SILSOE RESEARCH INSTITUTE
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Report No: R92/71488/OECD
OECD Approval No: 1386 Restricted Code
Approval Date: 8 September 1992

Test in accordance with the OECD Restricted Standard Code for the Official Testing of Agricultural Tractors

Massey-Ferguson 396 Four-Wheel Drive Tractor with 12-speed Transmission



Manufactured by: Massey-Ferguson Tractors Limited
Banner Lane
Coventry
Warwicks CV4 9GF
England

Submitted for test by: The manufacturer

Report No: 749

Date: May 1992

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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, England
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:	58 hours
Location of test:	Silsoe Research Institute Wrest Park, Silsoe, England

I. SPECIFICATION OF TRACTOR

TRACTOR

Make:	Massey-Ferguson
Model:	MF-396 with 12-speed transmission
Type:	Four wheel drive, unit construction
Serial No:	A06486
1st Serial No:	A06486

ENGINE

Make:	Perkins
Model:	1006-6 HR4
Type:	4 stroke, direct injection naturally aspirated diesel
Serial No:	YA31240U538147W (TPL46420)
Ist Serial No:	YA31240U538147W (TPL46420)

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

Make:	None

Fuel system

Fuel feed system:	Superpar mechanical feed pump
Make, type and model of fuel filter:	CAV paper, dual element filter with transparent sediment bowl
Capacity of fuel tank:	114 litres (118 litres without air conditioning)
Make, type and model of injection pump:	CAV distributor, DPA3369F170, Perkins 2643D629, LK/3/2310
Serial No:	24332LJG
Manufacturer's production setting of injection pump:	20.3 to 22.18 l/hr
. Flow rate	51.2-56 mm^3/stroke at 2200 rev/min engine speed at full load on 45°C pump inlet temperature
. Timing	Delivery starts 22° before T.D.C. static
Make, type and model of injectors:	CAV 4-hole, Perkins 2645A032, JU
Injection pressure:	22.3 MPa

Governor

Make:	CAV
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 bonnet, left hand side
Main cleaner:	
. Make	Donaldson
. Type	2 stage, dry paper element
. Model	ELB08-0025
. Location of air intake	From pre-cleaner
Maintenance indicator:	Warning light on instrument panel

Lubrication system

Type of feed pump:	Forced feed from Bi-rotor pump
Type of filter:	Full flow replaceable 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 litres
Type of temperature control:	Thermostat
System pressure:	75 kPa

Starting system

Make:	Magneti Marelll
Model:	M127
Type:	Electrical, pre-engaged, solenoid operated
Starter motor power rating:	2.8 kW
Cold starting aid:	ISKRA induction heater 12V
Safety device:	Operable only when high/low range and pto selectors are in neutral position

Electrical system

Voltage:	12
Generator:	Alternator
. Make	Massey-Ferguson powerpart
. Model	A 127-70
. Type	Belt driven
. Power	0.84 kW
Batteries:	2 M-F Powerpart, type 372 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 bonnet, left hand side
Height of outlet above ground:	2725 mm

TRANSMISSION TO WHEELS

Clutch

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

Gear box

Make:	M-F
Model:	None
Type:	Mechanical manual operation, 3 forward synchromesh combinations and 1 reverse with manually operated high/low reduction epicyclic unit and high/low shift with synchromesh. Three floor mounted levers selects forward and reverse, and range changes.
Number of gears:	12 forward, 4 reverse
Available options:	8 forward, 2 reverse

Rear axle 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	Pedal operated
. Method of disengagement	Pedal operated

Front axle and final drives

Make:	M-F
Model:	None
Type:	Crown wheel and pinion with differential and outboard epicyclic reduction gear final drives

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 diff-lock pedal
. Method of disengagement	Reverse of above

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	273.835	2.33
1	Lh	215.242	2.97
2	Ll	182.557	3.50
2	Lh	143.490	4.45
3	Ll	99.576	6.41
3	Lh	78.268	8.16
1	Hl	66.938	9.54
1	Hh	52.613	12.14
2	Hl	44.625	14.31
2	Hh	35.075	18.21
3	Hl	24.341	26.24
3	Hh	19.135	33.38
Reverse			
R	Lh	182.557	3.50
R	Lh	143.490	4.45
R	Hl	44.625	14.31
R	Hh	35.075	18.21

L = Low range H = High range l = Low reduction h = High reduction

(*) Calculated with a tyre dynamic radius index of 770 mm (ISO 4251/1-1984)
Number of revolutions of front wheels for one revolution of rear wheels: 1.374

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 multiplate
Number of plates:	7
Diameter of plates:	136 mm

Power take-off proportional to engine speed

540 rev/min

Location:	Rear of tractor
Diameter of power take-off shaft:	34.9 mm
Number of splines:	6 to ISO 500
Height above ground:	635 mm
Distance from the median plane of the tractor:	Central
Distance behind rear wheel axis:	438 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:	3.5064:1
Power restriction and maximum torque:	ISO recommendation 48 kW
Direction of rotation (viewed from behind tractor):	Clockwise

1000 rev/min

Location:	Rear of tractor
Diameter of power take-off shaft:	34.9 mm
Number of splines:	21, to ISO 500
Height above ground:	635 mm
Distance from the median plane of the tractor:	Central
Distance behind rear-wheel axis:	387 mm
PTO speed at rated engine speed:	1158 rev/min
Engine speed at standard power take-off speed:	1900 rev/min
Ratio of rotation speeds:	1.900:1
Direction of rotation (viewed from behind tractor):	Clockwise

POWER LIFT

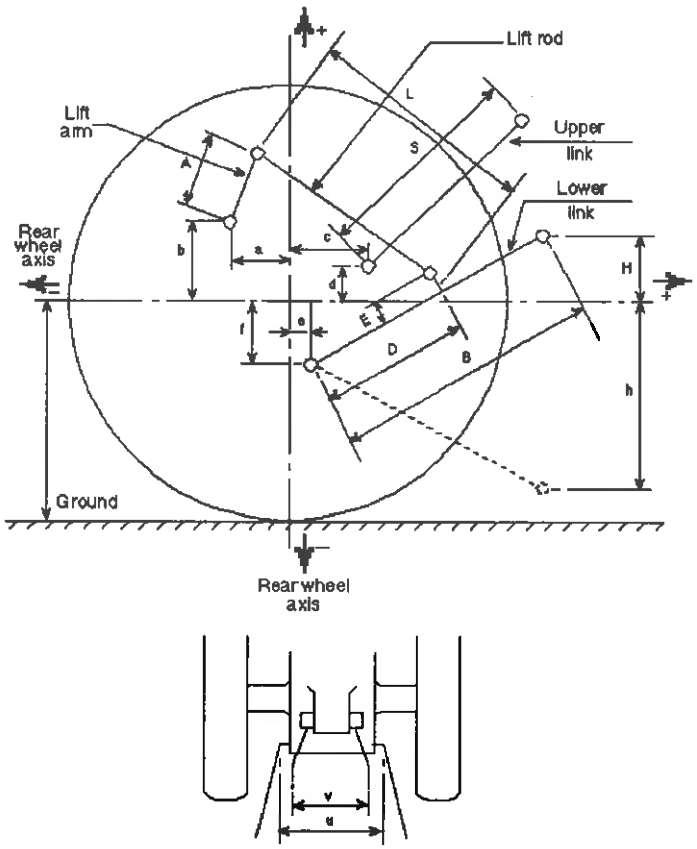
Make:	Massey-Ferguson
Model:	None
Type:	Hydraulic, with inlet suction control closed system
Type and number of cylinders:	1 single acting, internal
Type of linkage lock for transport:	Hydraulic
Relief valve pressure setting:	21.4 - 24.0 MPa
Opening pressure of cylinder safety valve:	None fitted
Lift 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 with metal mesh strainer, 1
Site of oil reservoir:	Transmission housing
Type, number and location of tapping points:	One on centre housing
Maximum volume of oil available to external cylinders:	23.0 litres

AUXILIARY HYDRAULIC SYSTEM

Make:	Sunstrand
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 and number of tapping points:	2 quick release couplings with own spool valves and separate returns to ISO
Maximum volume of oil available to external cylinders:	23.0 litres

THREE-POINT LINKAGE

Category:	2 to ISO standard 730-1:1990
Category adaptor:	None
Controls:	Draught or position control with top link sensing



LIFT TEST
Linkage geometry

Fig 2.1

Table 2.1

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

			Dimensions or range	Setting used in	
				Main Test	Test B2
Length of lift arms:		(A)	267 mm	267 mm	267 mm
Length of lower links:		(B)	1016 mm	1016 mm	1016 mm
Distance of lift arm pivot point from rear wheel centre line:	horizontally: vertically:	(a) (b)	196 mm 233 mm	196 mm 233 mm	196 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)	662 - 862 mm	803 mm	803 mm
Distance of upper link pivot point from rear wheel centre line:	horizontally: vertically:	(c) (d)	186, 200, 216 mm 205, 171, 132 mm	186 mm 205 mm	186 mm 205 mm
Distance of lower link pivot point from rear wheel centre line:	horizontally: vertically:	(e) (f)	32 mm forward 212 mm	32 mm 212 mm	32 mm 212 mm
Distance of lower link points to lift rod pivot points on lower link centre line:	horizontally: vertically:	(D) (E)	546 mm -22, +22 mm	546 mm +22 mm	546 mm +22 mnm
Length of lift rods:		(L)	617 - 740 mm	710 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)	610 - 160 mm	577 mm	452 mm
- in high position		(H)	88 - 302 mm	88 mm	168 mm
Height of lower hitch points when locked in transport position (*):		Any height within lift range (Hydraulic Transport Lock)			

* Assuming r = tyre dynamic radius index of 770 mm ISO 4251/1-1984

SWINGING DRAWBAR

Type:	Clevis
Height above ground, maximum:	428 mm
minimum:	428 mm
Type of adjustment:	None
Distance of hitch point from rear-wheel axis, horizontally:	676 - 803 mm
Distance of hitch point form power take-off shaft ends:	
. Vertically:	207 mm
. Horizontally:	225 - 352 mm (540 PTO) 276 - 403 mm (1000 PTO)
Lateral adjustment (centre of clevis):	
. Right-hand:	149 mm drawbar in 172 mm out
. Left-hand:	149 mm drawbar in 172 mm out
Distance of pivot point from rear axles horizontally:	133 mm forward
Width of clevis:	50 mm
Diameter of drawbar pin hole:	27 mm
Maximum vertical permissible load:	16 kN

TRAILER HITCH

Type:	None fitted
Hole diameter:	--

LINKAGE DRAWBAR

Type:	None fitted
Height above ground	
• Minimum	--
• Maximum	--

FRONT TOWING HITCH

Type:	Clevis in front weight frame
Vertical height to centre of clevis:	805 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 multiplate discs, 4 per side
Method of operation:	Independent or combined pedal hydraulic 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 steering and driving
. Rear	2 driving
Wheelbase:	2640 mm

Track width adjustment:

	Minimum, mm	Maximum, mm	Adjustment method
Front	1617*	1943	By reversing wheels and offset lug rims
Rear	1516	2326	Power assisted variable track and reversing wheels

* Limited by 40° steering angle setting device

PROTECTIVE STRUCTURE

Make:	GKN Sankey Industrial Products
Model:	Hi-Line
Type:	Safety cab
Manufacturer's name and address:	GKN Sankey Industrial Productions, Hadley Castle Works, P O Box 86, Telford TF1 4RE
Protective device:	
. Rollguard	Safety cab
. Tiltable/Not tiltable	Non tiltable
OECD approval number:	CSD 1165/15

DRIVER'S SEAT

Make/Model/Type:	Bostrom Viking, KAB303
Type of suspension:	Spring
Type of damping:	Hydraulic
Range of adjustment:	
. Longitudinal	140 mm
. Vertical	60 mm

LIGHTING

Unrestricted beam angle of headlight in plan view: 110°

	Height above ground to centre, mm	Size, mm	Distance from outside edge to median plane of tractor, mm
Headlight	1360	90 x 150	220
Sidelights	None	-	-
Rear lights	1770	90 x 50	640
Axle reflectors	730	80 dia	490
Cab reflectors	1770	42 x 50	685

II. TEST CONDITIONS

Overall dimensions (overall width at 1620 measured front track)

Length mm	Width		Height at top of	
	Minimum mm	Maximum mm	Protective structure mm	Exhaust pipe mm
4310	1986	2796	2730	2730

Ground clearance (unballasted tractor) 364 mm

Clearance-limiting part: Drawbar clevis

Tractor mass (with safety cab)

	Unballasted		Ballasted	
	Without driver kg	With driver kg	Without driver kg	With driver kg
Front	1613	1624	--	--
Rear	2578	2642	--	--
Total	4191	4266	--	--

Tyres and track width specification

	Front	Rear
Tyres . dimensions . ply rating . type	14.9 x 24 8 Cross ply	18.4 x 34 6 Cross ply
Maximum load (tyre manufacturer's), kg	1760	2250
Maximum load (tractor manufacturer's), kg	1760	2250
Inflation pressure (tyre manufacturer's), Bar	180 kPa	110 kPa
Dynamic radius index	590	770
Chosen track width (manufacturer's nominal)	1490	1500

Oils and lubrication

Capacity and change interval

	Capacity l	Oil change h	Filter change h
Engine	7.7	250	250
Front axle	5.5	1000	None
Final drive (front)	2.8	1000	None
Gearbox	49.8	1000	1200
Rear axle Hydraulic system) Final drives (rear)) Steering	Integral with rear axle		
Brakes	--	Top-up	None

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 kg/l at 15°C

Oils	Recommended	Used during test
Engine oil		
Type:	SAE 15W/40	As recommended
Viscosity:	54 cSt at 50°C	
Classification:	MIL-L-2104-C	
Transmission oils		
Type:	SAE 15W/30	As recommended
Viscosity:	54 cSt at 50°C	
Classification:	MIL-L-2104-C	
Rear final drives		
Type:	SAE 15W/30	As recommended
Viscosity:	54 cSt 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: 30 March 1992
Silsoe Research Institute,
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						
65.9	2200	628	17.03	20.33	258	3.28
1.2 POWER AT RATED ENGINE SPEED						
65.9	2200	628	17.03	20.33	258	3.28
1.3 STANDARD POWER TAKE-OFF SPEED (540 ± 10 rev/min)						
61.6	1896	541	15.35	18.31	249	3.36
1.4 PART LOADS 1.4.1 The torque corresponding to maximum power at rated engine speed						
65.9	2200	628	17.03	20.33	258	3.28
1.4.2 85% of the torque defined in 1.4.1						
56.6	2226	635	15.24	18.18	268	3.11
1.4.3 75% of the torque defined in 1.4.2						
42.7	2238	638	12.43	14.83	290	2.88
1.4.4 50% of the torque defined in 1.4.2						
28.8	2250	642	9.95	11.88	346	2.42
1.4.5 25% of the torque defined in 1.4.2						
14.4	2264	646	7.44	8.87	518	1.61
1.4.6 Unloaded						
0	2300	656	5.31	6.33	--	--

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 1.5.1	PART LOADS AT STANDARD POWER TAKE-OFF SPEEDS (± 10 rev/min) The torque corresponding to maximum power					
61.6	1896	541	15.35	18.31	249	3.36
1.5.2	85% of the torque obtained in 1.5.1					
52.6	1909	545	13.02	15.45	248	3.38
1.5.3	75% of the torque obtained in 1.5.2					
39.9	1927	550	10.70	12.77	268	3.12
1.5.4	50% of the torque obtained in 1.5.2					
26.8	1944	554	8.25	9.84	308	2.72
1.5.5	25% of the torque obtained in 1.5.2					
13.5	1964	560	6.00	7.16	444	1.88
1.5.6	Unloaded					
0	1988	570	3.99	4.76	--	--

No load, maximum engine speed: 2300 rev/min

Torque (equivalent crankshaft) at maximum power: 286.0 Nm

Maximum torque (equivalent crankshaft) (engine speed 1386 rev/min): *

Mean atmospheric conditions:

- Temperature 20°C
- Pressure 985 m bar
- Relative humidity 41%

Maximum temperatures:

- Coolant 82°C
- Engine oil 105°C
- Fuel 45°C
- Engine air intake 20°C

* Maximum torque of 344.2 Nm measurable within limits of test equipment. Speed for maximum torque measured on 1000 rev/min shaft was 1161 rev/min.

2. HYDRAULIC POWER AND LIFTING FORCE

Date of tests: 9 April 1992

2.1 Hydraulic power test

Sustained pressure with relief valve open: 24.0 MPa

Pump delivery rate at minimum pressure: 28.8 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	25.1	21.6	9.0
Flow rate and hydraulic pressure corresponding to maximum hydraulic power	26.8	21.0	9.38

Tapping point used for test: Auxiliary service connection

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

Opening pressure of the unloading valve: -- MPa

Closing pressure of the unloading valve: -- MPa

2.2 Power lift test - (To ISO 730-1:1990)

	At the hitch point	On the frame
Height of lower hitch points above ground in down position	193 mm	193 mm
Vertical movement	665 mm	835 mm
Maximum corrected force exerted through full range	23.5 kN	19.9 kN
Corresponding pressure of hydraulic fluid	21.6 MPa	21.6 MPa
Moment about rear-wheel axis	23.1 kNm	31.7 kNm
Maximum tilt angle of mast from vertical	--	10 degrees

- Linkage settings for test - see Table 2.1 and Figure 2.1

Lifting heights relative to the horizontal plane including the lower link pivot points											
mm	-430	-365	-265	-115	0	85	135	185	235	300	405
Lifting forces (the values measured are corrected to correspond to a hydraulic pressure equivalent to 90% of the actual relief valve pressure delivered by the hydraulic system)											
at the hitch points kN	--	23.5	25.2	26.7	27.4	27.8	27.8	27.9	28.0	28.4	--
Corresponding pressure: 21.6 MPa											
at the frame kN	20.2	20.6	21.1	21.6	21.6	21.4	21.2	21.0	20.8	20.6	18.9
Corresponding pressure: 21.6 MPa											

3. DRAWBAR POWER AND FUEL CONSUMPTION TEST (UNBALLASTED TRACTOR, 4 WHEEL DRIVE)

Date and location of tests: 10 April 1992
Silsoe Research Institute
Wrest Park
Silsoe

Type of track: Concrete

	Tyre inflation pressure (kPa)	
Height of drawbar above ground	Front	Rear
430 mm	180	110

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	Pressure
	kW	kN	km/h	rev/min	%	g/kwh	kWh/l	Deg.C	Deg.C	Deg.C	Deg.C	%	kPa
3.1 MAXIMUM POWER IN TESTED GEARS													
LL2	31.3	36.6	3.08	2255	15.0	397	2.11	38	78	105	18	31	101.5
LH2	39.8	36.6	3.94	2247	15.0	378	2.22	39	78	105	18	30	101.5
LL3	51.3	32.4	5.70	2199	12.6	337	2.49	40	78	100	15	39	101.7
LH3	53.1	25.0	7.64	2206	8.3	325	2.58	38	78	103	15	39	101.7
HL1	54.7	21.6	9.10	2207	6.5	318	2.64	42	79	108	17	33	101.6
HH1	54.3	16.6	11.78	2207	4.9	327	2.56	39	78	103	15	37	101.7
3.2 FUEL CONSUMPTION 3.2.1 In selected gear, at maximum power at rated speed													
HL1	54.7	21.6	9.10	2207	6.5	318	2.64	42	79	108	17	33	101.6
3.2.1.1 75% of pull at maximum power at rated speed													
HL1	43.0	16.4	9.45	2249	4.8	344	2.44	41	78	108	17	31	101.6
3.2.1.2 50% of pull at maximum power at rated speed													
HL1	28.6	10.7	9.67	2263	3.2	405	2.07	40	76	109	17	33	101.6
3.2.1.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.1													
LH1	42.8	16.3	9.47	1769	4.6	307	2.73	40	77	101	17	32	101.6
3.2.1.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.2													
HH1	28.7	10.7	9.65	1775	3.2	329	2.55	40	77	102	17	31	101.6
3.2.2 In selected gear nearest to 7.5 km/h, at maximum power at rated engine speed													
LH3	53.1	25.0	7.64	2206	8.3	325	2.58	38	78	103	15	39	101.7
3.2.2.1 75% of pull at maximum power at rated speed													
LH3	41.8	18.8	8.01	2248	5.6	347	2.42	41	78	108	17	34	101.6
3.2.2.2 50% of pull at maximum power at rated speed													
LH3	28.6	12.5	8.21	2261	3.7	400	2.10	40	78	109	17	33	101.6
3.2.2.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.1													
HL1	41.6	18.7	8.01	1921	5.5	306	2.74	41	78	107	17	33	101.6
3.2.2.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.2													
HL1	28.8	12.6	8.22	1937	3.8	338	2.48	40	77	106	17	32	101.6

TEST RESULTS

B. SUPPLEMENTARY TEST RESULTS

1. MAIN POWER TAKE-OFF (Optional 1000 rev/min shaft)

Date and location of tests: 30 March 1992
Silsoe Research Institute,
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						
66.7	2200	1158	17.35	20.71	260	3.22
1.2 POWER AT RATED ENGINE SPEED						
66.7	2200	1158	17.35	20.71	260	3.22
1.3 STANDARD POWER TAKE-OFF SPEED (1000 ± 10 rev/min)						
62.5	1898	999	15.21	18.15	243	3.44
1.4 PART LOADS 1.4.1 The torque corresponding to maximum power at rated engine speed						
66.7	2200	1158	17.35	20.71	260	3.22
1.4.2 85% of the torque defined in 1.4.1						
57.5	2234	1176	15.25	18.20	265	3.15
1.4.3 75% of the torque defined in 1.4.2						
43.3	2246	1182	12.74	15.20	294	2.84
1.4.4 50% of the torque defined in 1.4.2						
28.8	2260	1190	9.93	11.86	344	2.43
1.4.5 25% of the torque defined in 1.4.2						
14.9	2267	1193	7.99	9.53	537	1.56
1.4.6 Unloaded						
0	2299	1209	5.34	6.37	--	--

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	
3						
1.5	PART LOADS AT STANDARD POWER TAKE-OFF SPEEDS (± 10 rev/min)					
1.5.1	The torque corresponding to maximum power					
62.5	1898	999	15.21	18.15	243	3.44
1.5.2	85% of the torque obtained in 1.5.1					
53.8	1926	1013	13.36	15.94	248	3.37
1.5.3	75% of the torque obtained in 1.5.2					
41.0	1941	1022	10.92	13.03	266	3.14
1.5.4	50% of the torque obtained in 1.5.2					
27.6	1958	1030	8.50	10.15	307	2.72
1.5.5	25% of the torque obtained in 1.5.2					
13.8	1974	1039	6.20	7.40	448	1.86
1.5.6	Unloaded					
0	2006	1056	4.04	4.82	--	--

No load, maximum engine speed: 2299 rev/min

Torque (equivalent crankshaft) at maximum power: 289.6 Nm

Maximum torque (equivalent crankshaft) (engine speed 1161 rev/min): 359.2 Nm

Mean atmospheric conditions:

- Temperature 21°C
- Pressure 984 m bar
- Relative humidity 43%

Maximum temperatures:

- Coolant 81°C
- Engine oil 108°C
- Fuel 45°C
- Engine air intake 22°C

B. SUPPLEMENTARY POWER LIFT TESTS

2. Power lift test - (To manufacturers lift rod setting)

	At the hitch point	On the frame
Height of lower hitch points above ground in down position	318 mm	318 mm
Vertical movement	620 mm	785 mm
Maximum corrected force exerted through full range	26.1 kN	20.1 kN
Corresponding pressure of hydraulic fluid	21.6 MPa	21.6 MPa
Moment about rear-wheel axis	25.7 kNm	32.0 kNm
Maximum tilt angle of mast from vertical	--	14 degrees

Linkage settings for test - see Table 2.1 and Figure 2.1

Lifting heights relative to the horizontal plane including the lower link pivot points											
mm	-275	-240	-115	-55	0	35	135	185	285	380	510
Lifting forces (the values measured are corrected to correspond to a hydraulic pressure equivalent to 90% of the actual relief valve pressure delivered by the hydraulic system)											
at the hitch points kN	--	26.1	27.8	28.3	28.8	29.0	29.5	29.6	29.7	29.8	--
Corresponding pressure: 21.6 MPa											
at the frame kN	21.8	21.9	22.7	22.7	22.7	22.6	22.4	22.2	21.6	20.9	20.1
Corresponding pressure: 21.6 MPa											

B. SUPPLEMENTARY DRAWBAR TEST

3. DRAWBAR POWER AND FUEL CONSUMPTION TEST (UNBALLASTED TRACTOR, 2 WHEEL DRIVE)

Date and location of tests: 13 April 1992
Silsoe Research Institute
Wrest Park
Silsoe

Type of track: Concrete

	Tyre inflation pressure (kPa)	
Height of drawbar above ground	Front	Rear
430 mm	160	110

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	Pressure
	kW	kN	km/h	rev/min	%	g/kwh	kWh/l	Deg.C	Deg.C	Deg.C	Deg.C	%	kPa
3.1 MAXIMUM POWER IN TESTED GEARS													
LH2	29.9	27.5	3.91	2263	15.0	409	2.05	32	77	102	10	56	100.0
LL3	43.1	27.5	5.63	2250	15.0	346	2.42	33	78	96	10	61	100.0
LH3	50.5	25.5	7.14	2209	13.8	345	2.43	34	78	86	9	64	100.2
HL1	53.6	22.4	8.61	2205	11.0	333	2.52	31	77	95	9	63	100.2
HH1	55.3	17.6	11.32	2197	7.7	316	2.65	35	78	101	9	65	100.2
HL2	56.7	15.0	13.59	2206	6.3	316	2.65	35	78	102	9	63	100.2
HH2	55.9	11.4	17.65	2210	4.7	315	2.66	35	78	99	9	63	100.1
3.2 FUEL CONSUMPTION 3.2.1 In selected gear, at maximum power at rated speed													
HL2	56.7	15.0	13.59	2206	6.3	316	2.65	35	78	102	9	63	100.2
3.2.1.1 75% of pull at maximum power at rated speed													
[illegible]2	44.5	11.3	14.18	2255	4.4	313	2.68	32	77	101	10	63	100.1
3.2.1.2 50% of pull at maximum power at rated speed													
HL2	30.5	7.6	14.47	2268	3.0	375	2.24	33	77	102	10	63	100.1
3.2.1.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.1													
HH2	44.5	11.3	14.18	1773	4.5	290	2.89	33	77	93	10	61	100.0
3.2.1.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.2													
HH2	30.7	7.6	14.47	1783	3.1	333	2.51	33	77	93	10	62	100.0
3.2.2 In selected gear nearest to 7.5 km/h, at maximum power at rated engine speed													
LH3	50.5	25.5	7.14	2209	13.8	345	2.43	34	78	86	9	64	100.2
3.2.2.1 75% of pull at maximum power at rated speed													
LH3	41.2	19.1	7.77	2255	8.2	357	2.35	31	77	100	10	63	100.1
3.2.2.2 50% of pull at maximum power at rated speed													
LH3	28.2	12.6	8.08	2270	5.1	395	2.12	32	77	99	10	62	100.1
3.2.2.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.1													
HL1	41.0	19.1	7.74	1925	8.3	302	2.78	32	77	96	10	59	100.0
3.2.2.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.2													
HL1	28.0	12.5	8.09	1944	5.1	339	2.47	31	77	94	10	61	100.0

REPAIRS AND ADJUSTMENTS DURING TESTS: None

REMARKS: None

Test carried out by: E Nigro

Officer in charge: P C Seward

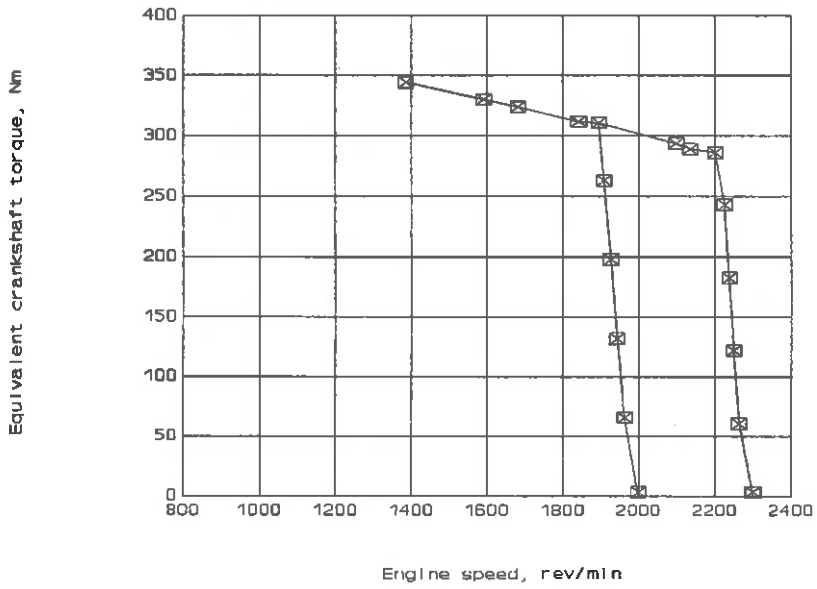
Signed: H M R Proctor — Head of Test Engineering Group

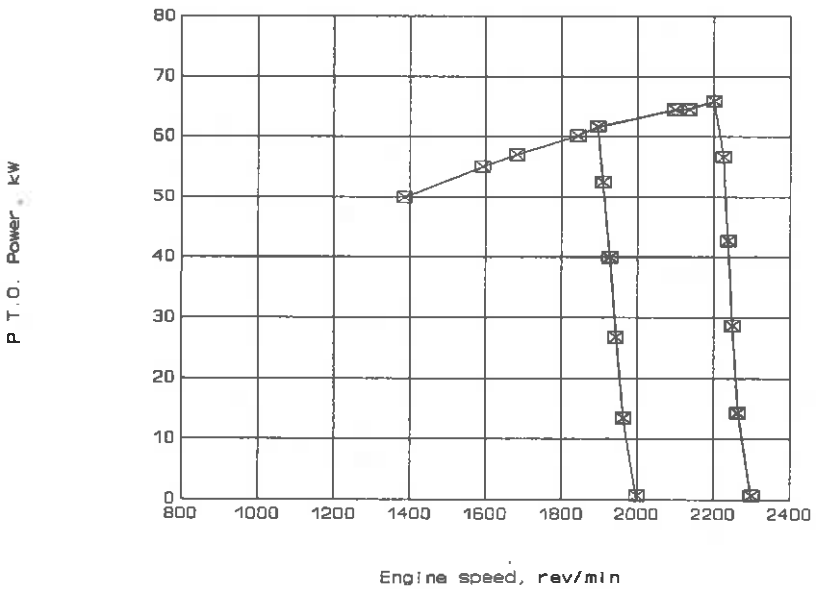
H M R Proctor — for the Director

Date: 19/5/92.

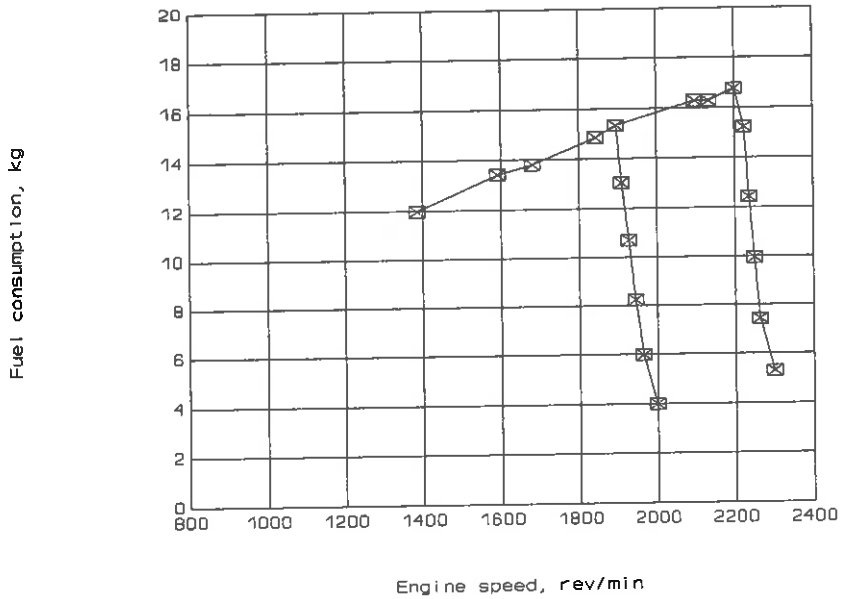
ANNEX 1

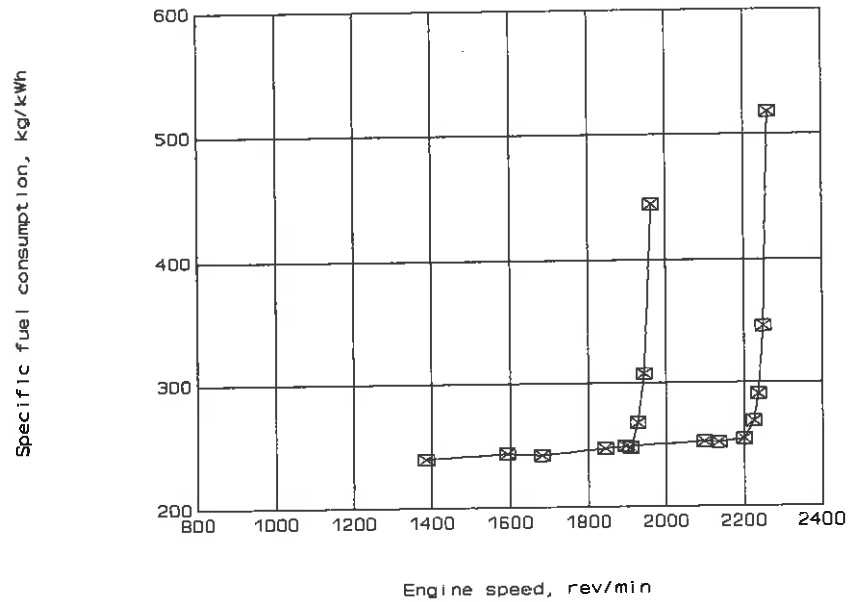
P.T.O. POWER TEST - MF 396 4WD (540 rev/min shaft)



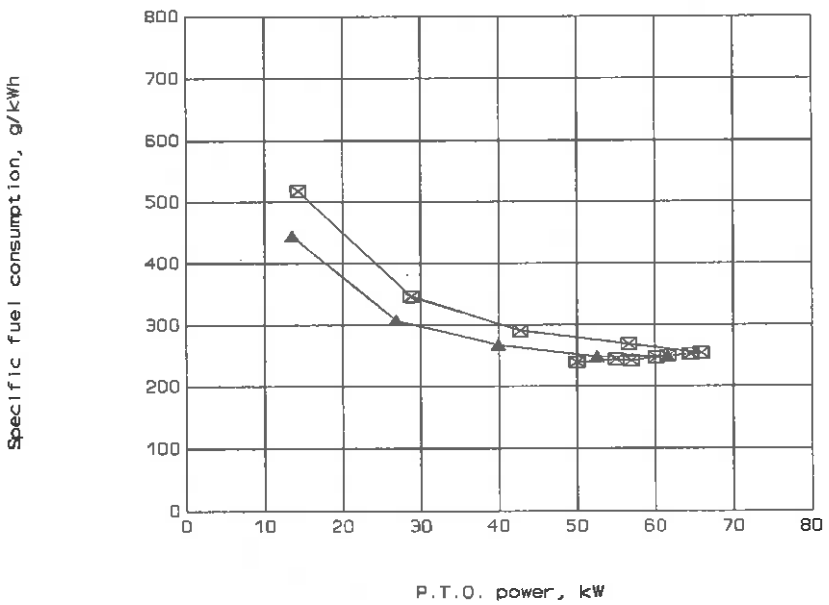


P.T.O. POWER TEST - MF 396 4WD (540 rev/min shaft)



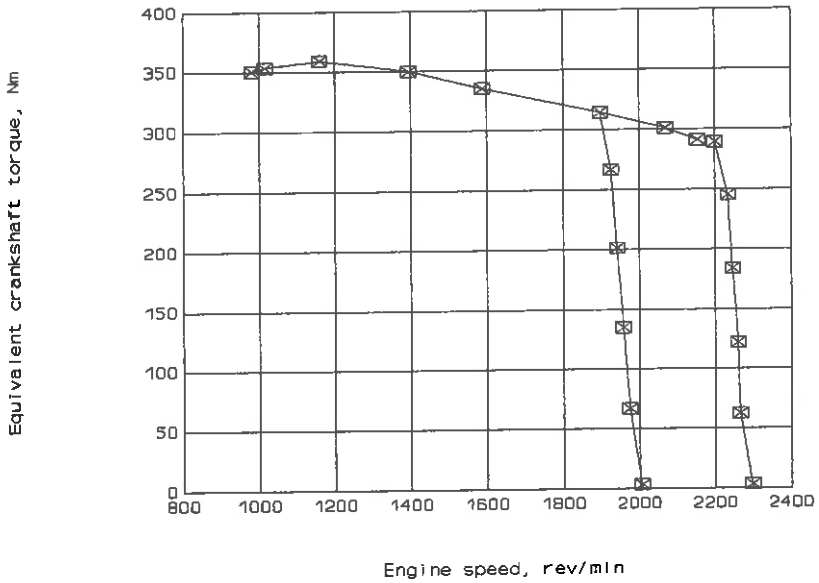


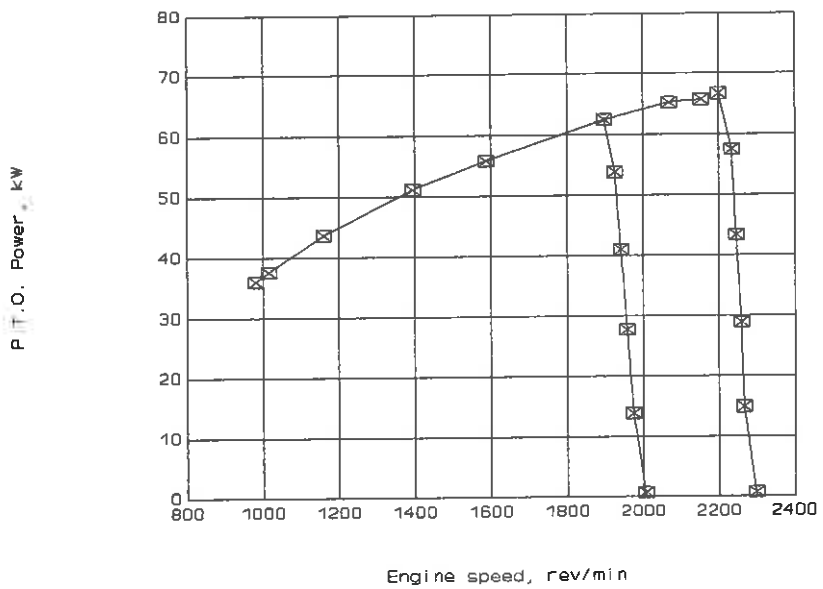
P.T.O. POWER TEST - MF 396 4WD (540 rev/min shaft)



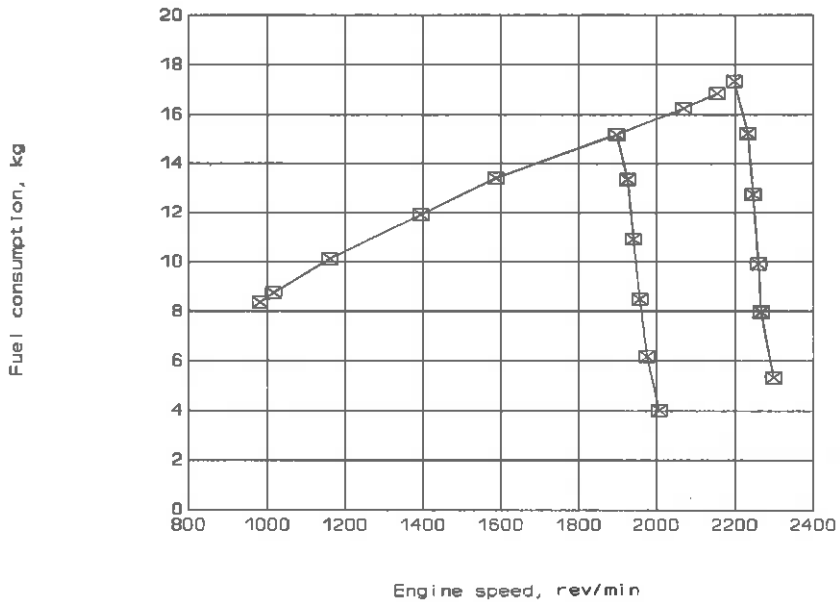
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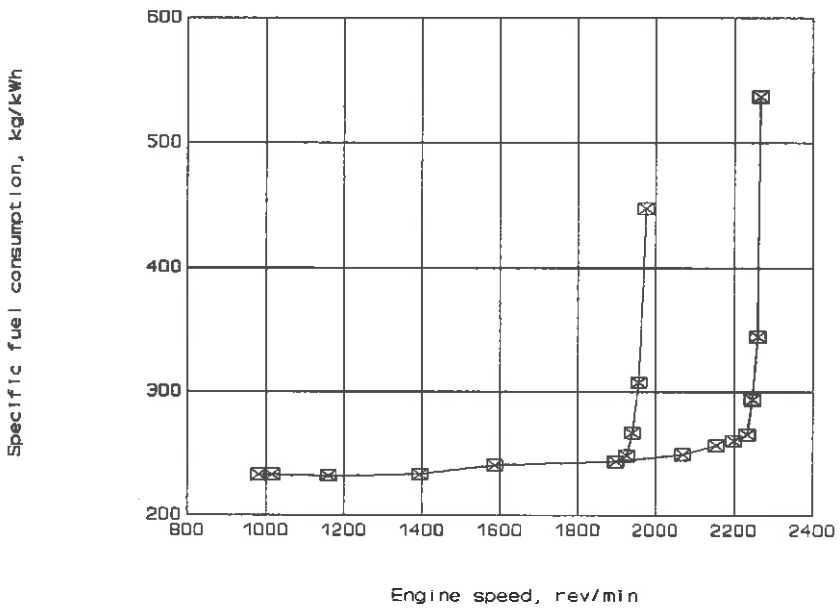
P.T.O. POWER TEST - MF 396 4WD (1000 rev/min shaft)





P.T.O. POWER TEST - MF 396 4 WD (1000 rev/min shaft)





P.T.O. POWER TEST - MF 396 4 WD (1000 rev/min shaft)

