AFRC Institute of ENGINEERING RESEARCH

OECD Approval No. 1060
Restricted Code

Test in accordance with the OECD restricted standard code for the official testing of agricultural tractors

Report on test of Massey-Ferguson 375 Tractor with 8-speed Transmission



Manufacturered by	Massey-Ferguson Manufacturing Ltd., Banner Lane, Coventry, Warwickshire. CV4 9GF
Test No.	R87/70572/OECD
Report No.	710
Date	March 1987

THE BRITISH SOCIETY FOR RESEARCH IN AGRICULTURAL ENGINEERING

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Tractor manufacturer's name and address:	Massey-Ferguson Manufacturing Limited Banner Lane, Coventry, Warwickshire CV4 9GF
Submitted for test by:	The manufacturer
Selected for test by:	The manufacturer with the agreement of the testing station
Place of running in:	Coventry
Duration of running in:	60 hours

I. SPECIFICATION OF TRACTOR

TRACTOR

Make:	Massey-Ferguson
Trade name:	Massey-Ferguson
Model:	M-F 375 with 8-speed transmission
Type:	Four wheel, rear wheel driven, unit construction
Serial No:	5006U27081
1st Serial No:	5006U01001

ENGINE

Make:	Perkins
Model:	A4.236
Type	4-stroke, direct injection, naturally aspirated diesel
Serial No:	LD 31140U102629N
Cylinders	
Number/disposition:	4, vertical, in-line
Bore/stroke:	98.5 mm/127.0 mm
Capacity:	3871 cm^3
Compression ratio:	16:1
Arrangement of valves:	Overhead
Cylinder liners:	Dry

Fuel System	
Fuel feed system:	AC Delco mechanical feed pump.
Make, type and model of fuel filter(s):	C.A.V. paper element filter with transparent sediment bowl
Capacity of fuel tank:	108 l
Make, type and model of injection pump:	C.A.V., distributor, DPA3241F490
Serial No:	27341 FDG
Manufacturer's production setting of injection pump:	13.1-14.8 l/h at 2000 rev/min engine speed at full load and 40°C pump inlet temperature
Injection pump timing:	Delivery starts 23° before T.D.C., static
Make, type and model of injectors:	C.A.V. 4-hole, BDLL 150S6705
Injection pressure:	17.1 M Pa
Governor	
Make:	C.A.V.
Type:	Mechanical incorporated in injection pump
Governed range of engine speed:	750 to 2420 rev/min
Rated engine speed:	2200 rev/min
Air cleaner	
Pre-cleaner	
Make and type:	Nelson-Burgess, Visibowl, centrifugal
Location:	Above engine cover
Main	
Make and type:	Nelson-Burgess, oil bath
Oil capacity	1 l
Maintenance indicator:	None
Location:	Under engine cover
Lubrication system	
Type of feed pump:	Forced feed from eccentric rotor pump
Total oil capacity including filter(s):	7.5 l
Oil change period:	250 hours
Type of filter(s):	Full flow replaceable element canister
Number:	1
Filter change period:	250 hours
Recommended oil:	See "Fuels and lubricants used in tests"

Cooling system	
Type of coolant:	Water or water and anti-freeze solution
Specification of pump	
Type:	Centrifugal
Description of fan:	Belt driven, puller
Number of fan blades:	4
Fan diameter:	457 mm
Coolant capacity:	15.1 l
Type of temperature control:	Thermostat
Superpressure system:	69 kPa
Starting system	
Safety device:	Operable only when high/low gear selector is in neutral position
Starter motor	
Make:	Lucas
Type:	Electrical, pre-engaged, solenoid operated
Model and power rating:	M127, 12V, 2.8 kW
Cold starting aid:	Lucas C.A.V. Thermostart
Electrical system	
Voltage:	12
Generator:	Alternator
Make:	Lucas
Model:	A127
Type:	Belt driven
Power:	0.54 kW
Batteries	2, M.F. Powerpart, lead-acid
Rating:	420 A CCA rating each or equivalent 75 Ah at 20-hour rating
Exhaust system	
Make:	Nelson-Burgess
Type:	Spark arrester silencer
Model:	17AE10
Location:	Under engine cover with vertical stack pipe
Height of outlet above ground:	2440 mm

TRANSMISSION

Clutch	
Make:	Laycock
Type:	Dry, for transmission and pto
Number of plates:	2
Diameter of plates:	305 mm and 254 mm
Method of operation:	Mechanically by pedal
Gear box	
Make:	Massey-Ferguson
Type:	Mechanical, manual operation
Arrangement:	4 forward and 1 reverse speeds with high/low range selector
Number of speeds:	8 forward, 2 reverse
Available options:	8 and 12 speed synchromesh and 12 speed multi-power
Rear axle and final drives	
Make:	Massey-Ferguson
Type:	Crown wheel and pinion, with outboard epicyclic reduction gears
Differential lock	
Type:	Mechanical
Method of engagement:	Pedal operated
Method of disengagement:	Automatic
Transmission oils	
Gear box, transmission, final drives and power lift housing:	
Capacity	49.8 l
Change period:	1000 hours
Recommended oil:	See "Fuels and lubricants used in tests"

Gear	Group No.	Number of engine revolutions for one revolution of the driving wheels	Nomimal travelling speed at rated engine speed: 2200 rev/min km/h
Forward			
1	L	227.64	2.62
2	L	155.21	3.85
3	L	113.63	5.26
4	L	84.66	7.05
1	H	55.64	10.73
2	H	37.94	15.74
3	H	27.78	21.50
4	H	20.69	28.86
Reverse			
R	L	167.15	3.57
R	H	40.86	14.61

L = Low range H = High range

Rear tyre size: 18.4-30

Tyre radius index: 720 mm

POWER TAKE-OFF

Main power take-off

Type: Independent, mechanically operated, through second plate in main clutch

Method of engagement: By hand lever

Number of shafts: 1

Power take-off proportional to engine speed

Location:	At rear of tractor
Diameter of power take-off shaft:	34.9 mm
Number of splines:	6 to ISO standard
Tyre sizes, Front, Rear:	7.50-16, 18.4-30
Height above ground:	592 mm
Distance from the median plane of the tractor:	Central
Distance behind rear axle:	296 mm
Pto speed at rated engine speed:	664 rev/min
Engine speed at standard power take-off speed (540 rev/min):	1789 rev/min
Engine to pto ratio:	3.3125:1
Power restriction:	I.S.O. recommendation, 48 kW
Direction of rotation (viewed facing driving end):	Clockwise

Power take-off proportional to ground speed

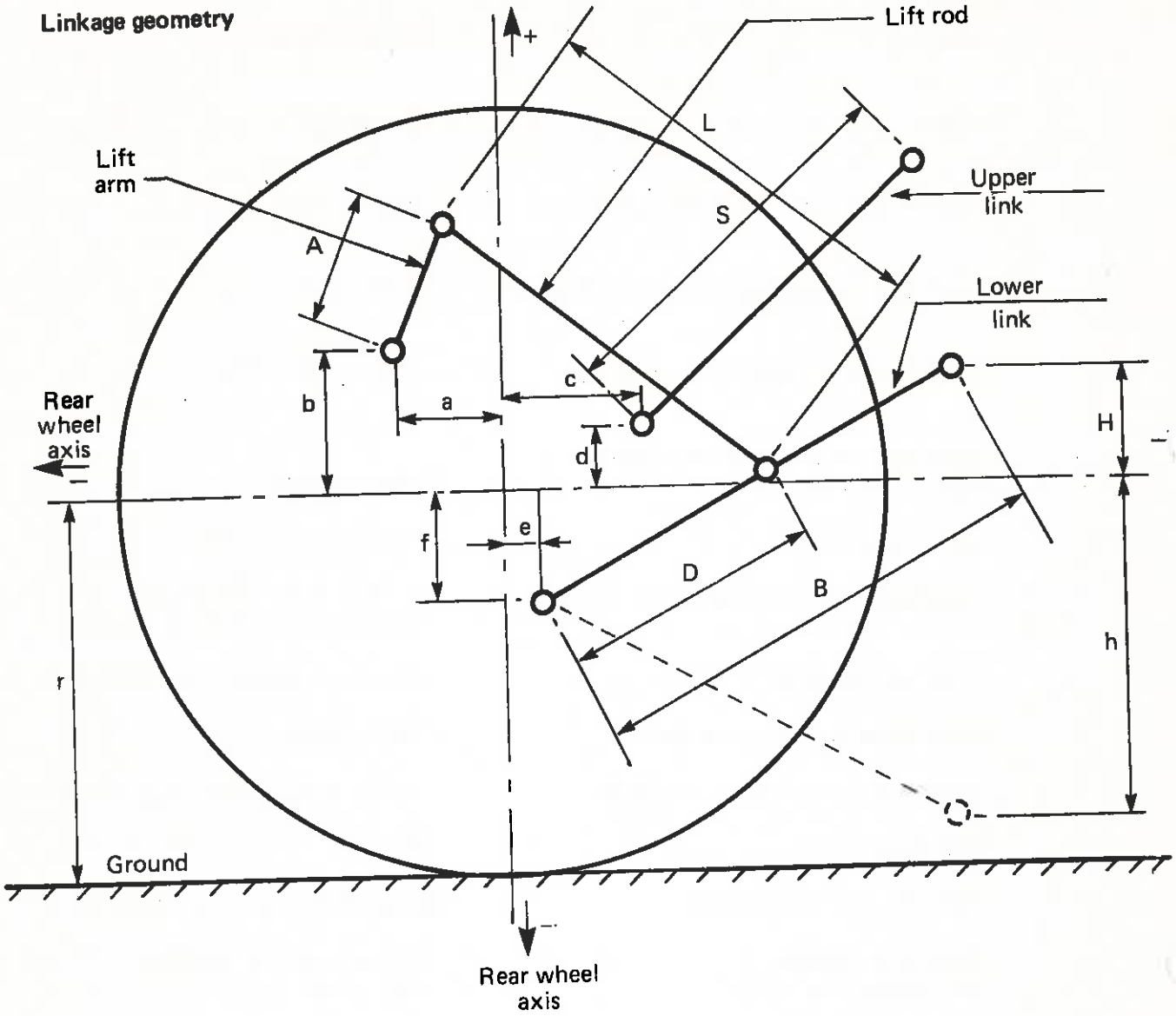
Speed of shaft:	540 rev/min
Size of tyre:	18.4-30
Travelling distance for one revolution of power take-off shaft:	327 mm
Number of pto shaft revolutions for one revolution rear wheels:	13.8
Direction of rotation with forward gear engaged:	Clockwise

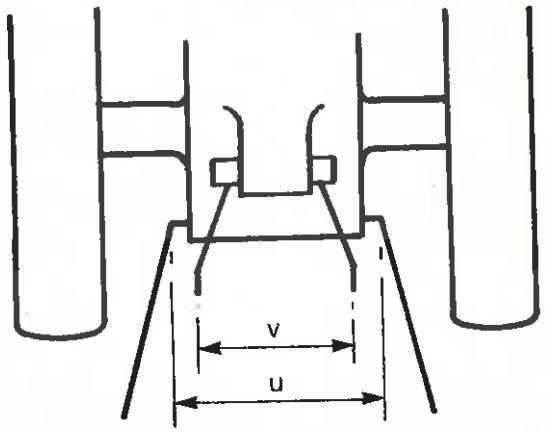
POWER LIFT

Make:	Massey-Ferguson
Type:	Hydraulic
Number and type of cylinders:	One, single acting,
Type of linkage lock for transport:	Hydraulic
Relief valve pressure setting:	20.5 - 24.0 MPa
Opening pressure of cylinder safety valve:	None fitted
Lift pump type:	4-cylinder piston
Transmission between pump and engine:	Driven from pto shaft, independent of main clutch
Make and number of filters:	Own make metal mesh strainer
Time between oil changes:	1000 hours
Time between filter changes:	Clean mesh every 1000 hours
Oil capacity:	47.4 l
Site of oil reservoir:	Main transmission housing
Type and number of tapping points:	One on centre housing top cover
Maximum volume of oil available to external cylinders:	18 l
Recommended oil	See "Fuels and lubricants used in tests"

THREE-POINT LINKAGE

Category:	1 or 2 to ISO standard
Category adapter:	Replacement ball ends
Controls	Draught or position control, top link sensing


Linkage geometry
+
Lift rod
L
Lift arm
A
S
Upper link
Lower link
Rear wheel axis
b
a
c
d
H
e
f
D
B
h
r
Ground
Rear wheel axis


v
u

Linkage dimensions for the lifting test

			Compulsory test	Supplementary test
Rear tyres: (size 18.4-30) radius index:		(r)	720 mm	720 mm
Front tyres:(size 7.50-16) loaded radius:		(r')	360 mm	360 mm
Length of lift arms:		(A)	267 mm	267 mm
Length of lower links:		(B)	975 mm	975 mm
Distance of lift arm pivot point from rear wheel centre line:	horizontally:	(a)	196 mm	196 mm
	vertically:	(b)	233 mm	233 mm
Horizontal distance between the two lower link points:		(u)	492 mm	492 mm
Horizontal distance between the two lift arm end points:		(v)	534 mm	534 mm
Length of upper link:		(S)	763 mm	763 mm
Distance of upper link pivot point from rear wheel centre line	horizontally:	(c)	186 mm	186 mm
	vertically:	(d)	205 mm	205 mm
Distance of lower link pivot point from rear wheel centre	horizontally:	(e)	32 mm forward	32 mm forward
	vertically:	(f)	212 mm	212 mm
Distance of lower link points to lift rod pivot points on lower link:		(D)	427 mm	427 mm
Length of lift rods:		(L)	640 mm	620 mm
Height of lower hitch points relative to the rear wheel centre line, situated 720 mm above the ground level				
- in low position:		(h)	520 mm	460 mm
- in high position:		(H)	244 mm	273 mm
Height of lower hitch points when locked in transport position:			Any height within lift range	

SWINGING DRAWBAR

Tyre sizes	Front:	7.50-16
	Rear:	18.4-30
Height above ground,	maximum:	523 mm
	minimum:	369 mm
Type of adjustment:		Inverting drawbar and clevis
Distance of hitch point from rear axle centre:		537 mm and 652 mm
Distance of hitch point from power take-off shaft ends:		
vertically:		69 mm to 223 mm
horizontally:		241 mm and 356 mm
Lateral adjustment:		210 mm and 390 mm
Distance of pivot point from rear axles horizontally:		130 mm forward
Diameter drawbar pin hole:		25.4 mm

FRONT TOWING HITCH

Vertical height to centre of clevis:	705 mm
Width of clevis:	63 mm
Diameter of pin hole:	33 mm

STEERING

Method of operation:	Hydrostatic system with hand operated steering motor powered by engine mounted pump operating a ram integral with track rod
Pump:	Bendix Hydralquip, gear type with integral oil reservoir
Motor:	Danfoss OSPC-ON
Ram	Massey-Ferguson double acting, integral with track rod
Working pressure:	17 MPa
Oil capacity:	1.2 l
Oil change period:	Top up only
Make and model of filter:	Bendix paper element integral with reservoir
Filter(s) change period:	None
Recommended oil:	See "Fuels and lubricants used in tests"

BRAKES

Service brake

Make:	Girling
Type:	Oil immersed multi-plate discs, 4 per side
Method of operation:	Independent or combined pedal, hydraulic actuation
Trailer braking take-off:	None fitted

Parking brake

Type:	Mechanical by cable connected to both service brakes
Method of operation:	Hand lever with ratchet

STEERING WHEELS

Number:	2
Location:	At front
Tyres:	Goodyear Super Rib Tractor
Size:	7.50-16
Ply rating:	6
Type of casing:	Cross-ply
Maximum permissible load on each tyre:	745 kg
Corresponding inflation pressure:	280 kPa
Track widths:	1278 mm to 1890 mm
Method of adjustment:	Extending axle

DRIVING WHEELS

Number:	2
Location:	At rear
Tyres:	Goodyear Traction Suregrip
Size:	18.4-30
Ply rating:	6
Type of casing:	Crossply
Maximum permissible load on each tyre:	2120 kg
Corresponding inflation pressure:	110 kPa
Track widths:	1523 mm by 102 mm steps to 2135 mm
Method of adjustment:	Reversing wheels and offset lug rims

WHEELBASE 2286 mm

DRIVER'S SEAT

Make:	Grammer DS44
Type of suspension:	Spring
Type of damping:	Hydraulic
Range of adjustment, longitudinal:	150 mm
vertical:	60 mm

LIGHTING

Unrestricted beam angle of head light in plan view 110°
Tyres: front 7.50-16: rear 18.4-30

	Height above ground of centre, mm	Size, mm	Distance from outside edge of tractor to centre, at 1523 mm track width, mm
Headlights,	1178	100 x 160	858
Sidelights,	1519	110 x 35	256
Rear lights,	1566	73 x 50	469
Mudguard reflectors,	1566	46 x 46	410
Rear axle reflectors	677	80 dia	533

CONDITIONS DURING TEST

Overall dimensions

(front: 7.50-16 rear: 18.4-30 tyres fitted)

Length, m	Width, min. m	Width, max. m	Height at top of, exhaust silencer, m	Height at top of, steering wheel, m
3.83	2.00	2.61	2.44	1.75

Ground clearance

Clearance: 311 mm limited by drawbar clevis in lowest position

Track setting

Front: 1380 mm
Rear: 1523 mm

Tractor mass

(without driver but with tanks full)

Front, kg	Rear, kg	Total, kg
1137	1480	2617

Fuel and lubricants used in tests

Fuel

Type: Diesel oil to Class D British Standard 2869:1970 specific gravity 0.8386 at 15°C, Cetane index 53.5

Oils	Recommended	Used during test
Engine		
Type:	SAE 15W/30	
Viscosity:	54cSt at 50°C	As recommended
Classification:	MIL-L-2104-C	
Transmission, final drives, and hydraulics		
Type:	SAE 15W/30	
Viscosity:	54 cSt at 50°C	As recommended
Classification:	MIL-L-2104-C	
Steering		
Type:	SAE 10W	
Viscosity:	18.5 cSt at 50°C	As recommended
Classification:		
Hydraulic brakes		
Type:	Mineral	
Viscosity:	7.2 cSt at 50°C	As recommended
Classification::	M-F CMS 1151A	
Recommended grease:	Consistency 2 lithium	As recommended
Number of lubrication points:	13	

II. TEST RESULTS

A. COMPULSORY TESTS

1. MAIN POWER TAKE-OFF PERFORMANCE

Date of tests: 10th December 1986,

Type of dynamometer: Water brake, Heenan & Froude

Power, kW	Speed, rev/min		Fuel consumption, Hourly, l/h	Hourly, kg/h	Specific, kg/kWh	Specific energy, kWh/l
	Engine	P.t.o.				
MAXIMUM POWER - 2 HOUR TEST						
50.9	2200	664	15.43	12.94	0.254	3.30
POWER AT RATED ENGINE SPEED						
50.9	2200	664	15.43	12.94	0.254	3.30
POWER AT STANDARD POWER TAKE-OFF SPEED						
46.3	1789	540	13.26	11.12	0.240	3.49
PART LOADS						
(1) The torque corresponding to maximum power at rated engine speed						
50.9	2200	664	15.43	12.94	0.254	3.30
(2) 85% of the torque obtained in (1)						
44.0	2236	675	13.73	11.51	0.262	3.20
(3) 75% of the torque defined in (2)						
33.2	2256	681	11.22	9.41	0.283	2.96
(4) 50% of the torque defined in (2)						
22.2	2262	683	9.03	7.57	0.341	2.46
(5) 25% of the torque defined in (2)						
11.2	2292	692	6.80	5.70	0.509	1.65
(6) Unloaded						
0	2339	706	4.98	4.18	-	-

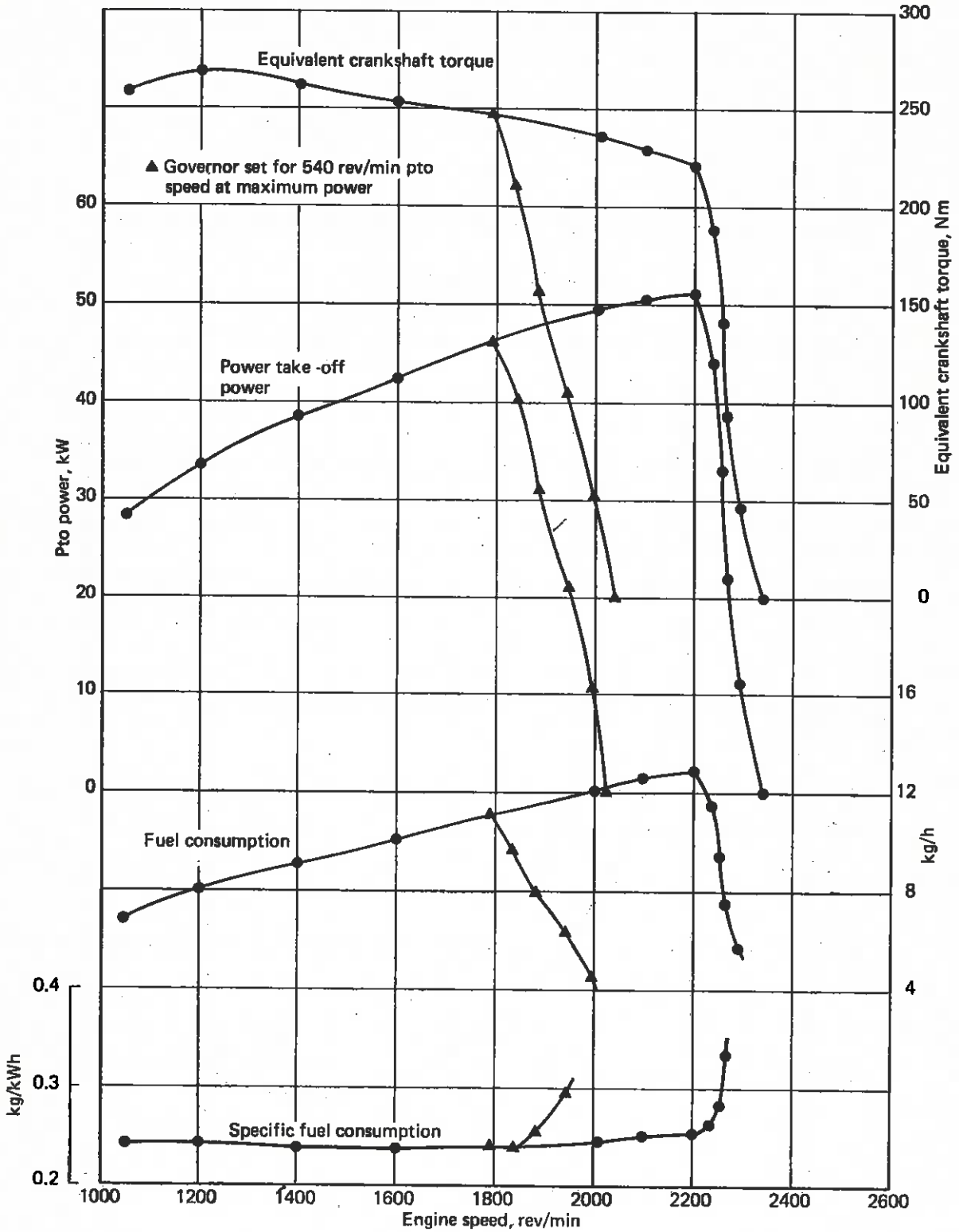
Part loads, the governor hand lever in the position corresponding to the standard p.t.o. speed at full load (540 rev/min).

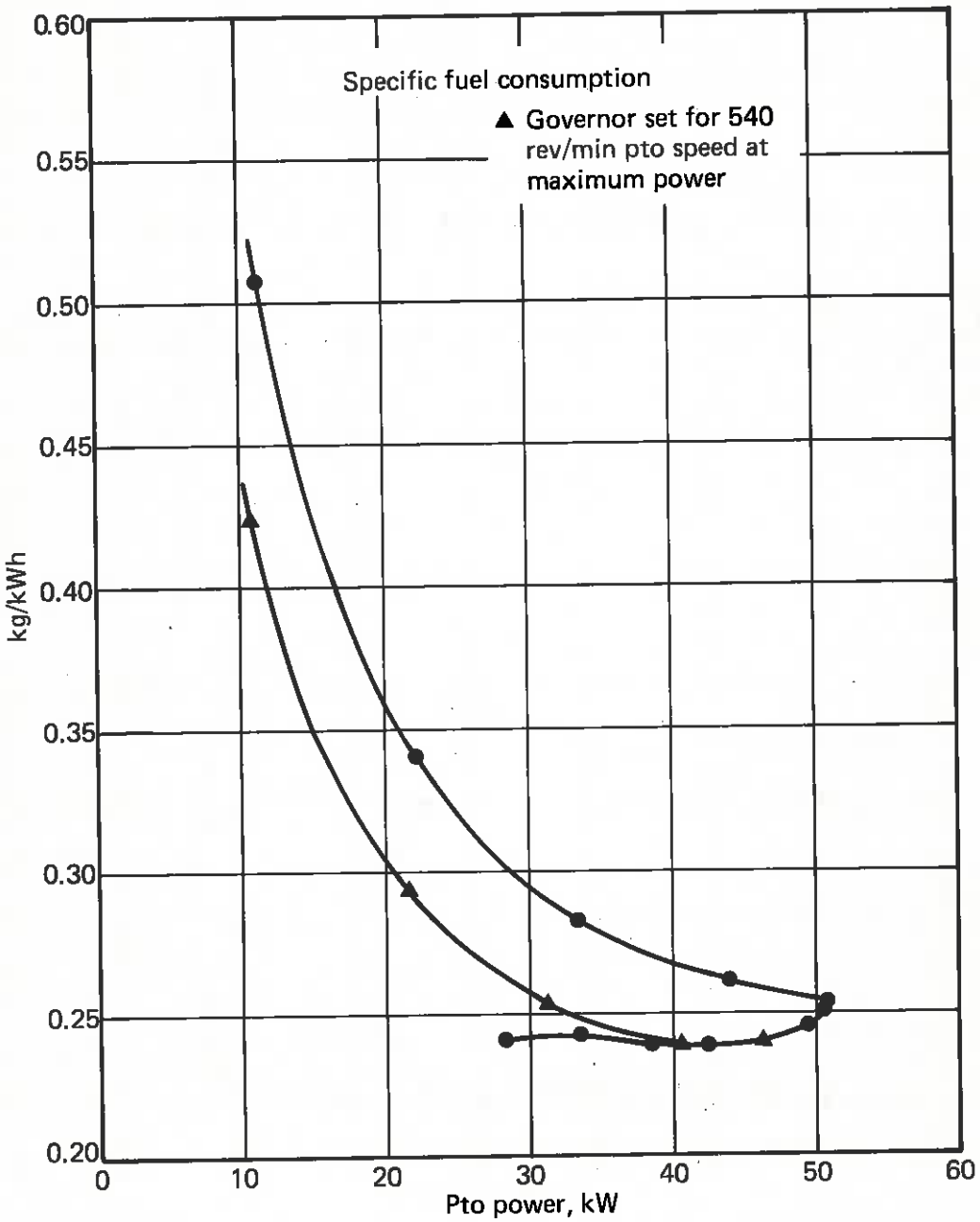
Power, kW	Speed, rev/min		Fuel consumption, Hourly, l/h	Hourly, kg/h	Specific, kg/kWh	Specific energy, kWh/l
	Engine	P.t.o.				
(1) The torque corresponding to maximum power at standard pto speed						
46.3	1789	540	13.26	11.12	0.240	3.49
(2) 85% of the torque obtained at maximum power						
40.4	1835	554	11.52	9.66	0.239	3.51
(3) 75% of the torque defined in (2)						
31.1	1882	568	9.43	7.91	0.254	3.30
(4) 50% of the torque defined in (2)						
21.4	1941	586	7.48	6.27	0.293	2.86
(5) 25% of the torque defined in (2)						
10.9	1994	602	5.51	4.62	0.424	1.98
(6) Unloaded						
0	2021	610	3.55	2.98	-	-

Standard specific fuel consumption, kg/kWh

(a) 0.262 (c) 0.239
(b) 0.341 (d) 0.293

No load, maximum engine speed		2339 rev/min
Equivalent crankshaft torque at maximum power		221.2 Nm
Maximum equivalent crankshaft torque		268.5 Nm at 1240 rev/min engine speed
Mean atmospheric conditions	temperature	20°C
	pressure	1028 m bar
	relative humidity	37%
Maximum temperature	coolant	80°C
	engine oil	108°C
	fuel	46°C
	air intake	20°C


Equivalent crankshaft torque
▲ Governor set for 540 rev/min pto speed at maximum power
Power take -off power
Fuel consumption
Specific fuel consumption
Pto power, kW
Equivalent crankshaft torque, Nm
kg/h
kg/kWh
Engine speed, rev/min
60
50
40
30
20
10
0
300
250
200
150
100
50
0
16
12
8
4
0.4
0.3
0.2
1000
1200
1400
1600
1800
2000
2200
2400
2600



Power take-off test

2. LIFTING FORCE AND HYDRAULIC POWER

Date of tests: 5th January 1987

Hydraulic fluid

Make and type: SAE 15W/30
Viscosity: 54 cSt at 50°C

Type of hydraulic system: Piston type pump delivering oil from main transmission housing

Hydraulic fluid temperature at beginning of test: 60°C

Power lift test

	Height of lower hitch point above ground in down position, mm	Vertical movement, mm	Maximum force exerted through full range, kN	Corresponding pressure of hydraulic fluid, MPa	Moment about rear axle, kNm	Maximum tilt angle of mast over range of lift, degrees
At the hitch point	200	764	16.8	20.8	15.8	-
On the frame	200	911	15.6	20.8	24.2	14

Main linkage dimensions - see drawings and table on pages 8 and 9

Lifting heights relative to the horizontal plane including the lower link pivot points

mm	-325	-285	-150	-75	0	150	300	427	530

Lifting forces at hitch points
(corresponding pressure 20.8 MPa)

kN	-	16.8	17.8	18.9	20.2	21.9	23.2	24.8	-

Lifting forces at test frame
(corresponding pressure 20.8 MPa)

kN	15.6	15.7	16.6	17.0	17.3	17.5	17.3	16.8	16.6

Hydraulic power test

Sustained pressure with relief valve open 23.1 MPa

Pump delivery rate at minimum pressure 20.4 l/min

Flow rate corresponding to a hydraulic pressure equivalent to 90 per cent of the actual relief valve pressure setting and corresponding hydraulic power

Flow rate	18.7 l/min
Pressure	20.8 MPa
Power	6.5 kW

Flow rate and hydraulic pressure corresponding to maximum hydraulic power

Flow rate	18.5 l/min
Pressure	21.2 MPa
Power	6.5 kW

Tapping point used for test: Auxiliary service connection

Temperature of hydraulic fluid, if different from $65^{\circ} \pm 5^{\circ}C$ Not applicable

Opening pressure of the unloading valve Not applicable

Closing pressure of the unloading valve Not applicable

3. MAXIMUM DRAWBAR POWER, TRANSMISSION AND FUEL CONSUMPTION CHARACTERISTICS

Date of tests: 11th February 1987
Type of track: Concrete
Height of drawbar above ground: 490 mm
Tyre size and pressure:
Front: 7.50-16 179 kPa
Rear: 18.4-30 83 kPa

Gear	Speed, km/h	Power, kW	Drawbar pull, kN	Engine speed, rev/min	Wheel-slip, %	Specific fuel consumption, kg/kWh	kWh/l	Temperature, °C: Fuel	Coolant	Engine oil	Atmospheric conditions: Temperature, °C	Relative humidity, %	Pressure, m bar
(1) MAXIMUM DRAWBAR POWER IN GEARS													
L3*	4.58	26.0	20.4	2253	14.0	0.361	2.31	33	77	94	7	66	992
L4*	6.27	34.5	19.8	2228	12.3	0.332	2.51	39	78	95	6	69	992
H1	9.95	43.1	15.6	2200	5.5	0.311	2.68	38	77	91	4	83	992
H2	14.92	43.5	10.5	2200	3.5	0.312	2.67	40	79	91	6	67	992
(2a) TRANSMISSION AND FUEL CONSUMPTION CHARACTERISTICS													
(i) SELECTED GEAR (Speed closest to 7.5 km/h)													
H1	9.95	43.1	15.6	2200	5.5	0.311	2.68	38	77	91	4	83	992
(ii) 75% OF PULL AT MAXIMUM POWER													
H1	10.35	33.4	11.6	2242	3.9	0.319	2.62	34	77	93	4	81	992
(iii) 50% OF PULL AT MAXIMUM POWER													
H1	10.63	23.2	7.8	2267	2.8	0.360	2.32	34	77	93	4	82	992
HIGHEST GEAR SAME PULL AS IN (ii) REDUCED ENGINE SPEED													
H2	10.32	33.6	11.7	1532	4.0	0.290	2.87	39	79	86	5	82	995
HIGHEST GEAR SAME PULL AS IN (iii) REDUCED ENGINE SPEED													
H2	10.63	23.2	7.8	1545	2.8	0.284	2.93	38	77	90	6	69	992
(2b) TRANSMISSION AND FUEL CONSUMPTION CHARACTERISTICS													
(i) +SELECTED GEAR (Maximum power)													
H2	14.92	43.5	10.5	2200	3.5	0.312	2.67	40	79	91	6	67	992
(ii) 75% OF PULL AT MAXIMUM POWER													
H2	15.43	33.9	7.9	2241	2.8	0.319	2.61	37	78	96	5	79	992
(iii) 50% OF PULL AT MAXIMUM POWER													
H2	15.79	22.4	5.1	2268	1.8	0.377	2.21	36	78	96	5	78	992
HIGHEST GEAR SAME PULL AS IN (ii) REDUCED ENGINE SPEED													
H3	15.43	33.4	7.8	1644	2.8	0.281	2.97	40	78	85	5	69	992
HIGHEST GEAR SAME PULL AS IN (iii) REDUCED ENGINE SPEED													
H3	15.80	22.8	5.2	1667	1.8	0.301	2.77	37	77	85	5	68	992

*Maximum power limited by slip
+Highest gear measurable within equipment safety limits

B. SUPPLEMENTARY TESTS

Linkage set in accordance with the manufacturers recommendations for general use, length of lift rods 620 mm.

Date of tests: 7th-8th January 1987

Hydraulic fluid

Make and type: SAE 15w/30
Viscosity: 54 cSt at 50°C

Type of hydraulic system: Piston type pump delivering oil from main transmission housing

Hydraulic fluid temperature at beginning of test: 60°C

Power lift test

	Height of lower hitch point above ground in down position, mm	Vertical movement, mm	Maximum force exerted through full range, kN	Corresponding pressure of hydraulic fluid, MPa	Moment about rear axle, kNm	Maximum tilt angle of mast over range of lift, degrees
At the hitch point	260	733	17.1	20.8	16.1	-
On the frame	260	903	16.2	20.8	25.2	16

Main linkage dimensions - see drawings and table on pages 8 and 9

Lifting heights relative to the horizontal plane including the lower link pivot points

mm	-260	-225	-130	-60	0	120	275	425	588

Lifting forces at hitch points (corresponding pressure 20.8 MPa

kN	-	17.1	18.0	19.2	20.1	21.5	22.7	24.7	-

Lifting forces at test frame (corresponding pressure 20.8 MPa

kN	16.2	16.3	16.7	17.1	17.3	17.2	16.8	16.2	15.2

REPAIRS AND ADJUSTMENTS DURING TESTS: None

REMARKS: None

Test carried out at AFRC Engineering by: P.C. Seward, M. Osborne

Officer in charge: P.C. Seward

Signed: D.W. Scott Head of Testing Group

R.M. Stayner for the Director

Date: 13th April 1987.