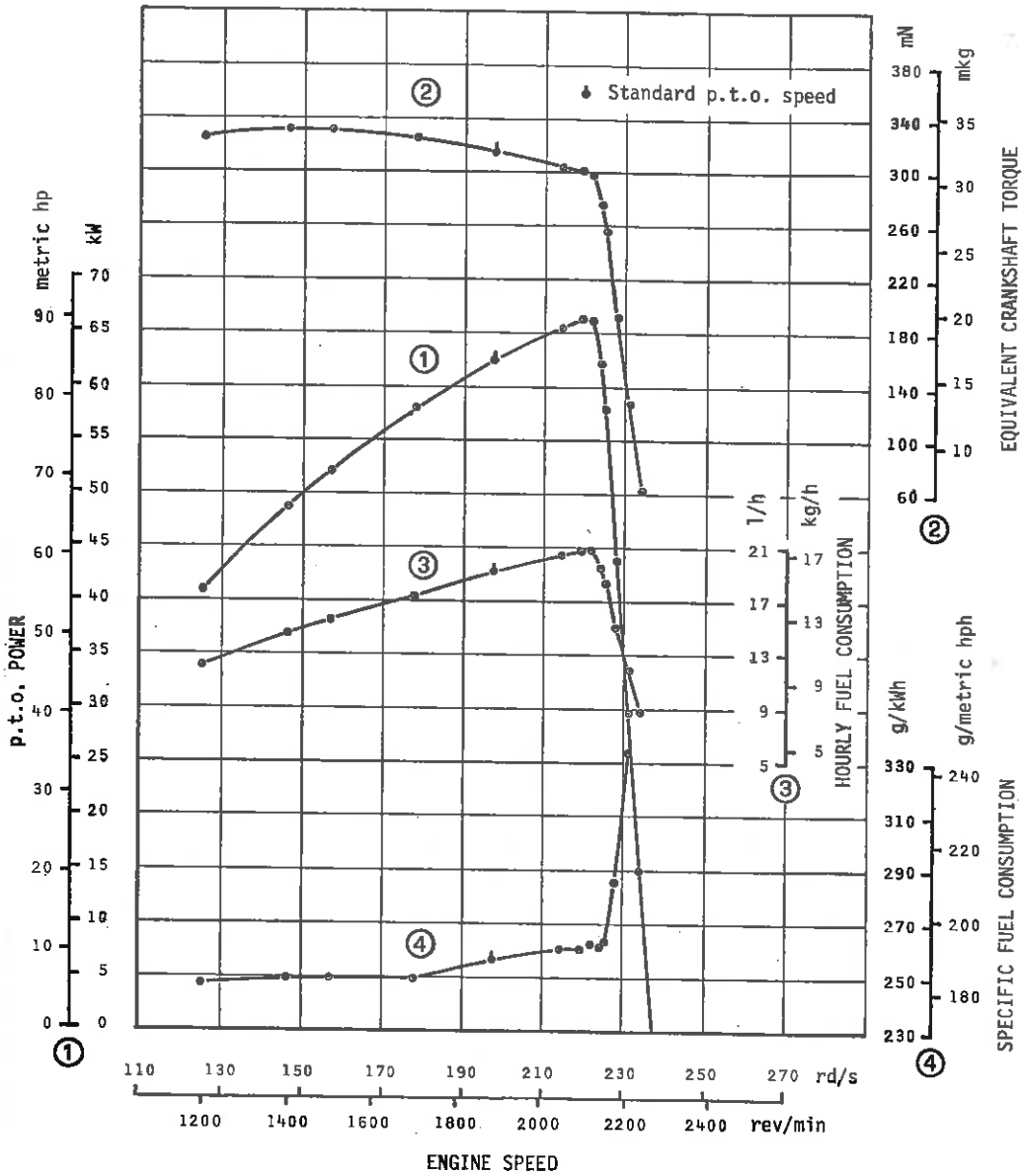


FIG. 1 - POWER TAKE-OFF TEST

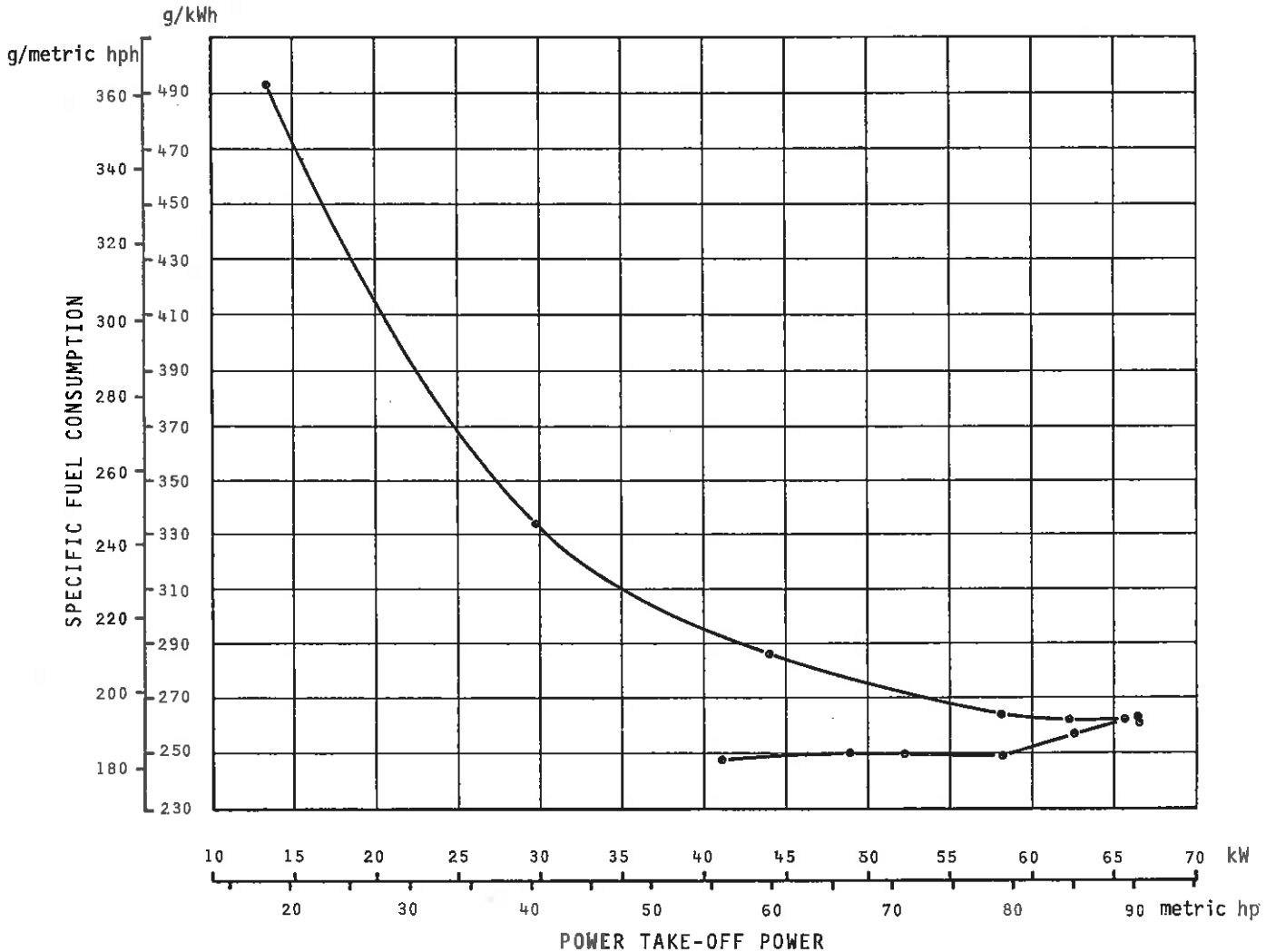


FIG. 2 - POWER TAKE-OFF TEST

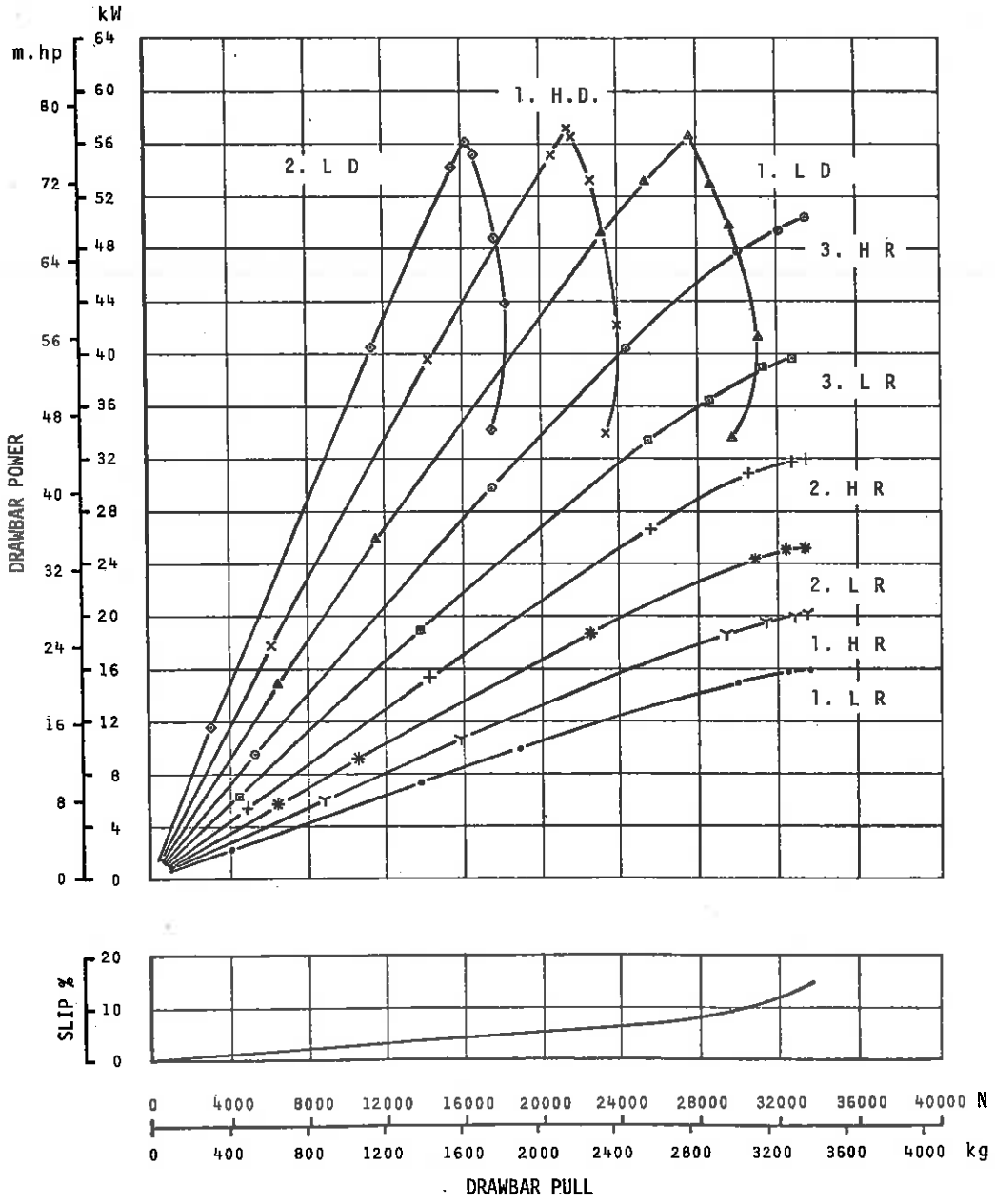


FIG. 3 - DRAWBAR TEST ON CONCRETE, WITH BALLAST
(Massey Ferguson 1104 Diesel Tractor)

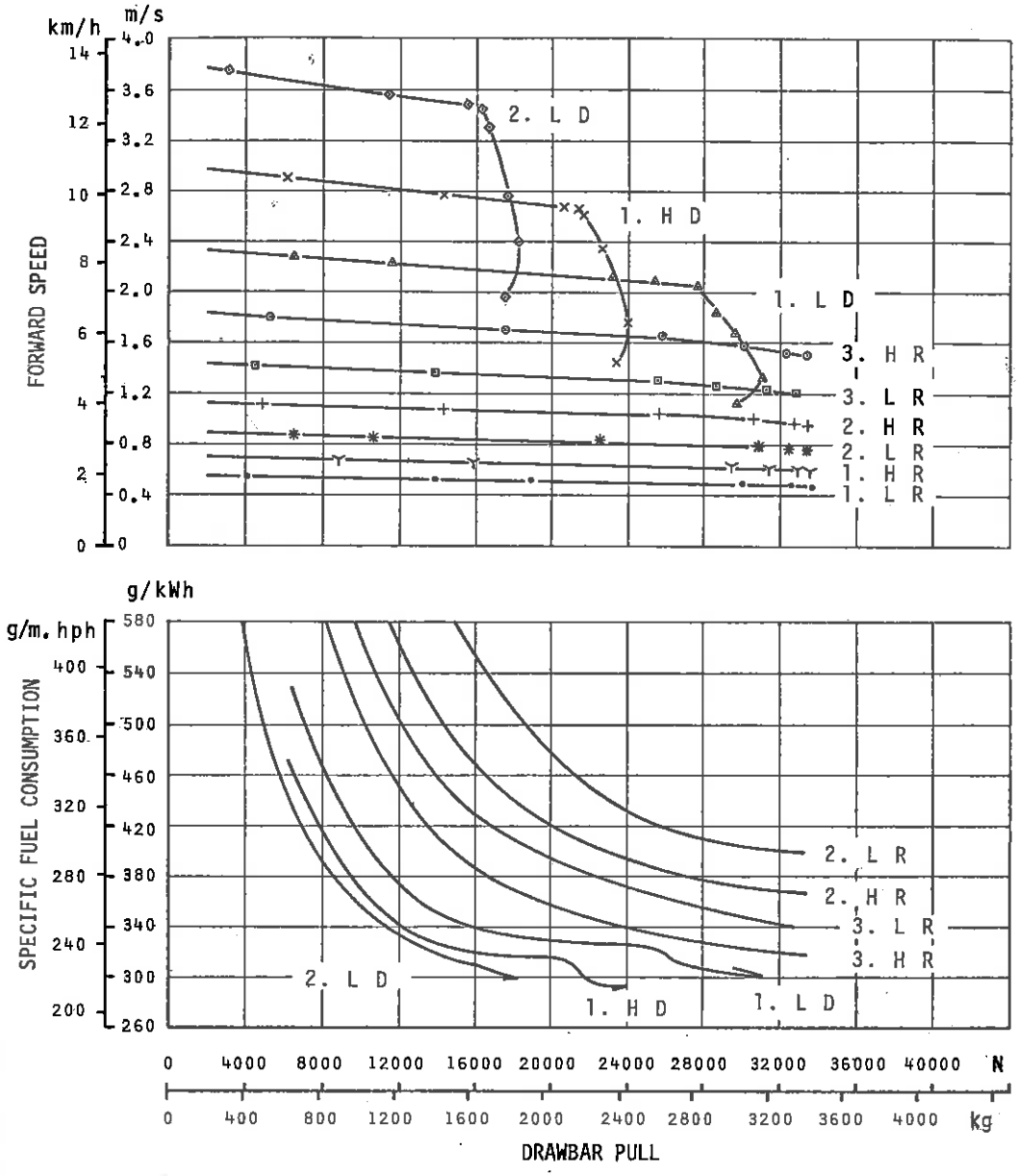


FIG. 4 - DRAWBAR TEST ON CONCRETE, WITH BALLAST
(Massey Ferguson 1104 Diesel Tractor)

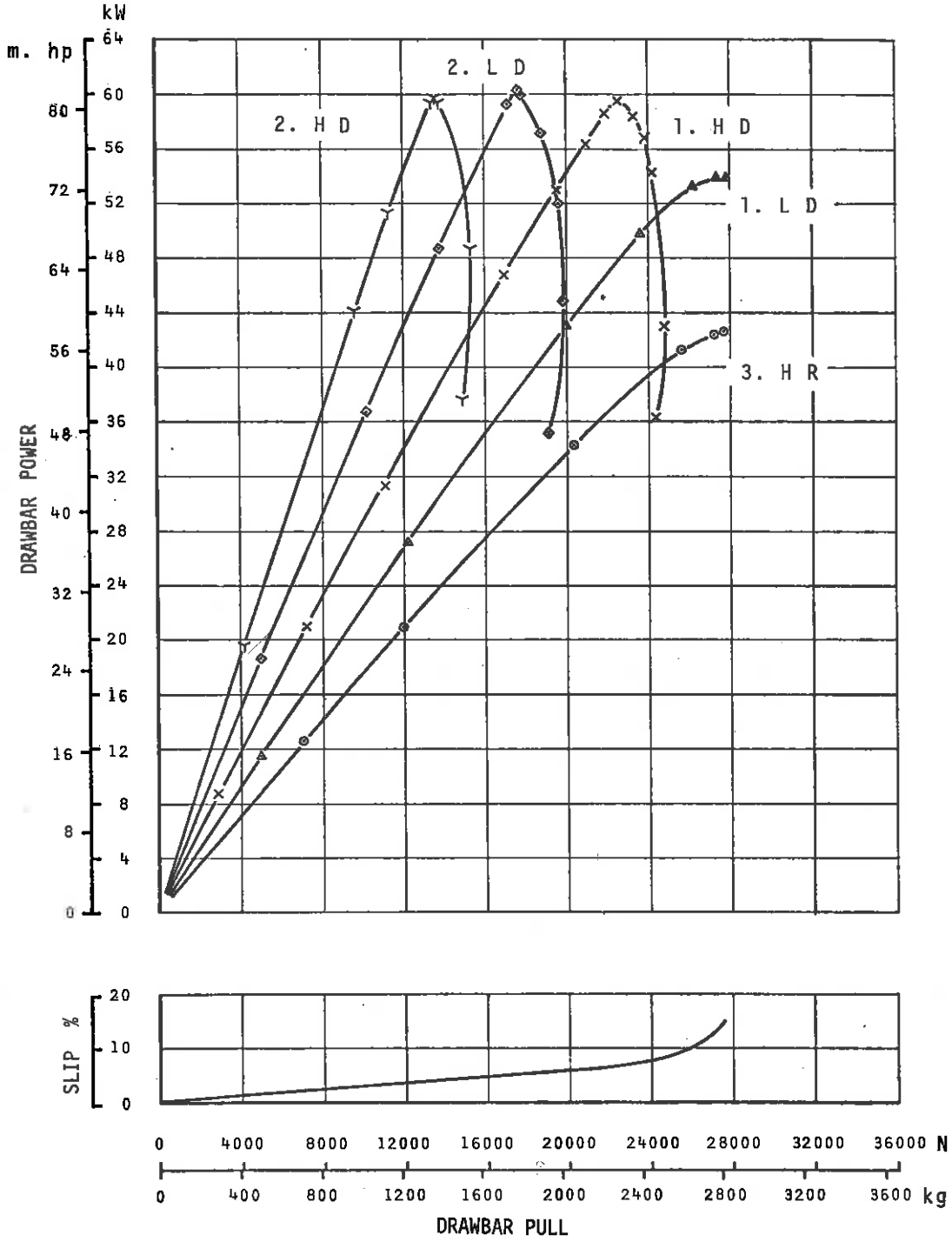


FIG. 5 - DRAWBAR TEST ON CONCRETE, WITHOUT BALLAST
(Massey Ferguson 1104 Diesel Tractor)

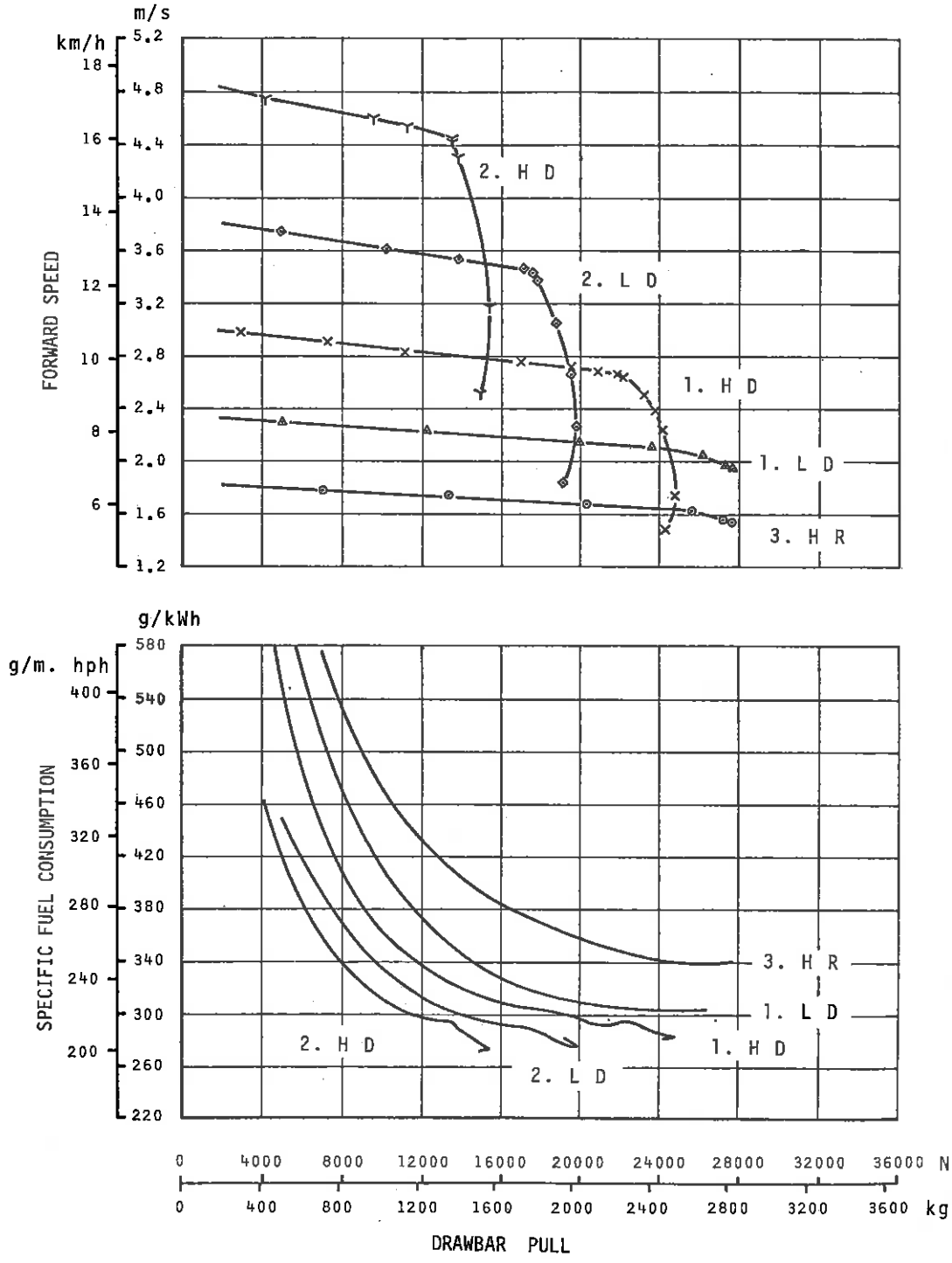


FIG. 6 - DRAWBAR TEST ON CONCRETE, WITHOUT BALLAST
(Massey Ferguson 1104 Diesel Tractor)

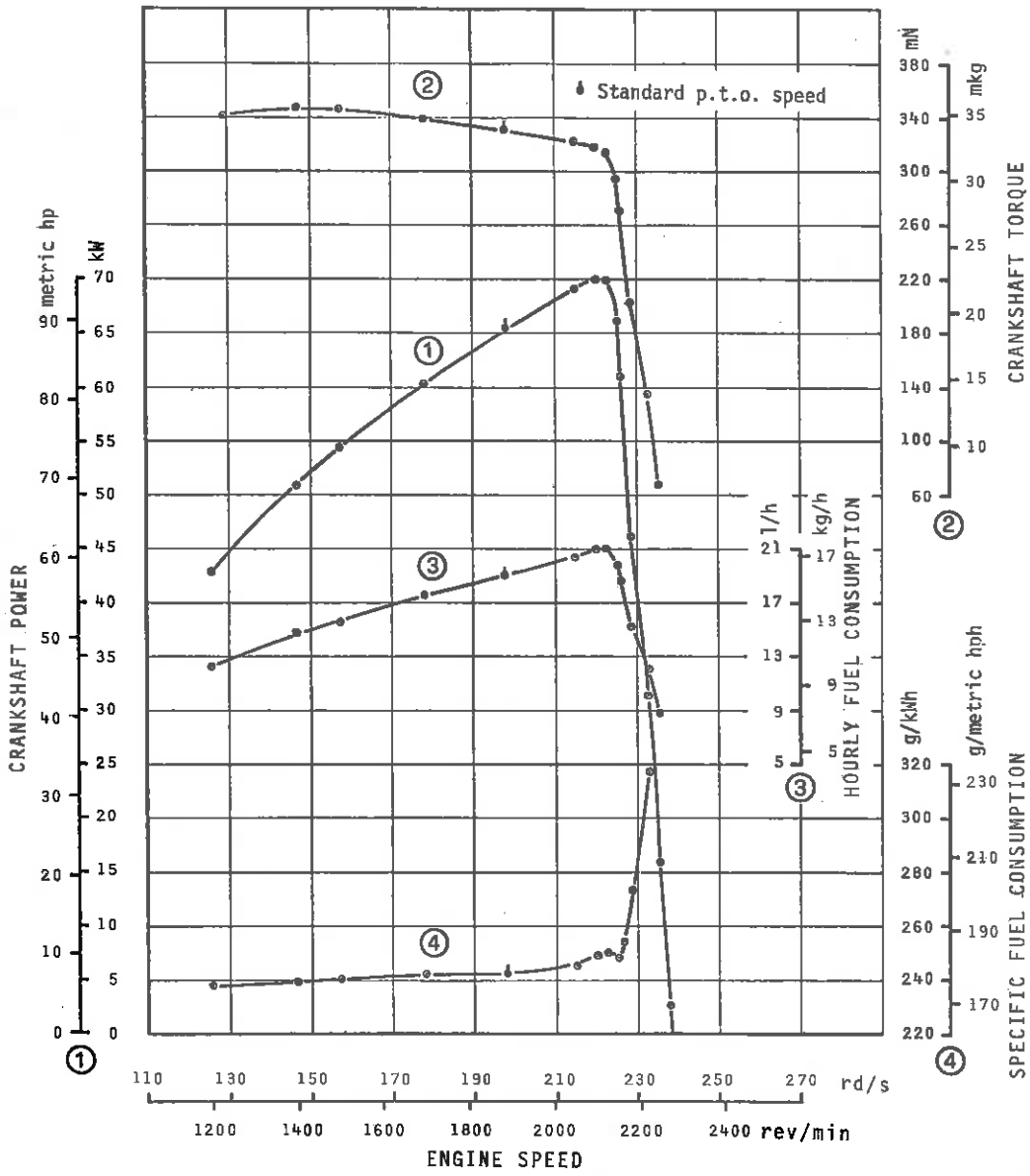


FIG. 7 - ENGINE TEST

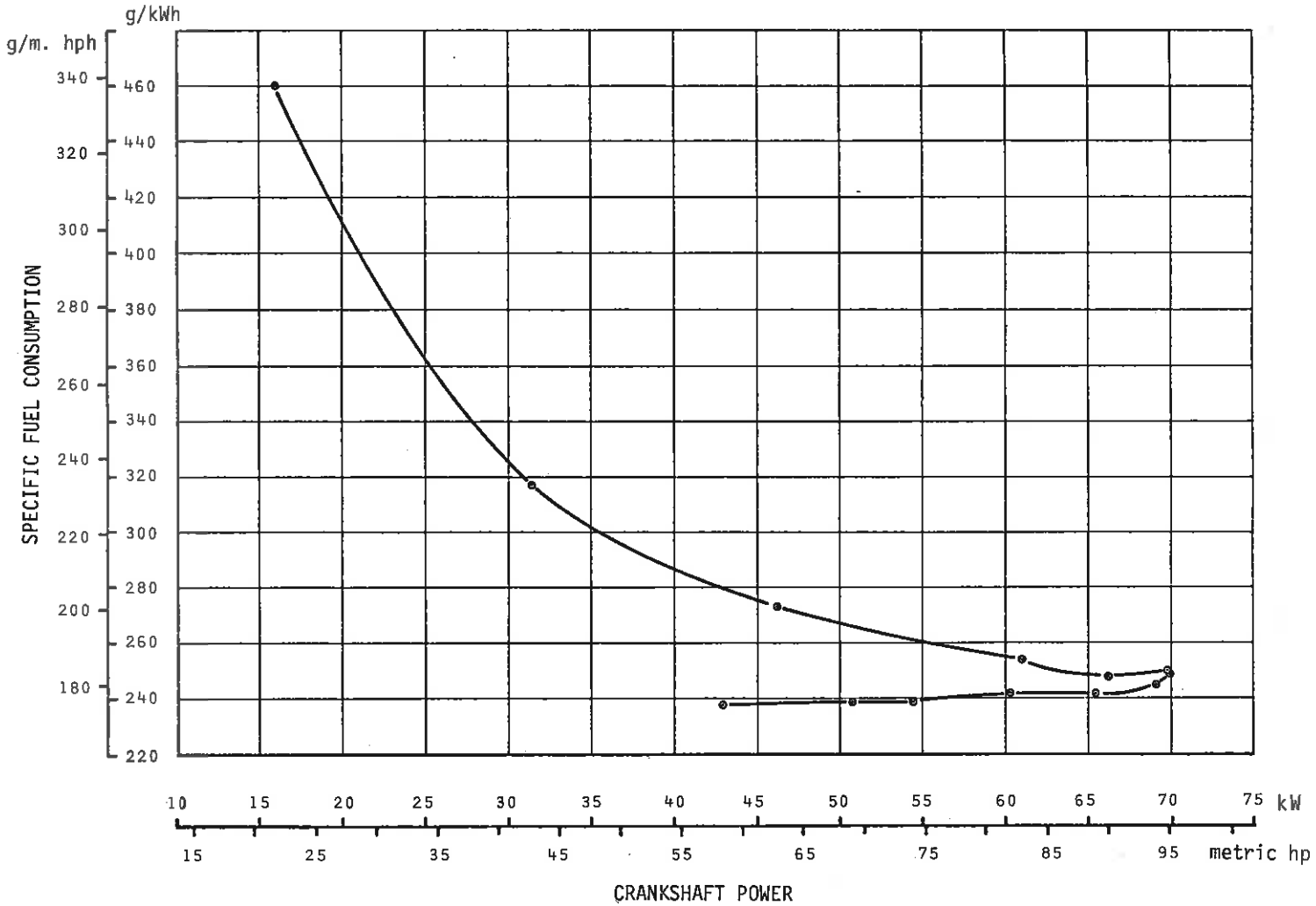


FIG. 8 - ENGINE TEST

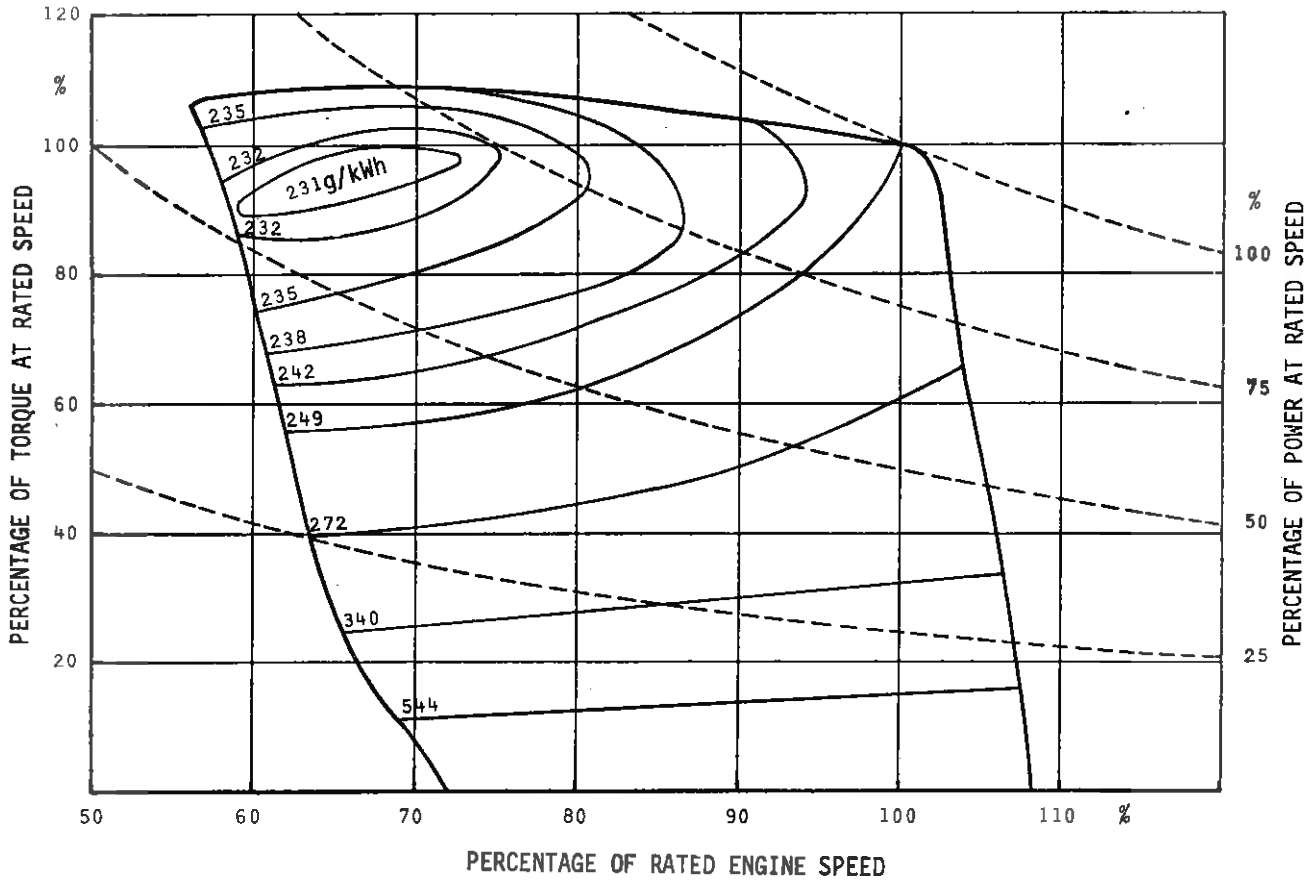


FIG. 9 - ENGINE TEST

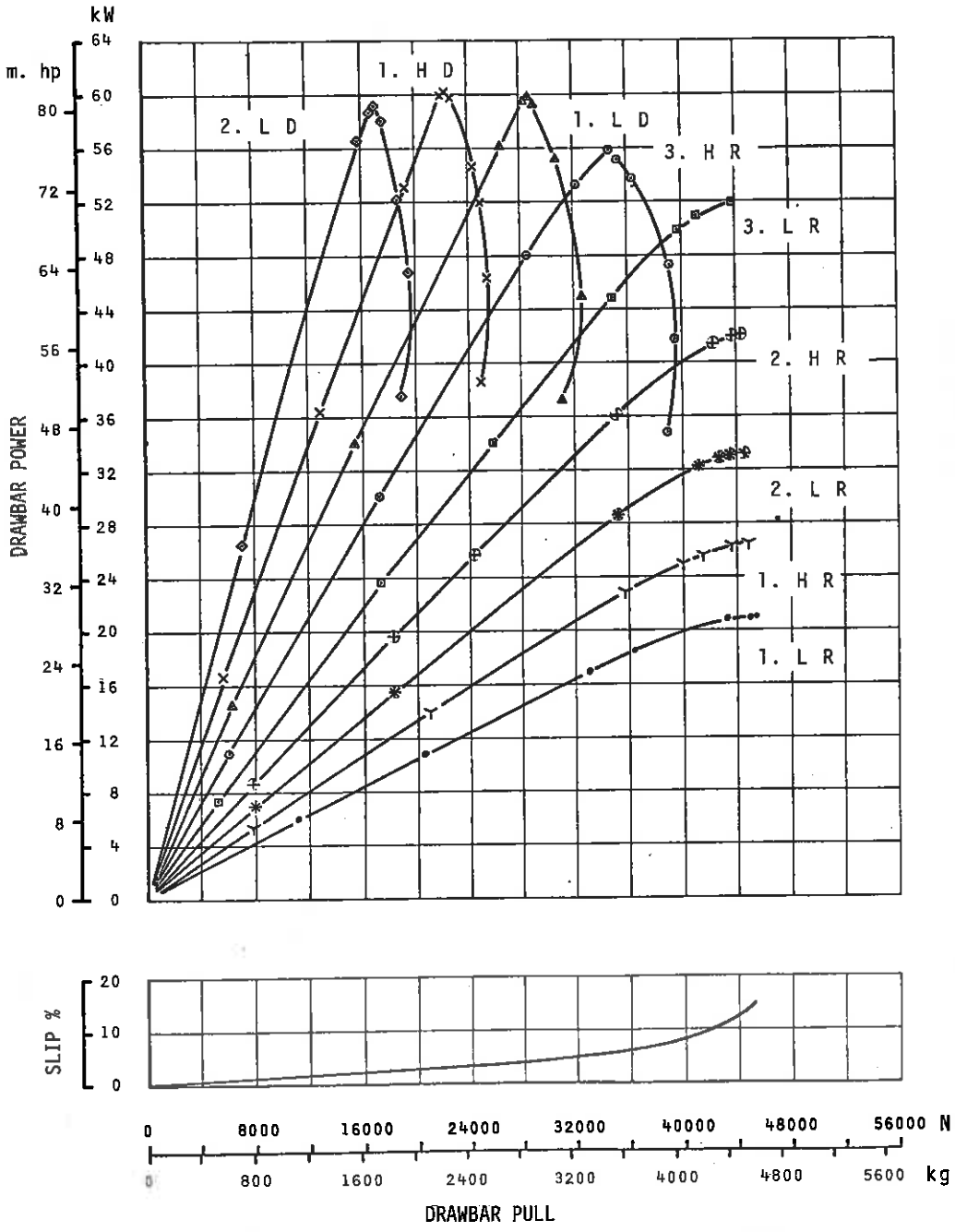


FIG. 10 - DRAWBAR TEST ON CONCRETE, WITH BALLAST
(Massey Ferguson 1104-4 Diesel Tractor)

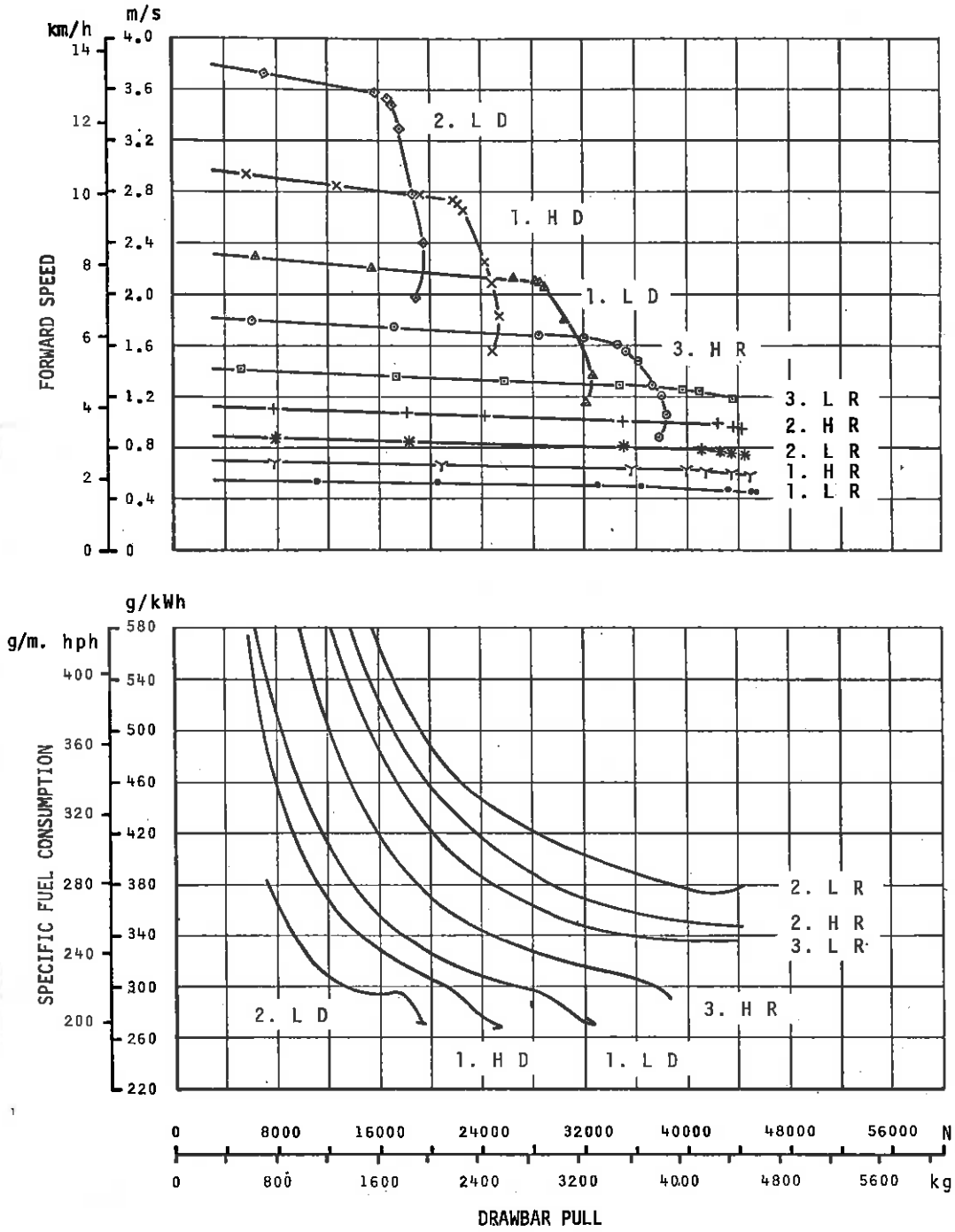


FIG. 11 - DRAWBAR TEST ON CONCRETE, WITH BALLAST
(Massey Ferguson 1104-4 Diesel Tractor)

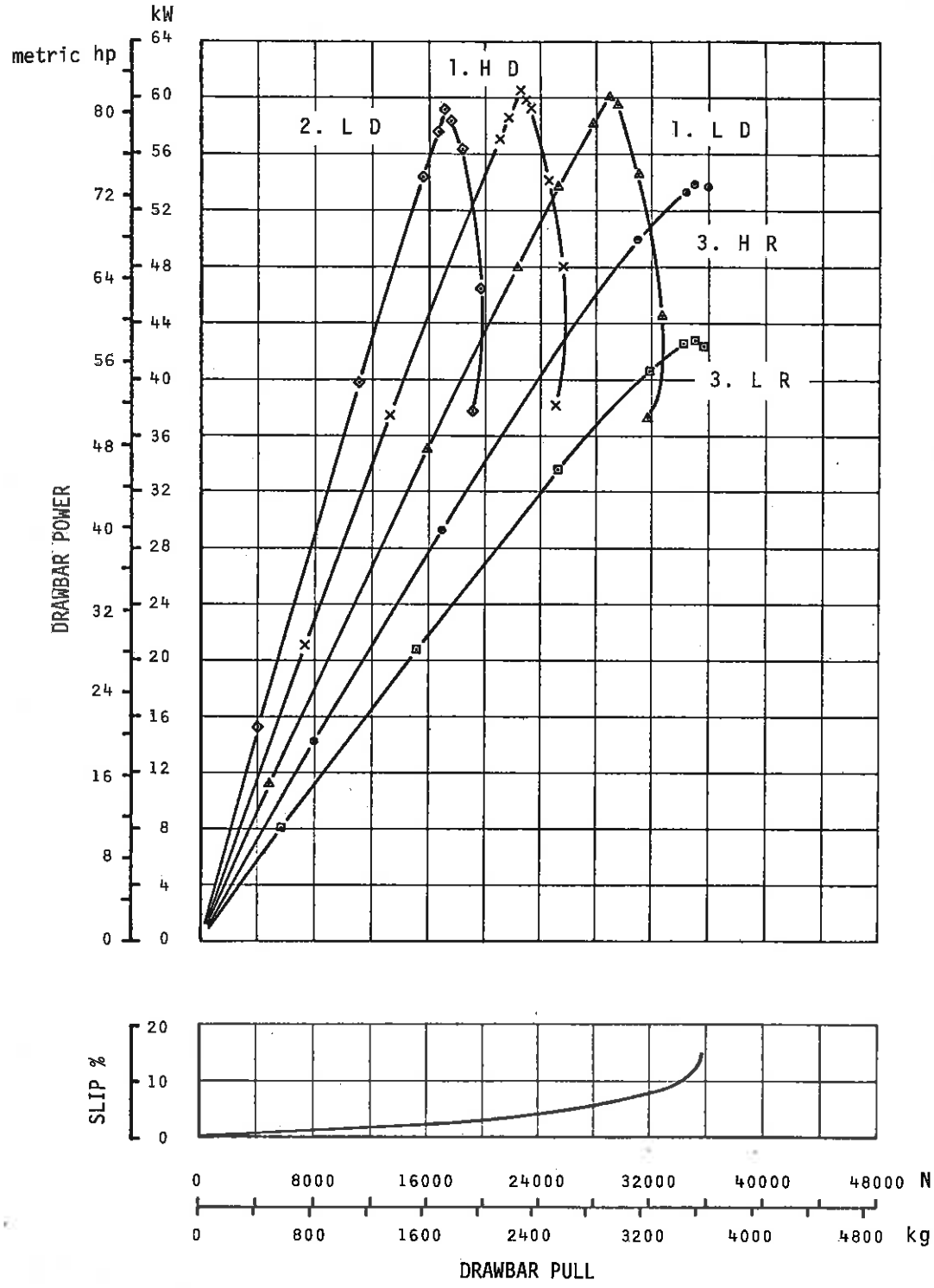


FIG. 12 - DRAWBAR TEST ON CONCRETE, WITHOUT BALLAST
(Massey Ferguson 1104-4 Diesel Tractor)

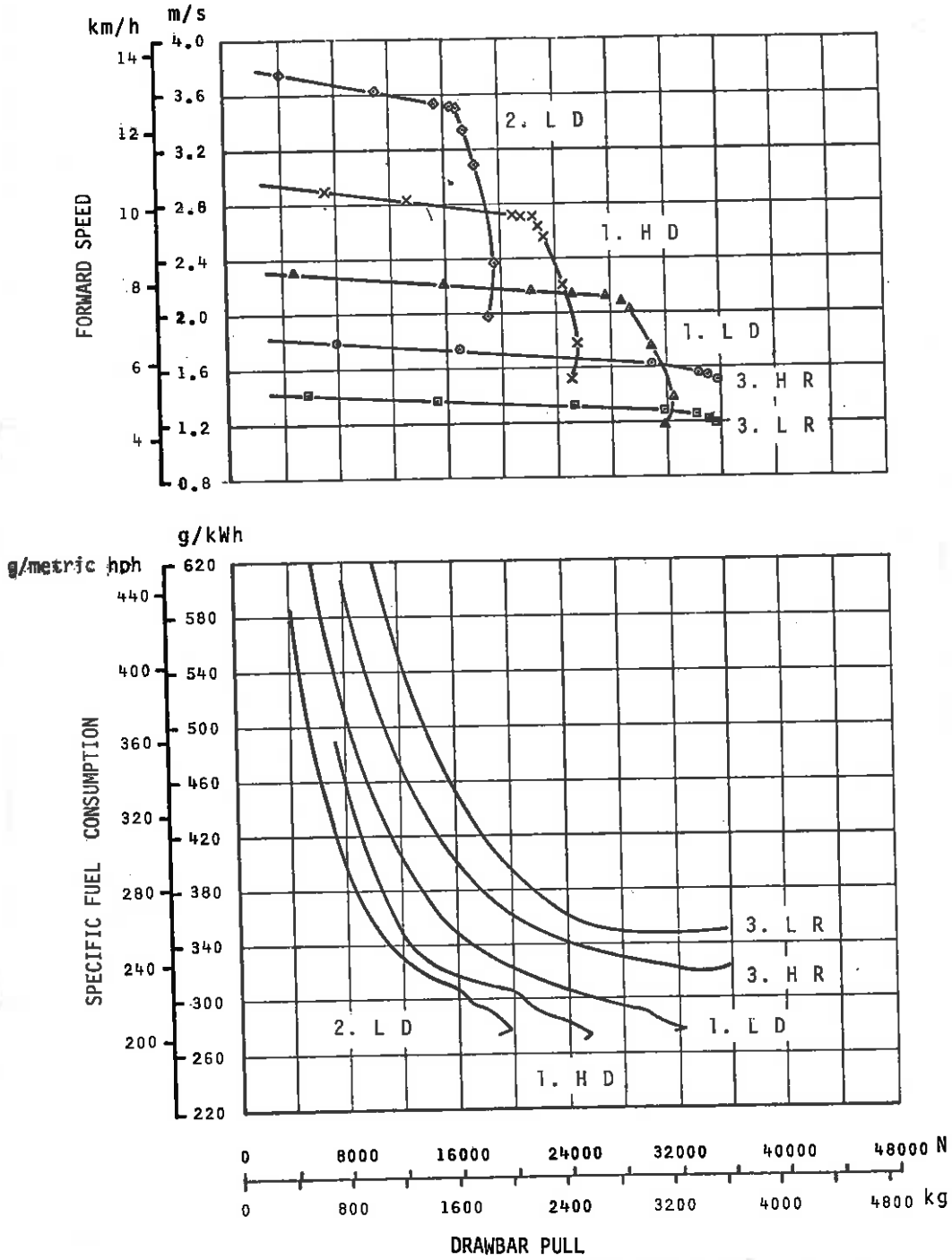


FIG. 13 - DRAWBAR TEST ON CONCRETE, WITHOUT BALLAST
(Massey Ferguson 1104-4 Diesel Tractor)