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OECD Approval No. 1105 Restricted Code

Date of approval: 4th December 1987

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

Massey-Ferguson 399 Two-wheel Drive Tractor with 12-speed Synchromesh Transmission



Manufacturered by	Massey-Ferguson Manufacturing Limited, Banner Lane, Coventry, Warwickshire CV4 9GF.
Test No.	R87/70575/OECD
Report No.	716
Date	September 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 399 with 12-speed synchromesh transmission
Type:	Four wheel, rear wheel driven, unit construction
Serial No:	5012U01017
1st Serial No:	5012U01001

ENGINE

Make:	Perkins
Model:	A6.3544
Type	4-stroke, direct injection, naturally aspirated diesel
Serial No:	TW 31159U756 259M
Cylinders	
Number/disposition:	6, vertical, in-line
Bore/stroke:	98.5 mm/127.0 mm
Capacity:	5806 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. twin paper element filters with transparent sediment bowls
Capacity of fuel tank:	126 l
Make, type and model of injection pump:	C.A.V., distributor, DPA3363F340
Serial No:	16849 KCG
Manufacturer's production setting of injection pump:	20.3-22.0 l/h at 2200 rev/min engine speed at full load and 50°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, LRB 6701413
Injection pressure:	22.3 MPa
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
Location	Under engine cover
Oil capacity	1 l
Maintenance indicator:	None
Lubrication system	
Type of feed pump:	Forced feed from eccentric rotor pump
Total oil capacity including filter(s):	15.4 l
Oil change period:	250 hours
Type of filter:	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:	6
Fan diameter:	457 mm
Coolant capacity:	20.1 l
Type of temperature control:	Twin thermostats
Superpressure system:	69 kPa
Starting system	
Safety device:	Operable only when high/low gear and pto selectors are 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:	17AE14
Location:	Under engine cover with vertical stack pipe
Height of outlet above ground:	2581 mm

TRANSMISSION

Clutch	
Make:	Laycock
Type:	Dry, for transmission only
Number of plates:	1
Diameter of plates:	330 mm
Method of operation:	Mechanically by pedal
Gear box	
Make:	Massey-Ferguson
Type:	Mechanical, manual operation
Arrangement:	3 forward and 1 reverse speeds with a manually operated high/low range epicyclic unit and high/low shift range with synchromesh
Number of speeds:	12 forward, 4 reverse
Available options:	None
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:	Pedal operated
Transmission oils	
Gear box, transmission, and power lift housing:	
Capacity	47.4 l
Change period:	1000 hours
Filter change period:	250 hours
Final drives:	
Capacity	2.4 l
Change period:	1000 hours
Filter change period:	None
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	LL	312.45	2.05
1	LH	245.60	2.61
2	LL	208.30	3.07
2	LH	163.73	3.91
3	LL	113.61	5.64
3	LH	89.31	7.17
1	HL	76.38	8.39
1	HH	60.04	10.67
2	HL	50.92	12.58
2	HH	40.02	16.00
3	HL	27.77	23.06
3	HH	21.83	29.34
R	LL	208.30	3.07
R	LH	163.73	3.91
R	HL	50.92	12.58
R	HH	40.02	16.00

L = Low range H = High range

Rear tyre size: 18.4-34

Tyre loaded radius 770 mm

FRONT AXLE

Make: Massey-Ferguson

Type: Non-driven, extendable

POWER TAKE-OFF

Main power take-off

Type:	Independent of main clutch
Method of engagement:	Lever and hydraulically operated multiplate wet clutch
Number of shafts:	1
Method of changing power take-off speeds	Manually by exchanging shafts

Power take-off proportional to engine speed

Tyre sizes, Front, Rear:	16.0-10, 18.4-34

(i) 540 rev/min

Location:	At rear of tractor
Diameter of power take-off shaft:	34.9 mm
Number of splines:	6 to ISO standard 500
Height above ground:	642 mm
Distance from the median plane of the tractor:	Central
Distance behind rear axle:	296 mm (Extended pto: 451 mm used with alternative swinging drawbar)
Pto speed at rated engine speed:	627 rev/min
Engine speed at standard power take-off speed:	1893 rev/min
Engine to pto ratio:	3.5064:1
Power restriction:	I.S.O. recommendation, 48 kW
Direction of rotation (viewed facing driving end):	Clockwise

(ii) 1000 rev/min

Location:	At rear of tractor
Diameter of power take-off shaft:	34.9 mm
Number of splines:	21 to ISO standard 500
Height above ground:	642 mm
Distance from the median plane of the tractor:	Central
Distance behind rear axle:	296 mm (Extended pto: 400 mm used with alternative swinging drawbar)
Pto speed at rated engine speed:	1158 rev/min
Engine speed at standard power take-off speed:	1900 rev/min
Engine to pto ratio:	1.900:1
Direction of rotation (viewed facing driving end):	Clockwise

POWER LIFT

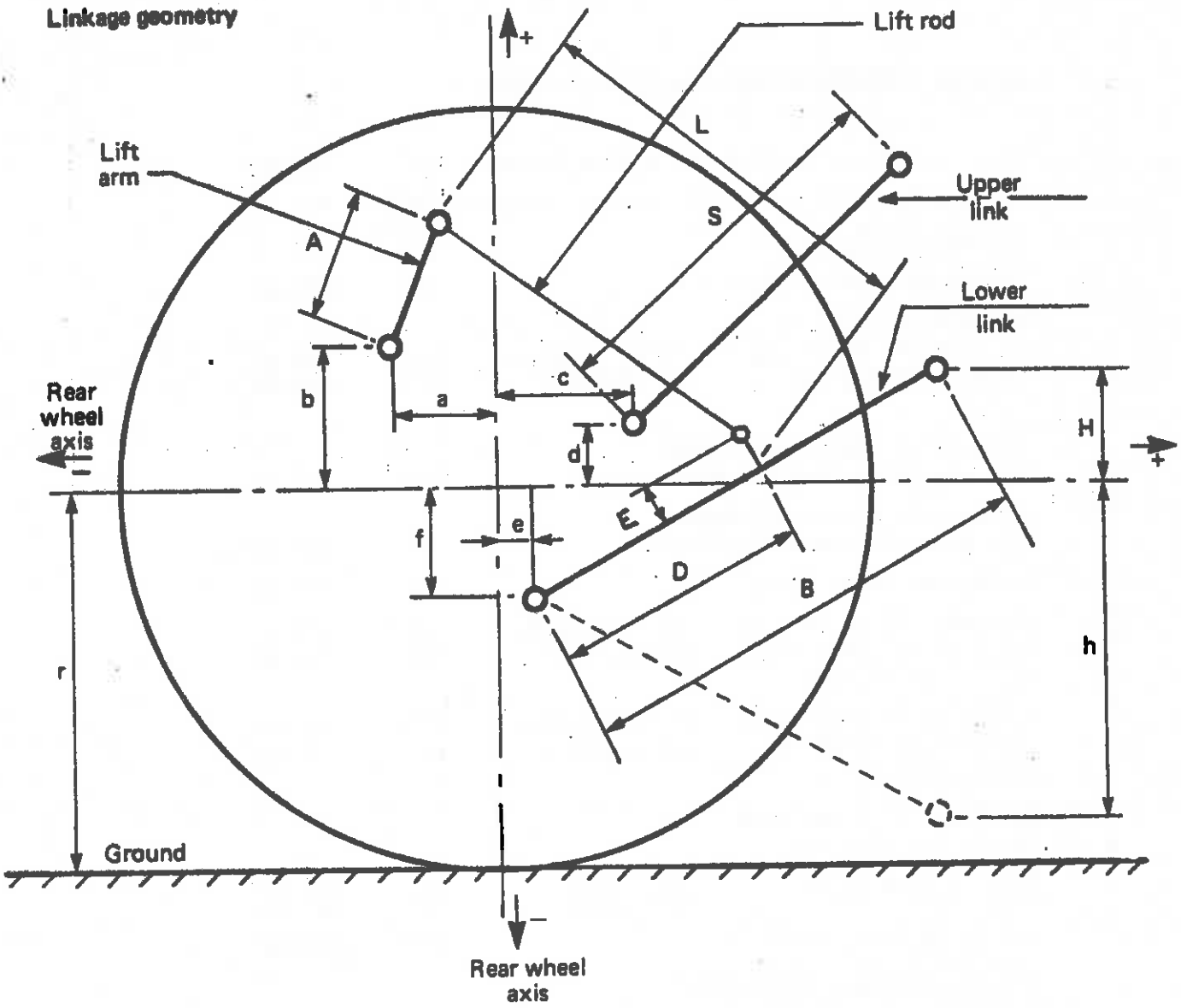
Make:	Massey-Ferguson
Type:	Hydraulic
Number and type of cylinders:	One main and two external assist, single acting, for standard linkage only
Type of linkage lock for transport:	Hydraulic
Relief valve pressure setting:	20.5 - 24.0 MPa
Opening pressure of cylinder safety valve:	None fitted
Main lift 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. A valve allows flow to spool valves and quick release couplings when selected
Maximum volume of oil available to external cylinders:	18 l
Recommended oil	See "Fuels and lubricants used in tests"

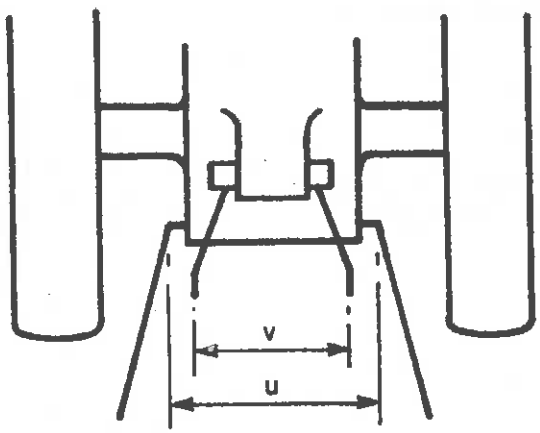
AUXILIARY HYDRAULIC SYSTEM

Make:	Sundstrand
Relief valve pressure setting:	17.0 - 20.6 MPa
Pump type:	Gear
Transmission between pump and engine:	Driven in tandem with steering pump from engine timing gears
Make and number of filters:	Parker Hannifin replacement canister and mesh strainer
Time between oil changes:	1000 hours
Time between filter changes:	250 hours, clean strainer 1000 hours
Oil capacity:	47.4 l
Site of oil reservoir:	Main transmission housing
Type and number of tapping points:	2 quick release couplings via 2 spool valves with separate returns to ISO standard. When fitted, a valve allows combination of main and auxiliary systems up to auxiliary system relief valve pressure
Maximum volume of oil available to external cylinders:	18 l
Recommended oil	See "Fuels and lubricants used in tests"

THREE POINT LINKAGE

Category:	2, to ISO standard 730/1
Category adaptor:	None
Controls	Draught or position control, top link sensing


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


v
u

Linkage dimensions for the lifting test

Rear tyres: (size 18.4-34) radius index:		(r)	770 mm
Front tyres:(size 10.0-16) loaded radius:		(r')	421 mm
Length of lift arms:		(A)	267 mm
Length of lower links:		(B)	1005 mm
Distance of lift arm pivot point from rear wheel centre line:	horizontally:	(a)	196 mm
	vertically:	(b)	233 mm
Horizontal distance between the two lower link points:		(u)	492 mm
Horizontal distance between the two lift arm end points:		(v)	534 mm
Length of upper link:		(S)	792 mm
Distance of upper link pivot point from rear wheel centre line	horizontally:	(c)	186 mm
	vertically:	(d)	205 mm
Distance of lower link pivot point from rear wheel centre	horizontally:	(e)	-32 mm
	vertically:	(f)	212 mm
Distance of lower link points to lift rod pivot points on lower link centre line:	horizontal:	(D)	399 mm
	vertical:	(E)	184 mm
Length of lift rods:		(L)	450 mm
Height of lower hitch points relative to the rear wheel centre line, situated 770 mm above the ground level			
- in low position:		(h)	570 mm
- in high position:		(H)	243 mm
Height of lower hitch points when locked in transport position:		Any height within lift range	

SWINGING DRAWBAR

		As tested	Alternate
Tyre sizes	Front:	10.0-16	
	Rear:	18.4-34	
Height above ground,	maximum:	573 mm	435 mm
	minimum:	423 mm	
Type of adjustment:		Inverting drawbar and clevis	None
Distance of hitch point from rear axle centre:		537 mm and 652 mm	676 mm and 803 mm
Distance of hitch point from power take-off shaft ends:			
vertically:		69 mm to 219 mm	207 mm
horizontally, 540 pto:		241 mm and 356 mm	225 mm and 352 mm
1000 pto:		241 mm and 356 mm	276 mm and 403 mm
Lateral adjustment:		210 mm and 390 mm	298 mm and 343 mm
Distance of pivot point from rear axles horizontally:		130 mm forward	130 mm forward
Diameter drawbar pin hole:		25.4 mm	25.4 mm

FRONT TOWING HITCH

Vertical height to centre of clevis:	745 mm
Width of clevis:	63 mm
Diameter of pin hole:	33 mm

STEERING

Method of operation:	Hydrostatic system with hand operated steering motor powered from engine mounted gear pump operating a ram integral with track rod
Pump:	Sundstrand gear type, in tandem with auxiliary hydraulic system pump. Oil from transmission housing.
Motor:	Danfoss OSPC-ON
Oil cooler:	Mounted to front of radiator
Ram	Massey-Ferguson double acting, integral with track rod
Working pressure:	17 MPa
Oil capacity:	47.4 l
Oil change period:	1000 hours
Make and model of filter:	Own make replaceable canister and metal strainer
Filter(s) change period:	250 hours
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:	10.0-16
Ply rating:	8
Type of casing:	Cross-ply
Maximum permissible load on each tyre:	1190 kg
Corresponding inflation pressure:	280 kPa
Track widths:	1365 mm by 102 mm steps to 1977 mm
Method of adjustment:	Extending axle

DRIVING WHEELS

Number:	2
Location:	At rear
Tyres:	Goodyear Traction Sure Grip
Size:	18.4-34
Ply rating:	8
Type of casing:	Crossply
Maximum permissible load on each tyre:	2565 kg
Corresponding inflation pressure:	140 kPa
Track widths:	1500 mm by 102 mm steps to 2112 mm
Method of adjustment:	Power assisted variable track

WHEELBASE 2576 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 10.0-16: rear 18.4-34

	Height above ground of centre, mm	Size, mm	Distance from outside edge of tractor to centre, at 1602 mm track width, mm
Headlights	1282	100 x 160	897
Sidelights	1625	110 x 35	300
Rear lights	1673	73 x 50	508
Mudguard reflectors	1675	46 x 46	452
Rear axle reflectors	722	80 dia	615

CONDITIONS DURING TEST

Overall dimensions

(front: 10.0-16, rear: 18.4-34 tyres fitted)

Length, m	Width, min. m	Width, max. m	Height at top of, Exhaust outlet, m	Height at top of, steering wheel, m
4.18	1.97	2.58	2.58	1.87

Ground clearance

Clearance: 344 mm limited by drawbar clevis in lowest position

Track setting

Front: 1467 mm
Rear: 1602 mm

Tractor mass

(without driver but with tanks full)

Front, kg	Rear,kg	Total,kg
1365	2191	3556

Fuel and lubricants used in tests

Fuel

Type: Diesel oil to Class D British Standard 2869:1970 specific gravity 0.8345 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, steering and hydraulics		
Type:	SAE 15W/30	
Viscosity:	54 cSt at 50°C	As recommended
Classification:	MIL-L-2104-C	
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: 21st July 1987,

Type of dynamometer: Water brake, Heenan & Froude

Power, kW	Speed, rev/min		Fuel consumption, Hourly,		Specific,	Specific energy,
	Engine	P.t.o.	l/h	kg/h	kg/kWh	kWh/l
MAXIMUM POWER - 2 HOUR TEST						
67.5	2200	627	20.79	17.35	0.257	3.25
POWER AT RATED ENGINE SPEED						
67.5	2200	627	20.79	17.35	0.257	3.25
POWER AT STANDARD POWER TAKE-OFF SPEED						
64.0	1893	540	18.79	15.68	0.245	3.41
PART LOADS						
(1) The torque corresponding to maximum power at rated engine speed						
67.5	2200	627	20.79	17.35	0.257	3.25
(2) 85% of the torque obtained in (1)						
59.2	2263	645	18.78	15.67	0.265	3.15
(3) 75% of the torque defined in (2)						
44.9	2301	656	15.43	12.88	0.287	2.91
(4) 50% of the torque defined in (2)						
30.3	2325	663	12.46	10.40	0.343	2.43
(5) 25% of the torque defined in (2)						
15.3	2352	671	9.39	7.84	0.512	1.63
(6) Unloaded						
0	2384	680	6.82	5.69	-	-

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,		Specific,	Specific energy,
	Engine	P.t.o.	l/h	kg/h	kg/kWh	kWh/l
(1) The torque corresponding to maximum power at standard pto speed						
64.0	1893	540	18.79	15.68	0.245	3.41
(2) 85% of the torque obtained at maximum power						
56.6	1964	560	16.68	13.92	0.246	3.39
(3) 75% of the torque defined in (2)						
43.1	2005	572	13.54	11.30	0.262	3.19
(4) 50% of the torque defined in (2)						
29.5	2047	584	10.84	9.05	0.307	2.72
(5) 25% of the torque defined in (2)						
15.1	2091	596	8.05	6.72	0.445	1.88
(6) Unloaded						
0	2139	610	5.39	4.50	-	-

Standard specific fuel consumption, kg/kWh

(a) 0.265 (c) 0.246
(b) 0.343 (d) 0.307

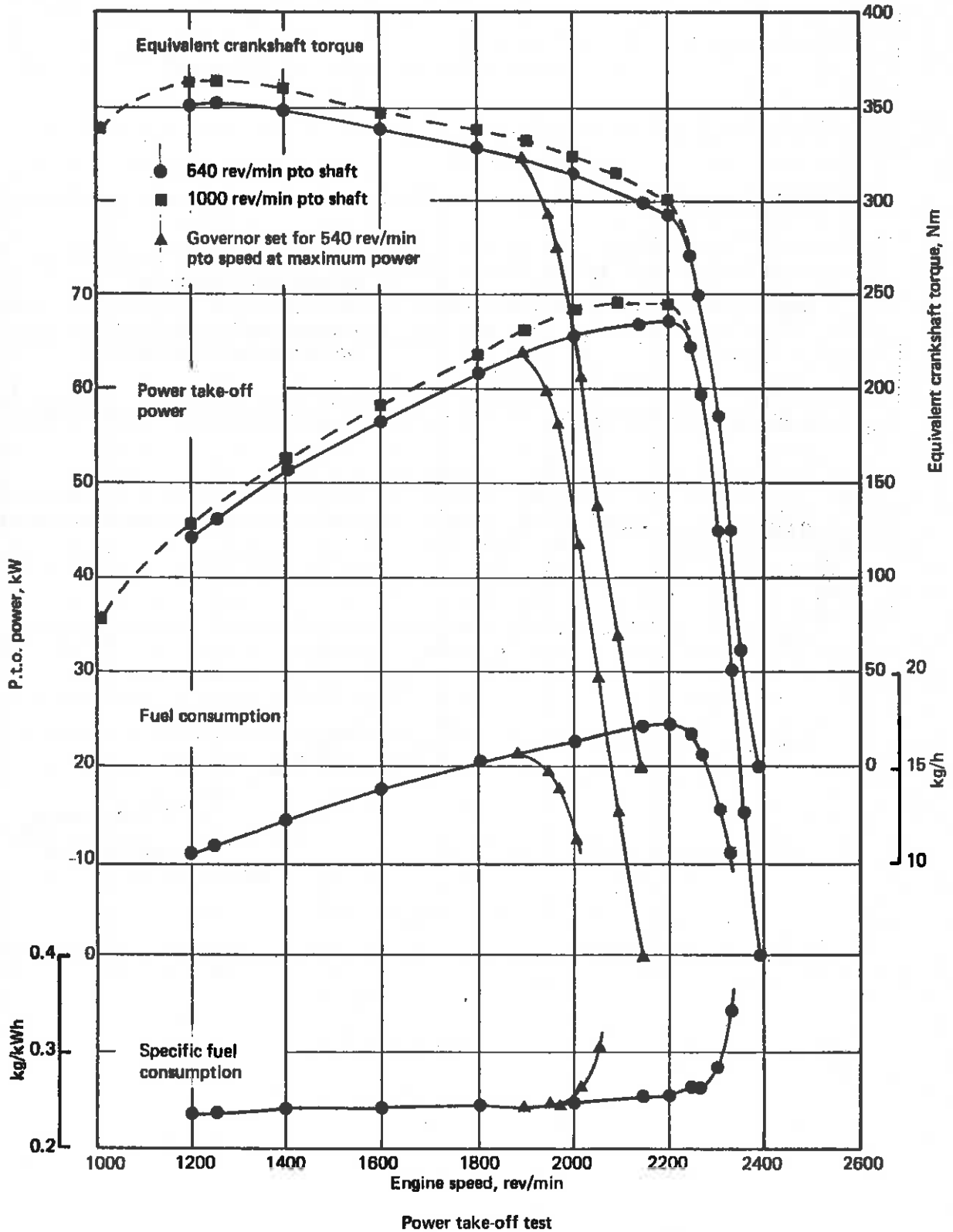
No load, maximum engine speed		2384 rev/min
Equivalent crankshaft torque at maximum power		292.9 Nm
Maximum equivalent crankshaft torque		352.2 Nm at 1250 rev/min engine speed
Mean atmospheric conditions	temperature	24°C
	pressure	1010 m bar
	relative humidity	79%
Maximum temperature	coolant	84°C
	engine oil	101°C
	fuel	28°C
	air intake	25°C

The following results were obtained with the 1000 rev/min pto shaft fitted.

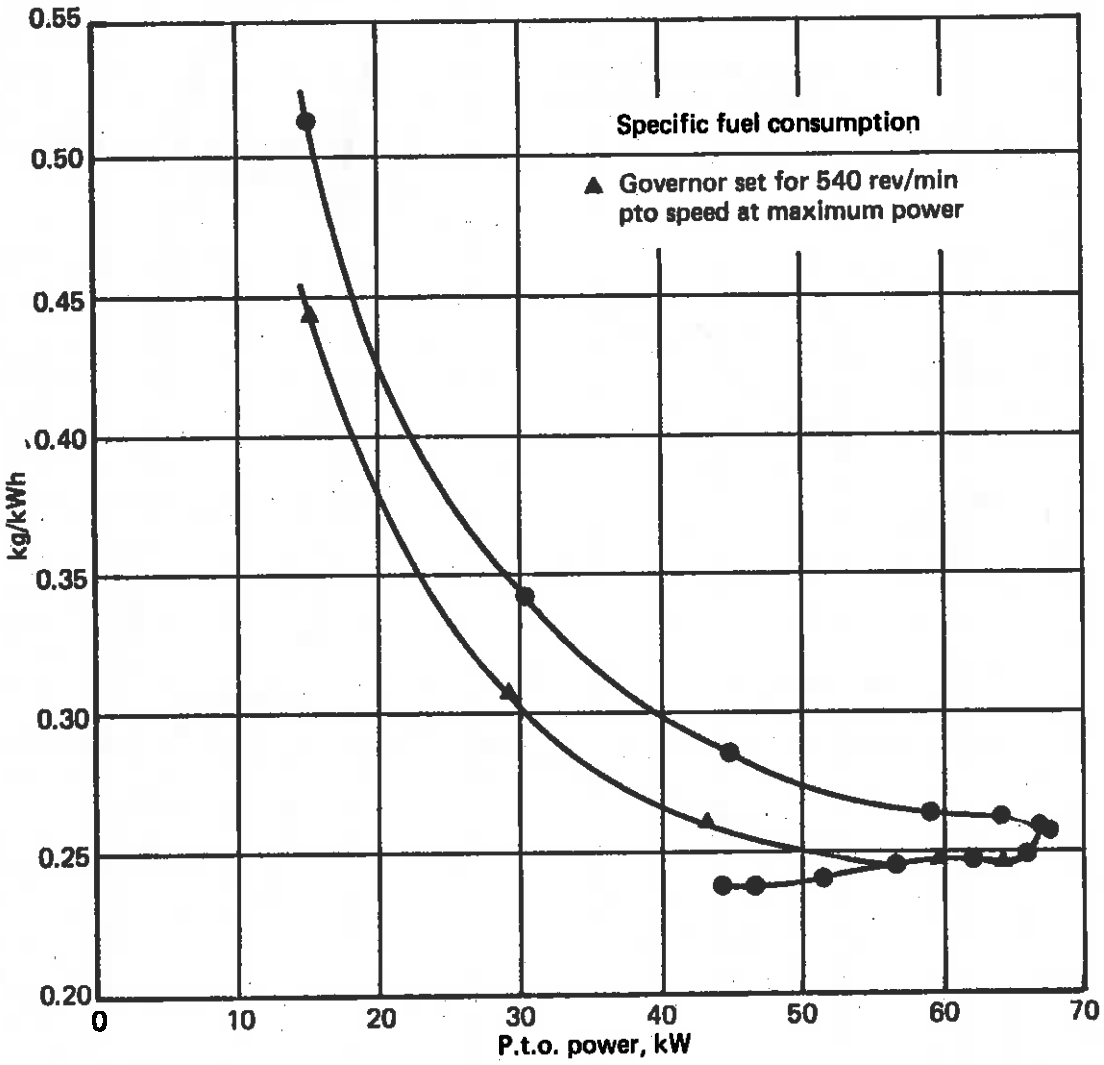
Power, kW	Speed, rev/min		Fuel consumption, Hourly,		Specific, kg/kWh	Specific energy, kWh/l
	Engine	P.t.o.	l/h	kg/h		
MAXIMUM POWER - 2 HOUR TEST						
69.1	2200	1158	20.75	17.32	0.251	3.32
POWER AT RATED ENGINE SPEED						
69.1	2200	1158	20.75	17.32	0.251	3.32
POWER AT STANDARD POWER TAKE-OFF SPEED						
66.2	1900	1000	19.23	16.05	0.242	3.45

Equivalent crankshaft torque at maximum power 300.0 Nm.

Maximum equivalent crankshaft torque 362.9 Nm at 1250 rev/min engine speed.



Power take-off test



Power take-off test

2. LIFTING FORCE AND HYDRAULIC POWER

Date of tests: 27th July 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 (with standard linkage and 2 assist rams)

	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	813	27.7	21.0	27.0	-
On the frame	200	954	19.3	21.0	30.6	12

Main linkage dimensions - see drawings and table on pages 9 and 10

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

mm	-383	-358	-300	-150	0	150	300	405	510

Lifting forces at hitch points
(corresponding pressure 21.0 MPa)

kN	-	30.6	29.3	28.7	28.1	27.9	27.7	27.7	-

Lifting forces at test frame
(corresponding pressure 21.0 MPa)

kN	29.8	28.7	27.3	25.7	24.3	22.8	21.4	20.4	19.3

Hydraulic power test

Sustained pressure with relief valve open	23.9 MPa
Pump delivery rate at minimum pressure	33.3 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	29.2 l/min
Pressure	21.5 MPa
Power	10.5 kW

Flow rate and hydraulic pressure corresponding to maximum hydraulic power

Flow rate	30.4 l/min
Pressure	21.0 MPa
Power	10.6 kW

Tapping point used for test:	Auxiliary service connection fitted for test only

Temperature of hydraulic fluid, if different from $60^{\circ} \pm 5^{\circ}C$	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: 7th August 1987
Type of track: Concrete

Height of drawbar above ground: 510 mm

Tyre size and pressure:
Front: 10.0-16 179 kPa
Rear: 18.4-34 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													
3LH	6.20	*45.5	26.4	2258	15.0	0.356	2.34	46	81	94	20	70	1013
1HL	7.17	*52.6	26.4	2210	15.0	0.342	2.44	49	82	94	21	75	1013
1HH	9.77	56.7	20.9	2200	8.9	0.318	2.62	47	84	96	16	80	1013
2HL	11.74	57.7	17.7	2200	7.0	0.312	2.67	48	84	95	18	80	1015
2HH	15.22	57.5	13.6	2200	5.0	0.310	2.69	50	84	97	17	76	1014
(2) TRANSMISSION AND FUEL CONSUMPTION CHARACTERISTICS													
(i) SELECTED GEAR (Maximum power)													
2HL	11.74	57.7	17.7	2200	7.0	0.312	2.67	48	84	95	18	80	1015
(ii) 75% OF PULL AT MAXIMUM POWER													
2HL	12.34	45.6	13.3	2268	4.9	0.324	2.58	49	83	98	18	80	1014
(iii) 50% OF PULL AT MAXIMUM POWER													
2HL	12.82	31.7	8.9	2300	2.5	0.373	2.24	47	81	98	18	80	1014
HIGHER GEAR SAME PULL AS IN (ii) REDUCED ENGINE SPEED													
2HH	12.38	45.4	13.2	1786	4.9	0.288	2.90	49	83	88	21	79	1013
HIGHER GEAR SAME PULL AS IN (iii) REDUCED ENGINE SPEED													
2HH	12.72	31.8	9.0	1802	2.6	0.313	2.67	46	80	89	19	78	1013

*Maximum power limited by slip

B. OPTIONAL TESTS

1. LOCATION OF CENTRE OF GRAVITY

Height above ground, mm	884
Distance forward from the vertical plane containing the axis of the rear wheels, mm	989
Distance from the median plane of the tractor, mm	0

2. NOISE MEASUREMENT AT THE DRIVER'S EAR

Date of tests: 7th August 1987
Type of sound level meter: Bruel and Kjaer 2209
Type of track: Concrete
Cab fitted: None

Results of tests:

Gear	Drawbar pull at which the tractor develops maximum sound level, kN	Measured travelling speed, km/h	Sound level, dBA
*3LH	20	6.8	99
*3LH	Light load	7.8	97
3HH	Light load	31.3	98

* The 3LH gear corresponds to the nominal travelling speed nearest to 7.5 km/h

3. MEASUREMENT OF EXTERNAL NOISE LEVEL

Date of tests: 7th August 1987
Type of sound level meter: Bruel and Kjaer 2209
Type of track: Concrete
Results of tests
  Gear: 3HH
  Travelling speed before acceleration: 23.5 km/h
  Sound level: 91 dBA

C. SUPPLEMENTARY TESTS

Lifting force

1. Standard linkage set to manufacturer's recommendations.
2. Alternative linkage set as for compulsory tests.
3. Alternative linkage set to manufacturer's recommendations.

Linkage dimensions for the supplementary lifting tests

		Test 1	Test 2	Test 3
Rear tyres: (size 18.4-34) radius index:	(r)	770 mm	770 mm	770 mm
Front tyres:(size 10.0-16) loaded radius:	(r')	421 mm	421 mm	421 mm
Length of lift arms:	(A)	267 mm	267 mm	267 mm
Length of lower links:	(B)	1005 mm	1016 mm	1016 mm
Distance of lift arm pivot point from rear wheel centre line: horizontally:	(a)	196 mm	196 mm	196 mm
Distance of lift arm pivot point from rear wheel centre line: vertically:	(b)	233 mm	233 mm	233 mm
Horizontal distance between the two lower link points:	(u)	492 mm	492 mm	492 mm
Horizontal distance between the two lift arm end points:	(v)	534 mm	534 mm	534 mm
Length of upper link:	(S)	792 mm	803 mm	803 mm
Distance of upper link pivot point from rear wheel centre line horizontally:	(c)	186 mm	186 mm	186 mm
Distance of upper link pivot point from rear wheel centre line vertically:	(d)	205 mm	205 mm	205 mm
Distance of lower link pivot point from rear wheel centre horizontally:	(e)	-32 mm	-32 mm	-32 mm
Distance of lower link pivot point from rear wheel centre vertically:	(f)	212 mm	212 mm	212 mm
Distance of lower link points to lift rod pivot points on lower link centre line: horizontally:	(D)	406 mm	546 mm	546 mm
Distance of lower link points to lift rod pivot points on lower link centre line: vertically:	(E)	203 mm	22 mm	22 mm
Length of lift rods:	(L)	441 mm	720 mm	683 mm
Height of lower hitch points relative to the rear wheel centre line, situated 770 mm above the ground level				
- in low position:	(h)	403 mm	570 mm	391 mm
- in high position:	(H)	242 mm	141 mm	272 mm
Height of lower hitch points when locked in transport position:	Any height within lift range			

LIFTING FORCE

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

1. Power lift test (with standard linkage and 2 assist rams set to manufacturers recommendation)

Date of test: 18th July 1987

Hydraulic fluid temperature at beginning of test: 60°C

	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	367	645	31.8	21.0	30.9	-
On the frame	367	803	23.0	21.0	36.4	12

Main linkage dimensions - see drawings and table on pages 9 and 25

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

mm	-233	-191	-150	-50	0	100	250	395	490

Lifting forces at hitch points
(corresponding pressure 21.0 MPa)

kN	-	42.0	38.8	35.2	34.9	34.0	32.8	31.8	-

Lifting forces at test frame
(corresponding pressure 21.0 MPa)

kN	39.2	35.9	34.2	31.4	30.5	28.9	26.5	24.4	23.0

2. Power lift test (Alternative linkage set as for compulsory tests)

Date of test: 4th August 1987

Hydraulic fluid temperature at beginning of test: 60°C

	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	711	20.2	21.0	19.9	-
On the frame	200	814	19.5	21.0	31.1	10

Main linkage dimensions - see drawings and table on pages 9 and 25

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

mm	-381	-358	-250	-100	0	100	200	325	390

Lifting forces at hitch points
(corresponding pressure 21.0 MPa)

kN	-	20.2	21.5	23.2	24.1	24.6	24.7	25.4	-

Lifting forces at test frame
(corresponding pressure 21.0 MPa)

kN	19.7	19.6	20.4	21.2	21.2	20.8	20.3	19.8	19.5

3. Power lift test (Alternative linkage set to manufacturers recommendation)

Date of test: 3rd August 1987

Hydraulic fluid temperature at beginning of test: 60°C

	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	379	663	22.0	21.0	21.6	-
On the frame	379	807	19.6	21.0	31.2	14

Main linkage dimensions - see drawings and table on pages 9 and 25

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

mm	-190	-179	-100	0	100	200	300	450	575

Lifting forces at hitch points
(corresponding pressure 21.0 MPa)

kN	-	22.0	23.4	24.6	25.5	26.3	26.8	27.9	-

Lifting forces at test frame
(corresponding pressure 21.0 MPa)

kN	19.8	20.0	20.9	21.3	21.4	21.3	21.0	20.2	19.6

REPAIRS AND ADJUSTMENTS DURING TESTS: None

REMARKS: None

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

Officer in charge: P.C. Seward

Signed: D W. Smith Head of Testing Group

R. M. Stagnor for the Director

Date: 29th October 1987.