AFRC Institute of ENGINEERING RESEARCH

Report No: R91/71248/OECD
OECD Approval No: 1318 Restricted Code
Approval Date: 10 June 1991

Test in accordance with the OECD Restricted Standard Code for the official testing of agricultural tractors

Massey-Ferguson 399 Four-Wheel Drive Tractor with 12-speed Synchromesh Transmission without cab

Manufactured by:	Massey-Ferguson Tractors Ltd Banner Lane Coventry Warwickshire CV4 9GF
Submitted for test by:	The manufacturer
Report No:	742
Date:	December 1990

THE BRITISH SOCIETY FOR RESEARCH IN AGRICULTURAL ENGINEERING

AFRC Institute of Engineering Research
Wrest Park Silsoe Bedford MK45 4HS

R91/71248/OECD

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- Tractor manufacturer's name and address:	Massey-Ferguson Tractors Limited Banner Lane, Coventry, Warwicks. CV4 9GF
- Location of tractor assembly:	Coventry
- 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:	50 hours
- Location of test:	AFRC Engineering, Silsoe

I. SPECIFICATION OF TRACTOR

TRACTOR

- Make:	Massey-Ferguson
- Model:	M-F 399 with 12-speed synchromesh transmission
- Type:	Four wheel drive, unit construction, C011
- Serial No:	5013 R37488
- 1st Serial No:	5013 R32341

ENGINE

- Make:	Perkins
- Model:	1006-6HR3
- Type:	4-stroke, direct injection naturally aspirated diesel
- Serial No:	YA31240U520978U

Cylinders

- Number/disposition:	6, vertical, in-line
- Bore/stroke:	100 mm/127 mm
- Capacity:	5985 cm^3
- Compression ratio:	16.5:1
- Arrangement of valves:	Overhead
- Cylinder liners:	Dry

Supercharging

None

Fuel system

- Fuel feed system:	Superpar mechanical feed pump
- Make, type and model of fuel filter:	Twin C.A.V. paper, dual element filters with transparent sediment bowl
- Capacity of fuel tank:	118 l
- Make, type and model of injection pump:	C.A.V. distributor, Type 977, DPA3369F101 Perkins 2643D803 UK/5/2310
- Serial Number:	15795 GHG
- Manufacturer's production setting of injection pump:	
. Flow rate:	22.00-24.7 l/h at 2200 rev/min engine speed at full load on 45°C pump inlet temperature
. Timing:	Delivery starts 17° before T.D.C., static
- Make, type and model of injectors:	C.A.V. 4-HOLE, Perkins 2645A032, JU
- Injection pressure:	22.3 MPa

Governor

- Make:	C.A.V.
- Model:	Not applicable
- Type:	Mechanical incorporated in injection pump
- Governed range of engine speed:	750 to 2310 rev/min
- Rated engine speed:	2200 rev/min

Air cleaner

- Pre-cleaner:	
. Make:	Donaldson
. Type:	Centrifugal
. Model:	Visibowl
. Location of air intake:	Above centre of bonnet
- Main cleaner:	
. Make:	Donaldson
. Type:	Oil bath
. Model:	OBAR 08039
. Location of air intake:	From pre-cleaner
- Maintenance indicator:	None

Lubrication system

- Type of feed pump:	Forced feed from Bi-Rotor pump
- Type of filter:	Full flow replacement element
- Number:	1

Cooling system

- Type of coolant:	Water or water and antifreeze solution
- Type of pump:	Centrifugal
- Specification of fan:	Belt driven puller
- Number of fan blades:	7
- Fan diameter:	483 mm
- Coolant capacity:	23.0 l
- Type of temperature control:	Thermostat
- Superpressure system:	75 kPa

Starting system

- Make:	Magneti Marelli
- Model:	M 127
- Type:	Electrical, pre-engaged, solenoid operated
- Starter motor power rating:	12 V, 2.8 kW
- Cold starting aid:	ISKRA Induction heater 12V
- Safety device:	Operable only when low/high lever and pto selectors are in neutral

Electrical system

- Voltage:	12
- Generator:	Alternator
. Make:	M-F Powerpart
. Model:	A127-70
. Type:	Belt driven
. Power:	0.84 kW
- Batteries:	2 M-F Powerpart, type 372 heavy duty lead acid maintenance free
. Rating:	420 CCA rating each or equivalent 70 Ah at 20-hour rating

Exhaust system

- Make:	Nelson Burgess
- Model:	38639A
- Type:	Horizontal silencer
- Location:	Under engine cover with vertical stack pipe
- Height of outlet above ground:	2640 mm

TRANSMISSION TO WHEELS

Clutch — Transmission only

- Make:	LUK
- Model:	None
- Type:	Dry for transmission only
- Number of plates:	1
- Diameter of plates:	330 mm
- Method of operation:	Mechanically by pedal

Gear box

- Make:	M-F
- Model:	None
- Type:	Mechanical manual operation 3 forward synchromesh combinations and 1 reverse with manually operated dual range epicyclic unit and high/low shift range with synchromesh
- Number of gears:	12 forward, 4 reverse
- Available options:	None

Rear axle and final drives

- Make:	Own make
- Model:	None
- Type:	Crown wheel and pinion with outboard epicyclic reduction gear final drives

- Differential lock:

  . Type: Mechanical dog clutch on differential gears

  . Method of engagement: Foot pedal operated

  . Method of disengagement: Automatic

Front axle and final drives

- Make: M-F

- Model: None

- Type: Crown wheel and pinion with differential and outboard epicyclic reduction gear final drive

- Differential lock:

  . Type: Mechanical dog clutch on differential gears

  . Method of engagement: Hydraulically actuated in unison with rear differential in response to electrical signal from rear differential lock system

  . Method of disengagement: Automatic

Total ratios and travelling speeds

Gear	Group No.	Number of engine revolutions for one revolution of the driving wheels	Nominal travelling speed at rated engine speed:* 2200 rev/min km/h
Forward			
1	Ll	311.56	2.12
1	Lh	244.89	2.69
2	Ll	207.71	3.17
2	Lh	163.26	4.04
3	Ll	113.30	5.82
3	Lh	89.10	7.40
1	Hl	76.16	8.65
1	Hh	59.86	11.02
2	Hl	50.77	12.99
2	Hh	39.91	16.52
3	Hl	27.69	23.81
3	Hh	21.77	30.29
Reverse			
R	Ll	207.71	3.17
R	Lh	163.26	4.04
R	Hl	50.77	12.99
R	Hh	39.91	16.52

High/low synchromesh range, l = low, h = high
Dual range epicyclic, L = low, H = high

(*) Calculated with a tyre dynamic radius index of 795 mm (ISO 4251/1-1984)

Number of revolutions of front wheels for one revolution of rear wheels: 1.348:1

POWER TAKE-OFF

Main power take-off

- Type:	Independent
- Method of engagement:	By hand lever hydraulically engaging wet multi-plate clutch
- Number of shafts:	1
- Method of changing power take-off speeds:	Manually by exchanging shafts

Clutch

- Make:	Own make
- Model:	None
- Type:	Hydraulically actuated wet multi-plate
- Number of plates:	7
- Diameter of plates:	128 mm

Power take-off proportional to engine speed

540 rev/min

- Location:	At rear of tractor
- Diameter of power take off shaft:	34.9 mm
- Number of splines:	6 to ISO 500
- Height above ground:	655 mm
- Distance from the median plane of the tractor:	Central
- Distance behind rear-wheel axis:	296 mm
- PTO speed at rated engine speed:	627 rev/min
- Engine speed at standard power take-off speed:	1893 rev/min
- Ratio of rotation speeds:	3.506:1
- Power restriction and maximum torque:	48 kW (ISO recommendation)
- Direction of rotation (viewed from behind tractor):	Clockwise

1000 rev/min

- Location:	At rear of tractor
- Diameter of power take-off shaft:	34.9
- Number of splines:	21, to ISO 500
- Height above ground:	655 mm
- Distance from the median plane of the tractor:	Central
- Distance behind rear-wheel axis:	296 mm
- PTO speed at rated engine speed:	1158 rev/min
- Engine speed at standard power take-off speed:	1900
- Ratio of rotation speeds:	1.9:1
- Direction of rotation (viewed from behind tractor):	Clockwise

POWER LIFT

- Make:	Massey-Ferguson
- Model:	None
- Type:	Hydraulic, with inlet suction control
- Type and number of cylinders:	1, single acting internal and 2, optional external assist
- 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
- Type and number of filters:	Full flow, metal mesh strainer, 1
- Site of oil reservoir:	Transmission housing
- Type, number and location of tapping points:	One on centre housing, top cover,
- Maximum volume of oil available to external cylinders:	18.0 l

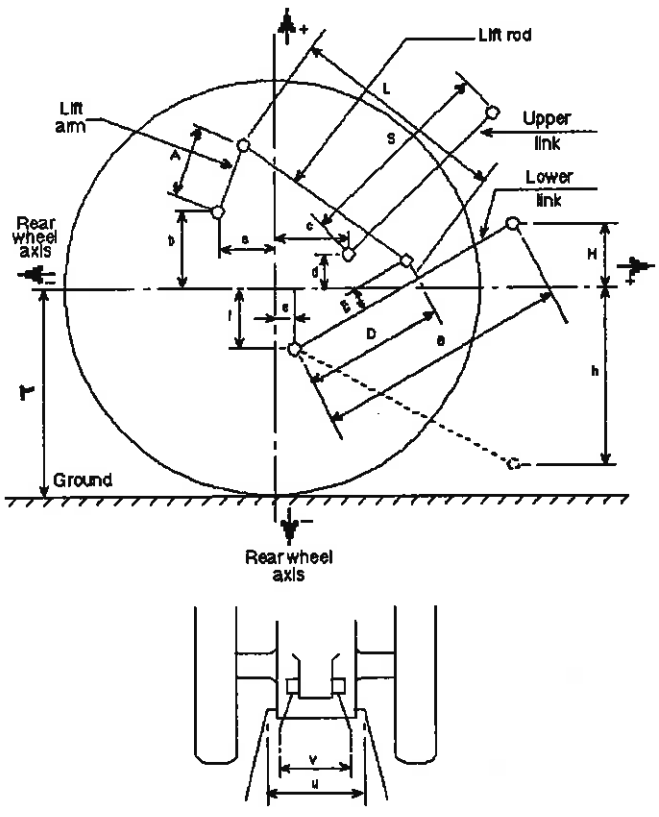
AUXILIARY HYDRAULIC SYSTEM

- Make:	Sundstrand
- Model:	None
- Type:	Gear
- Relief valve pressure setting:	17.0 - 20.6 MPa
- Lift pump type:	Gear
- Transmission between pump and engine:	Engine mounted in tandem with steering pump
- Type and number of filters:	Metal mesh strainer and Parker Hannifin replaceable canister in shared circuit with steering system
- Site of oil reservoir:	Main transmission housing

- Type, location and number of tapping points:	2 quick release couplings with returns to ISO (Not fitted for test)
- Maximum volume of oil available to external cylinders:	18.0 l

Three-point linkage

- Category:	2 to ISO standard 730/1-1977
- Category adaptor:	None
- Controls:	Draught or position control, top link sensing



LIFT TEST
Linkage geometry

Table 2.1

Dimensions of linkage when attached to the standard frame (ISO 730/3-1982 CAT 2)

		Dimensions or range (mm)	Setting used in main test (mm)	Setting used in supplementary test (mm)
Length of lift arms:	(A)	267	267	267
Length of lower links:	(B)	1005	1005	1005
Distance of lift arm pivot point from rear wheel centre line: horizontally:	(a)	196	196	196
vertically:	(b)	233	233	233
Horizontal distance between the two lower link end points:	(u)	492	492	492
Horizontal distance between the two lift arm end points:	(v)	534	534	534
Length of upper link:	(S)	660 to 863	810	810
Distance of upper link pivot point from rear wheel centre line: horizontally:	(c)	186,200,216	186	186
vertically:	(d)	205,171,132	205	205
Distance of lower link pivot point from rear wheel centre line: horizontally:	(e)	32 forward	32	32
vertically:	(f)	212	212	212
Distance of lower link points to lift rod pivot points on lower link centre line: horizontally:	(D)	406+339	339	406
vertically:	(E)	203+184	184	203
Length of lift rods:	(L)	407 to 465	460	441
Height of lower hitch points relative to the rear wheel centre line, situated 770 mm above the ground level:				
- in low position:	(h)	619 to 308	595	405
- in high position:	(H)	274 to 120	145	178
Height of lower hitch points when locked in transport position:		Any height within lift range		

*Assuming r = 795 mm = tyre dynamic radius index to ISO 4251/1-1984

		Drawbar as tested
SWINGING DRAWBAR		
- Type:		Clevis
- Height above ground,	maximum:	582 mm
	minimum:	432 mm
- Type of adjustment:		Inverting drawbar and clevis
- Distance of hitch point from rear-wheel axis, horizontally:		537, 652 and 702 mm
- Distance of hitch point from power take-off shaft ends:		
. Vertically:		31 and 242 mm
. Horizontally:		241, 356 and 406 mm
- Lateral adjustment centre of clevis:		
. Right-hand:		158 mm drawbar in 200 mm out
. Left-hand:		158 mm drawbar in 200 mm out
- Distance of pivot point from rear axles horizontally:		130 mm forward
- Width of clevis:		65 mm
- Diameter of drawbar pin hole:		25 mm
- Maximum vertical permissible load:		11.6 kN
TRAILER HITCH		
- Type:		Not fitted
LINKAGE DRAWBAR		
- Type:		Not fitted

FRONT TOWING HITCH

- Type:	Clevis in front weight frame
- Vertical height to centre of clevis:	832 mm
- Width of clevis:	63 mm
- Diameter of pin hole:	33 mm

STEERING

- Make:	Own make
- Model:	None
- Type:	Hydrostatic
- Method of operation:	
. Pump:	Sundstrand gear type mounted on engine in tandem with auxiliary hydraulic system pump
. Motor:	Danfoss OSPC-ON
. Ram:	1 double acting operating steering arm
. Filter:	1 replaceable canister in shared circuit with auxiliary hydraulics
- Working pressure:	17.0 MPa

BRAKES

Service brake

. Make:	Girling
. Model:	None
. Type:	Oil immersed multi-plate discs, 4 per side
- Method of operation:	Independent on rear wheels or combined pedal; compensated actuation
- Trailer braking take-off:	None fitted

Parking brake

- Type:	Mechanical via cable
- Method of operation:	Hand lever with ratchet

WHEELS

- Number: 4
  - . Front: 2
  - . Rear: 2
- Wheelbase: 2640
- Track width adjustment:

	Minimum, mm	Maximum, mm	Ajustment method
Front	1726	1980	By reversing wheels and offset lug rims
Rear	1530	2230	By reversing wheels and offset lug rims

PROTECTIVE STRUCTURE

- Make: None fitted

DRIVER'S SEAT

- Make/Model/Type: Grammer DS44/1H
- 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°

	Height above ground of centre, mm	Size mm	Distance from outside edge to median plane of tractor mm
Headlight	1375	90 x 150	220
Sidelights	1674	30 x 105	800
Rear lights	1680	45 x 95	580
Axle reflectors	660	80 dia	490
Rear cluster reflectors	1680	50 x 45	625

II. TEST CONDITIONS

Overall dimensions

Length mm	Width		Height at top of	
	Minimum mm	Maximum mm	Exhaust pipe mm	Steering wheel mm
4280	2111	2680	2640	1920

Ground clearance (unballasted tractor) 360 mm

- Clearance-limiting part: Drawbar clevis in lowest position

Tractor mass (with safety cab)

	Unballasted		Ballasted	
	Without driver kg	With driver kg	Without driver kg	With driver kg
Front	1600	1612	--	--
Rear	1886	1947	--	--
Total	3486	3559	--	--

Tyres and track width specification

	Front	Rear
Tyres		
. dimensions	13.6 R28	16.9 R38
. ply rating	A8	A8
. type	Radial	Radial
Maximum load (tyre manufacturer's) kg	1660	2760
maximum load (tractor manufacturer's) kg	1660	2721
inflation pressure (tyre manufacture's)	160 kPa	160 kPa
dynamic radius index	610 mm	795 mm
. Chosen track width (manufacturer's nominal)	1780mm	1730 mm

Oils and lubrication

Capacity and change interval

	Capacity l	Oil change h	Filter change h
Engine	14.3	250	250
Air filter	1.0	250	--
Front axle	6.5	1000	--
Final drives (front, 2 off)	2.6	1000	--
Gearbox	47.4	1000	250
Rear axle) Hydraulic system) Steering)	Integral	with	gearbox
Final drives (rear, 2 off)	5.8	1000	--
Brakes	N/A	Top-up	--

Fuels and lubricants used in tests

Fuel

Type:	Diesel oil with Cetane index of 54.5 and kinematic viscosity of 2.9 cSt at 40°C within the specification limits of Class A2 British Standard 2869/1983	
Specific gravity:	0.8380 at 15°C	
Oils	Recommended	Used during test
Engine oil and air filter:		
Type:	SAE 15W/30	As recommended
Viscosity:	54 cSt at 50°C	
Classification	MIL-L-2104-C	
Transmission oils		
Type:	SAE 15W/30	As recommended
Viscosity:	54cSt at 50°C	
Classification:	MIL-L-2104-C	
Rear final drives:		
Type:	SAE 15W/30	As recommended
Viscosity:	54cSt at 50°C	
Classification:	MIL-L-2104-C	
Front differential and final drives:		
Type:	SAE 15w/30	As recommended
Viscosity:	54 cSt at 50°C	
Classification:	MIL-L-2104-C	
Hydraulic brakes:		
Type:	Mineral	As recommended
Viscosity:	7.2 cSt at 50°C	
Classification:	M-F CMS 1151A	
Hydraulic fluid:		
Type:	SAE 15W/30	As recommended
Viscosity:	54 cSt at 50°C	
Classification:	MIL-L-2104-C	
Steering oil:		
Type:	SAE 15W/30	As recommended
Viscosity:	54 cSt at 50°C	
Classification:	MIL-L-2104-C	
Recommended grease:	Consistency 2 lithium	As recommended
Number of lubrication points:	13	

III. TEST RESULTS

A. COMPULSORY TEST RESULTS

1. MAIN POWER TAKE-OFF

- Date and location of tests: 13th December 1990
  AFRC Engineering, Wrest Park,
  Silsoe, Bedford

- Type of dynamometer: Water brake, Heenan & Froude

Power kW	Speed		Fuel consumption			Specific energy kWh/l
	Engine rev/min	P.T.O. rev/min	Hourly kg/h	Hourly l/h	Specific g/kWh	
1.1	MAXIMUM POWER - TWO HOUR TEST					
77.4	1989	1047	19.12	22.82	247	3.39
1.2	POWER AT RATED ENGINE SPEED					
73.1	2203	1160	18.43	22.00	252	3.32
1.3	STANDARD POWER TAKE-OFF SPEED (1000 ± 10 rev/min)					
77.0	1904	1002	18.89	22.54	245	3.42
1.4 1.4.1	PART LOADS The torque corresponding to maximum power at rated engine speed					
73.1	2203	1160	18.43	22.00	252	3.32
1.4.2	85% of the torque defined in 1.4.1					
63.2	2232	1175	16.65	19.87	263	3.18
1.4.3	75% of the torque defined in 1.4.2					
47.6	2249	1184	13.72	16.37	288	2.91
1.4.4	50% of the torque defined in 1.4.2					
32.0	2255	1187	10.91	13.02	341	2.46
1.4.5	25% of the torque defined in 1.4.2					
16.3	2268	1194	8.23	9.82	505	1.66
1.4.6	Unloaded					
0	2280	1200	5.90	7.04	-	-

Power kW	Speed		Fuel consumption			Specific energy kWh/l
	Engine rev/min	P.T.O. rev/min	Hourly kg/h	l/h	Specific g/kWh	
1.5 PART LOADS AT STANDARD POWER TAKE-OFF SPEEDS (± 10 rev/min)						
1.5.1 The torque corresponding to maximum power						
77.0	1904	1002	18.89	22.54	245	3.42
1.5.2 85% of the torque obtained in 1.5.1						
66.3	1934	1010	15.72	18.76	237	3.53
1.5.3 75% of the torque obtained in 1.5.2						
50.7	1952	1028	12.72	15.18	251	3.34
1.5.4 50% of the torque obtained in 1.5.2						
34.1	1971	1037	9.90	11.81	291	2.89
1.5.5 25% of the torque obtained in 1.5.2						
16.8	1987	1046	6.85	8.18	408	2.05
1.5.6 Unloaded						
0	2014	1060	4.52	5.40	-	-

- No load, maximum engine speed: 2280 rev/min
- Torque (equivalent crankshaft) at maximum power: 371.4 Nm
- Torque (" ") at rated speed: 317.0 Nm
- Maximum torque (equivalent crankshaft): 423.9 Nm
  (engine speed 1101 rev/min)
- Mean atmospheric conditions:
  - . Temperature: 20°C
  - . Pressure: 1025 m bar
  - . Relative humidity: 34%
- Maximum temperatures:
  - . Coolant: 86°C
  - . Engine oil: 107°C
  - . Fuel: 50°C
  - . Engine air intake: 30°C

2. HYDRAULIC POWER AND LIFTING FORCE

- Date of tests: 18th December 1990

2. HYDRAULIC POWER TEST

- Sustained pressure with relief valve open: 24.0 MPa

- Pump delivery rate at minimum pressure: 31.5 l/min

	Flow rate l/min	Pressure MPa	Power kW
Flow rate corresponding to a hydraulic pressure equivalent to 90% of the actual relief valve pressure setting and corresponding hydraulic power	29.2	21.6	10.5
Flow rate and hydraulic pressure corresponding to maximum hydraulic power	30.4	21.0	10.6

- Tapping point used for test: Auxilliary service connection

- Temperature of hydraulic fluid if different from 65 ± 5°C NA °C

- Opening pressure of the unloading valve NA MPa

- Closing pressure of the unloading valve NA MPa

2.2 POWER LIFT TEST

(2 assist rams fitted and linkage set to compulsory settings)

	At the hitch point	On the frame
Height of lower hitch points above ground in down position	200 mm	200 mm
Vertical movement	740 mm	843 mm
Maximum corrected force exerted through full range	27.5 kN	21.0 kN
Corresponding pressure of hydraulic fluid	21.0 MPa	21.0 MPa
Moment about rear-wheel axis	26.8 kNm	33.2 kNm
Maximum tilt angle of mast from vertical	N/A degrees	10 degrees

- Linkage settings for test - see Table 2.1 and Figures 2.1 and 2.2

Lifting heights relative to the horizontal plane including the lower link pivot points											
mm	-413	-383	-250	-100	0	+50	+100	+200	+300	+357	+430
Lifting forces (the values measured are corrected to correspond to a hydraulic pressure equivalent to 90% of the actual relief valve pressure setting or to maximum power delivered by the hydraulic system, whichever is lower)											
at the hitch points kN	--	30.8	29.1	28.4	28.3	28.0	27.9	27.5	27.5	27.5	--
Corresponding pressure: 21.0 MPa											
at the frame kN	31.4	28.8	27.2	25.9	24.8	24.1	23.9	22.9	22.0	21.5	21.0
Corresponding pressure 21.0 MPa											

3. Drawbar power and fuel consumption (unballasted tractor)
(4 Wheel drive)
Date of tests: 25th January 1991
Type of track: Concrete

	Tyre inflation	
Height	Front	Rear
410 mm	83	83

Gear and Range	Power	Drawbar pull	Speed	Engine speed	Slip of wheels or track	Spec. fuel cons.	Spec. energy	Temperature			Atmospheric conditions		
								Fuel	Coolant	Eng. oil	Temp	Rel. humidity	Pres.
	kW	kN	km/h	rev/min	%	g/kWh	kWh/l	°C	°C	°C	°C	%	kPa
3.1 MAXIMUM POWER IN TESTED GEARS													
1*	36.7	37.1	3.56	2246	15.0	400	2.09	25	75	79	4	70	1028
3LL*	52.8	37.1	5.12	2227	15.0	341	2.46	28	75	92	3	71	1028
3LH**	61.9	34.4	6.47	2105	10.6	313	2.68	28	75	91	3	72	1029
1HL	64.6	32.4	7.19	1986	9.7	307	2.73	32	76	87	4	70	1029
1HH	66.3	25.2	9.46	1981	6.6	298	2.81	32	76	92	3	74	1029
2HL	66.7	21.1	11.36	1992	5.5	297	2.82	32	76	91	3	72	1029
2HH	65.5	16.2	14.57	1985	4.4	303	2.76	33	76	86	3	73	1029
3.2 FUEL CONSUMPTION 3.2.1 In selected gear, at maximum power at rated speed													
2HL	62.0	17.7	12.61	2200	4.7	311	2.70	33	76	88	3	74	1029
3.2.1.1 75% of pull at maximum power at rated speed													
2HL	48.1	13.3	13.06	2248	3.8	340	2.46	30	75	85	3	71	1028
3.2.1.2 50% of pull at maximum power at rated speed													
2HL	32.6	8.9	13.26	2263	2.9	404	2.07	27	75	87	3	73	1028
.1.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.1													
2HH	48.3	13.6	12.78	1730	3.8	288	2.91	30	75	83	3	75	1028
3.2.1.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.2													
2HH	32.5	9.0	13.02	1745	2.9	324	2.58	27	75	83	3	73	1028
3.2.2 In selected gear nearest to 7.5 km/h, at maximum power at rated speed													
3LH	60.0	31.3	6.90	2200	8.9	319	2.63	30	75	92	3	71	1028
3.2.2.1 75% of pull at maximum power at rated speed													
3LH	47.4	23.6	7.23	2242	6.1	336	2.49	29	75	91	3	71	1029
3.2.2.2 50% of pull at maximum power at rated speed													
3LH	32.3	15.7	7.43	2258	4.3	390	2.15	29	75	91	3	71	1029
3.2.2.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.1													
1HL	47.5	23.6	7.26	1917	6.1	284	2.95	28	75	80	3	72	1028
3.2.2.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.2													
1HL	32.5	15.7	7.44	1929	4.3	336	2.49	27	75	81	3	71	1028

*Power limited by wheelslip
**Power limited by wheelslip and bounce

B. SUPPLEMENTARY TESTS

4. SUPPLEMENTARY HYDRAULIC POWER LIFT TEST TO MANUFACTURER'S SETTINGS

4.1 With standard linkage

	At the hitch point	On the frame
Height of lower hitch points above ground in down position	390 mm	390 mm
Vertical movement	583 mm	736 mm
Maximum corrected force exerted through full range	32.5 kN	24.0 kN
Corresponding pressure of hydraulic fluid	21.0 MPa	21.0 MPa
Moment about rear-wheel axis	31.6 kNm	38.0 kNm
Maximum tilt angle of mast from vertical	N/A degrees	12 degrees

- Linkage settings for test - see Table 2.1 and Figures 2.1 and 2.2

Lifting heights relative to the horizontal plane including the lower link pivot points											
mm	-239	-193	-100	-50	0	+50	+100	+200	+300	+390	+497
Lifting forces (the values measured are corrected to correspond to a hydraulic pressure equivalent to 90% of the actual relief valve pressure setting or to maximum power delivered by the hydraulic system, whichever is lower)											
at the hitch points kN	--	40.9	38.0	37.0	36.0	35.1	34.8	33.7	33.0	32.5	--
Corresponding pressure: 21.0 MPa											
at the frame kN	39.8	37.6	34.2	33.0	31.8	30.8	29.9	28.0	26.5	25.1	24.0
Corresponding pressure 21.0 MPa											

5. SUPPLEMENTARY DRAWBAR POWER AND FUEL CONSUMPTION TEST (UNBALLASTED TRACTOR)
(2 wheel drive only)

Date of tests: 29th January 1991
Type of track: Concrete

	Tyre inflation pressure	
Height of drawbar above ground	Front	Rear
590 mm	83 kPa	83 kPa

Gear and Range	Power	Drawbar pull	Speed	Engine speed	Slip of wheels or track	Spec. fuel cons.	Spec. energy	Temperature			Atmospheric conditions		
								Fuel	Cool -ant	Eng. oil	Temp	Rel. humi- dity	Pres.
	kW	kN	km/h	rev/min	%	g/kWh	kWh/l	°C	°C	°C	°C	%	kPa
3.1	MAXIMUM POWER IN TESTED GEARS												
3LL	38.1	26.8	5.12	2247	15.0	381	2.23	24	75	90	2	75	1017
3LH	47.9	26.8	6.43	2232	15.0	356	2.38	26	75	89	2	75	1017
1HL	55.3	26.5	7.51	2213	13.8	340	2.49	28	75	84	2	74	1017
1HH	62.5	25.3	8.89	2000	11.3	315	2.69	28	75	90	2	74	1018
2HL	63.0	21.1	10.74	1983	8.3	311	2.73	31	76	92	1	75	1019
2HH	63.0	16.1	14.06	1991	6.0	311	2.73	31	76	87	1	74	1018
3.2	FUEL CONSUMPTION												
3.2.1	In selected gear, at maximum power at rated speed												
2HL	57.6	17.0	12.18	2204	6.5	327	2.59	31	75	90	1	76	1019
3.2.1.1	75% of pull at maximum power at rated speed												
2HL	44.8	12.8	12.57	2241	5.0	351	2.42	26	75	88	2	74	1018
3.2.1.2	50% of pull at maximum power at rated speed												
2HL	30.3	8.52	12.81	2255	3.6	421	2.02	25	75	91	2	73	1018
3.2.1.3	Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.1												
2HH	43.8	12.8	12.32	1726	5.0	297	2.86	25	74	88	2	74	1017
3.2.1.4	Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.2												
2HH	30.3	8.72	12.53	1733	3.7	335	2.53	26	74	85	1	76	1018
3.2.2	In selected gear nearest to 7.5 km/h, at maximum power at rated speed												
1HH	59.2	21.2	10.07	2194	13.4	321	2.64	29	75	91	1	75	1018
3.2.2.1	75% of pull at maximum power at rated speed												
1HH	47.0	16.0	10.57	2237	8.0	342	2.48	24	74	84	1	75	1018
3.2.2.2	50% of pull at maximum power at rated speed												
1HH	31.8	10.6	10.82	2254	4.4	404	2.10	25	75	84	1	75	1017
3.2.2.3	Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.1												
2HL	46.8	16.0	10.53	1891	6.0	300	2.83	25	74	84	1	75	1017
3.2.2.4	Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.2												
2HL	32.1	10.7	10.81	1912	4.4	343	2.47	25	74	85	1	76	1017

*Maximum power limited by wheelslip

REPAIRS AND ADJUSTMENTS DURING TESTS: None

REMARKS: None

Test carried out by: P C Seward, E Nigro

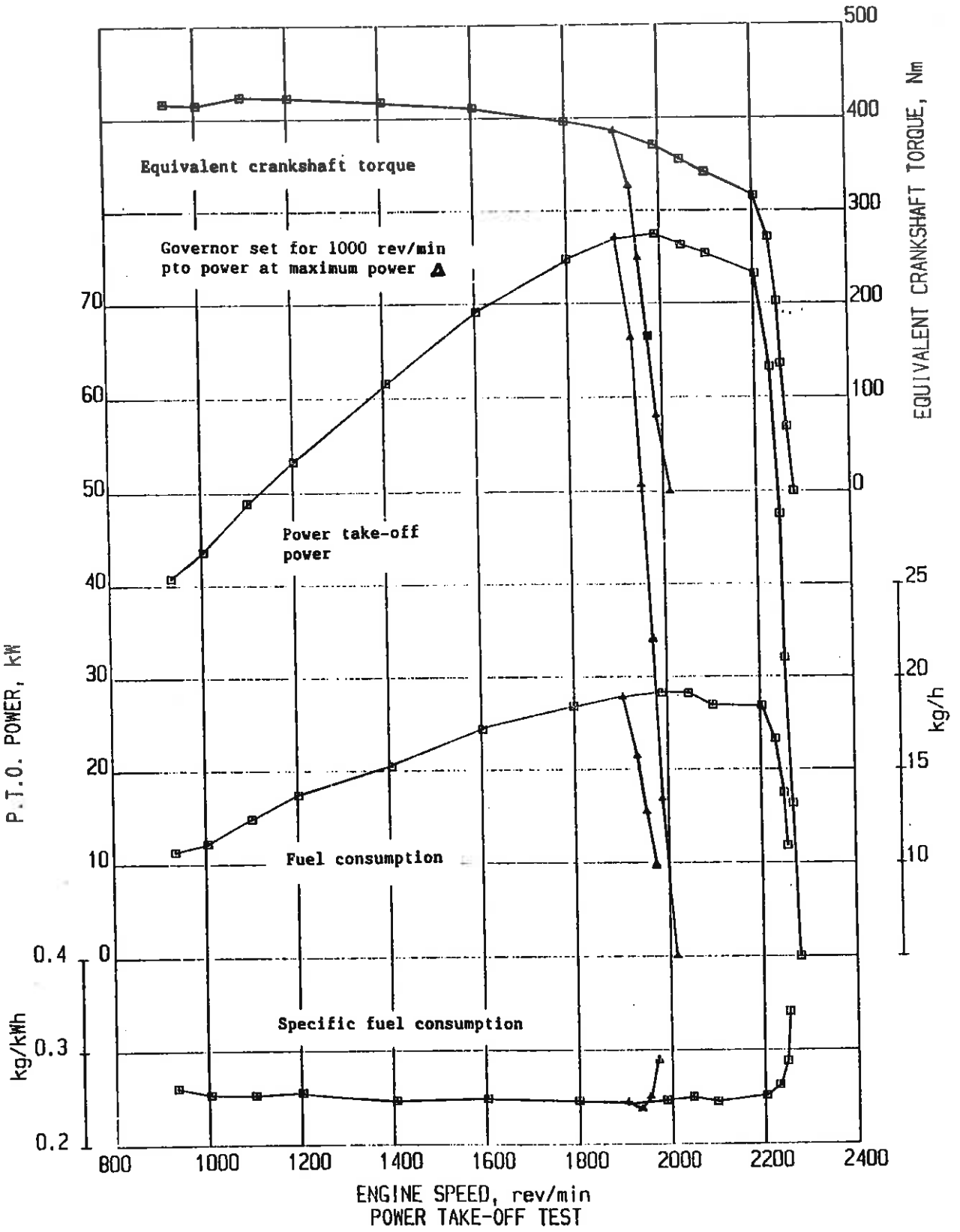
Officer in charge: P C Seward

Signed: H M R Proctor — Head of Test Engineering Group

H M R Proctor — for the Director

Date: 10/7/91

Massey-Ferguson 399 Four-Wheel Drive Tractor with 12-speed Synchromesh Transmission without cab



Massey-Ferguson 399 Four-Wheel Drive Tractor with 12-speed Synchromesh Transmission without cab