SILSOE RESEARCH INSTITUTE
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Report No: R92/71464/OECD
OECD Approval No: 1435 Restricted Code
Approval Date: 30 March 1993

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

Ford New Holland 6640 (EA51) Four-Wheel Drive Tractor with 12-speed Synchromesh Transmission



Manufactured by: Ford New Holland Ltd
Basildon
Essex
England

Submitted for test by: The manufacturer

Report No: 762

Date: September 1992

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Tractor manufacturer's name and address:	Ford New Holland Ltd Basildon, Essex, England
Location of tractor assembly:	Basildon, Essex
Submitted for test by:	The manufacturer
Selected for test by:	The manufacturer
Place of running in:	Basildon, Essex
Duration of running in:	115 hours
Location of test:	Silsoe Research Institute Wrest Park, Silsoe, Bedford, England

I. SPECIFICATION OF TRACTOR

Tractor

Make:	Ford New Holland
Model:	6640 (EA51)
Type:	Four wheel drive
Serial No:	BD05914
1st Serial No:	BC80959

Engine

Make:	Ford New Holland (PowerStar™)
Model:	NA 304 CID NA
Type:	4 stroke naturally aspirated direct injection diesel
Serial No:	NA335226

Cylinders

Number/disposition:	4 vertical Inline
Bore/stroke:	111.8 mm/127.0 mm
Capacity:	4987 cm^3
Compression ratio:	17.5:1
Arrangement of valves:	Overhead
Cylinder liners:	None, monobloc construction

Supercharging

Make:	Not fitted

Fuel system

Fuel feed system:	Gravity
Make, type and model of fuel filter:	Plastic strainer in tank and CAV paper element filter with sediment bowl and water trap between tank and injection pump
Capacity of fuel tank:	103.4 ℓ
Make, type and model of injection pump:	Lucas CAV DPS-DSA 995
Serial No:	23702 LJG
Manufacturer's production setting of injection pump:	
. Flow rate:	63.0 - 67.0 mm^3 per stroke at 850 rev/min pump speed and full load
. Timing:	Delivery starts 10° before T.D.C.
Make, type and model of injectors:	CAV multihole JB 6801133 nozzle
Injection pressure:	240 - 248 Bar

Governor

Make:	CAV
Model:	None
Type:	Mechanical incorporated in fuel injection pump
Governed range of engine speed:	700 rev/min to 2345 rev/min
Rated engine speed:	2200 rev/min Reduced to 2170 rev/min in EEC and EFTA countries to comply with road speed requirements

Air cleaner

Pre-cleaner:	None
Main cleaner:	
. Make:	Locker Air Maze
. Type:	Dry paper element (Exhaust Aspirated)
. Model:	3 stage
. Location of air intake:	Under bonnet above and forward of radiator
Maintenance indicator:	Warning light on instrument panel

Lubrication system

Type of feed pump:	Forced feed from eccentric rotor pump
Type of filter:	Metal mesh strainer in sump and full flow replaceable paper element filter
Number:	1

Cooling system

Type of coolant:	Water and antifreeze 50% solution
Type of pump:	Centrifugal impeller
Specification of fan:	Belt driven puller with thermally controlled viscous clutch
Number of fan blades:	5
Fan diameter:	480 mm
Coolant capacity:	16 ℓ
Type of temperature control:	Thermostat
System pressure:	90 kPa

Starting system

Make:	Bosch
Model:	JF
Type:	Electrical, positive engagement, solenoid operated
Starter motor power rating:	3.1 kW
Cold starting aid:	CAV Thermostart
Safety device:	Only operable when all gear levers are in neutral and PTO switch is in 'off' position

Electrical system

Voltage:	12 V
Generator:	
. Make:	Magnetti Marelli
. Model:	A 127 I
. Type:	Belt driven alternator
. Power:	100 amps at 6000 rev/min
Batteries:	Lucas lead acid
. Rating:	107 Ah at 20 hours rating

Exhaust system

Make:	Nelson Burgess
Model:	None
Type:	Horizontal silencer under bonnet with vertical stack pipe
Location:	Under left-hand front bonnet
Height of outlet above ground:	2866 mm

Transmission to wheels

Clutch

	Transmission only
Make:	AP
Model:	None
Type:	Single dry plate
Number of plates:	1
Diameter of plates:	330 mm
Method of operation:	Hydraulic via foot pedal

Gear box

Make:	Ford New Holland (Synchroshift™)
Model:	12 x 12 Synchromesh
Type:	Mechanical manual synchromesh operation, 4-speed and 3 ranges selected with two side mounted levers. A third side mounted lever selects forward or reverse for each combination
Number of gears:	12 forward, 12 reverse
Available options:	16 x 16 Power shift

Rear axle and final drives

Make:	Ford New Holland
Model:	None
Type:	Crown wheel and pinion with differential and epicyclic reduction gear final drive

Differential lock:

. Type:	Mechanical
. Method of engagement:	Electro-hydraulic actuation in response to signal from switch on the right hand control panel
. Method of disengagement:	Via panel switch or in response to electric signal from brakes on application

Front axle and final drives

Make:	Carraro
Model:	709/S
Type:	Crown wheel and pinion with differential and epicyclic reduction gear final drives

Differential lock:

. Type:	Limited slip
. Method of engagement:	Automatic
. 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	2170 rev/minø km/h
Forward				
1	L	324.45	2.03	2.00
2	L	222.97	2.96	2.92
3	L	164.25	4.01	3.95
4	L	106.58	6.19	6.10
1	M	143.22	4.60	4.54
2	M	98.42	6.70	6.61
3	M	72.50	9.09	8.97
4	M	47.04	14.02	13.83
1	H	65.00	10.14	10.01
2	H	44.67	14.76	14.56
3	H	32.91	20.04	19.77
4	H	21.35	30.88	30.46
Reverse				
1	L	316.34	2.08	2.05
2	L	217.39	3.03	2.99
3	L	160.15	4.12	4.06
4	L	103.91	6.35	6.26
1	M	139.64	4.72	4.66
2	M	95.96	6.87	6.78
3	M	70.69	9.33	9.20
4	M	45.87	14.37	14.17
1	H	63.37	10.40	10.26
2	H	43.55	15.14	14.93
3	H	32.08	20.55	20.27
4	H	20.82	31.67	31.24

L = Low range M = Mid range H = High range

(*) 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: 1.3442

(ø) Restricted to 2170 rev/min in EEC and EFTA countries.

Power take-off

Main power take-off

Type:	Independent
Method of engagement:	Electro - hydraulically operated multi-plate clutch in response to signal from switch on right hand control panel
Number of shafts:	1, (can be exchanged to give either 6 or 21 splines)
Method of changing power take-off speeds:	
Two speed Shiftable (fitted)	Manually by hand lever in cab

Clutch

Make:	Ford New Holland
Model:	None
Type:	Wet multiplate
Number of plates:	5
Diameter of plates:	148.6 mm

Two speed shiftable power take-off
(Fitted for test)

	540 rev/min	1000 rev/min
Location:	Rear of tractor	Rear of tractor
Diameter of power take-off shaft:	34.9 mm	34.9 mm
Number of splines:	6 or 21	6 or 21
Height above ground:	748 mm	748 mm
Distance from the median plane of the tractor:	Central	Central
Distance behind rear wheel axis:	457 mm	457 mm
Pto speed at rated engine speed:	629 rev/min at 2200 620 rev/min at 2170	1046 rev/min at 2200 1032 rev/min at 2170
Engine speed at standard power take-off speed:	1890 rev/min	2103 rev/min*
Ratio of rotation speeds:	3.50:1	2.103:1
Power restriction and maximum torque:	None	None
Direction of rotation (viewed from behind tractor):	Clockwise	Clockwise

* (also provides Economy 540 rpm pto speed at 1135 engine rpm)

Optional PTO systems available (not fitted for test)

Two speed power take-off proportional to engine speed - changeable shafts

540 rev/min

Location:	Rear of tractor
Diameter of power take-off shaft:	34.9 mm
Number of splines:	6
Height above ground:	748 mm
Distance from the median plane of the tractor:	Central
Distance behind rear wheel axis:	457 mm
Pto speed at rated engine speed:	629 rev/min at 2200 620 rev/min at 2170
Engine speed at standard power take-off speed:	1890 rev/min
Ratio of rotation speeds:	3.50:1
Power restriction and maximum torque:	None
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
Height above ground:	748 mm
Distance from the median plane of the tractor:	Central
Distance behind rear wheel axis:	457 mm
Pto speed at rated engine speed:	1074 rev/min at 2200 1059 rev/min at 2170
Engine speed at standard power take-off speed:	2049 rev/min
Ratio of rotation speeds:	2.049:1
Power restriction and maximum torque:	None
Direction of rotation (viewed from behind tractor):	Clockwise

Single speed 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
Height above ground:	748 mm
Distance from the median plane of the tractor:	Central
Distance behind rear-wheel axis:	457 mm
PTO speed at rated engine speed:	625 rev/min at 2200 616 rev/min at 2170
Engine speed at standard power take-off speed:	1902 rev/min
Ratio of rotation speeds:	3.522:1
Power restriction and maximum torque:	None
Direction of rotation (viewed from behind tractor):	Clockwise

Power lift

Make:	Sauer Sundstrand
Model:	None
Type:	Gear type, fixed displacement closed centre load sensing system
Type and number of cylinders:	1 located inside of transmission housing plus the option of an additional externally mounted, single acting (1 fitted for test)
Type of linkage lock for transport:	Hydraulic
Relief valve pressure setting:	18.0 - 18.7 MPa
Opening pressure of cylinder safety valve:	19.7 MPa
Lift pump type:	None
Transmission between pump and engine:	Gear driven from pto shaft, independent of main and pto clutches
Type and number of filters:	1, Replaceable paper element filter canister
Site of oil reservoir:	Rear axle housing
Type, number and location of tapping points:	1, Front face of hydraulic top cover
Maximum volume of oil available to external cylinders:	18.2 ℓ

Auxiliary Hydraulic System

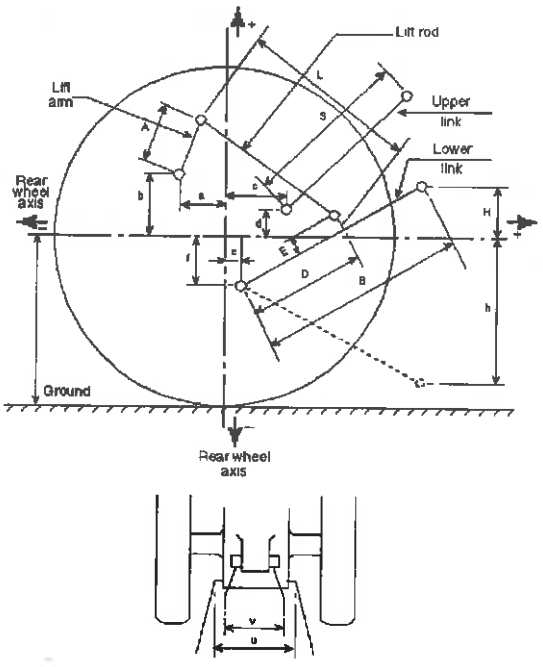
Make:	Sauer Sundstrand
Model	None
Type:	Gear type
Relief valve pressure setting:	18.0 - 18.7 MPa
Lift pump type:	None
Transmission between pump and engine:	Direct drive from camshaft gear
Type and number of filters:	1, replaceable paper element canister
Site of oil reservoir:	Rear axle housing

Alternative power lift system available (not fitted for test)

Make:	Sauer Sundstrand
Model:	None
Type:	Piston type, variable displacement closed centre load sensing system
Type and number of cylinders:	1 located inside of transmission housing plus the option of an additional 1 or 2 externally mounted, single acting
Type of linkage lock for transport:	Hydraulic
Relief valve pressure setting:	19.0 - 19.7 MPa
Opening pressure of cylinder safety valve:	19.7 MPa
Lift pump type:	None
Transmission between pump and engine:	Gear driven from pto shaft, independent of main and pto clutches
Type and number of filters:	3, replaceable paper element filter canisters
Site of oil reservoir:	Rear axle housing
Type, number and location of tapping points:	1, Front face of hydraulic top cover
Maximum volume of oil available to external cylinders:	18.2 ℓ

Three-point linkage

Category:	2 to ISO standard 730-1:1990
Category adaptor:	None
Controls:	Draught or position control sensed through top link. Optional - Electronic draught/position control sensed through lower link.



LIFT TEST
Linkage geometry

Fig 2.1

Table 2.1

Dimensions of linkage when attached to the standard frame (ISO 730-1:1990 CAT 2, 610 mast height)

(B2.3 ISO mast height from 730/3-1982 CAT 2)

			Dimensions or range	Setting used in test		
				Main test	B2.2	B2.3
Length of lift arms:		(A)	254	254	254	254
Length of lower links:		(B)	915	915	915	915
Distance of lift arm pivot point from rear wheel centre line:	horizontally: vertically:	(a) (b)	102 341	102 341	102 341	102 341
Horizontal distance between the two lower link points:		(u)	527	527	527	527
Horizontal distance between the two lift arm end points:		(v)	610	610	610	610
Length of upper link:		(S)	610 - 830	730	730	696
Distance of upper link pivot point from rear wheel centre line:	horizontally: vertically:	(c) (d)	325 149 - 205	325 149	325 149	325 205
Distance of lower link pivot point from rear wheel centre line:	horizontally: vertically:	(e) (f)	102 229	102 229	102 229	102 229
Distance of lower link points to lift rod pivot points on lower link centre line:	horizontally: vertically:	(D) (E)	412 - 520 on centre line	466 on centre line	466 on centre line	520 on centre line
Length of lift rods:		(L)	743-879	825	800	743
ISO mast height:			-	610	610	510
Height of lower hitch points (*) relative to the rear wheel centre line, situated 795 mm(+) above the ground level:						
- in low position		(h)	308 to 794	605	549	285
- in high position		(H)	-77 to 224	50	75	215
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 795 mm to ISO 4251/1-1984

+ or 749 mm for supplementary test (B2.2)

Swinging drawbar (Incorporated in automatic pick-up hitch with hook on opposite end and selectable by reversing drawbar)	**Drawbar as tested**	**Pick up hitch**
Type:	Clevis	Hook
Height above ground, unballasted maximum:	518 mm	492 mm
minimum:	463 mm	--
Type of adjustment:	Inverting drawbar	None
Distance of hitch point from rear-wheel axis,horizontally:	714 mm - 865 mm	482 mm
Distance of hitch point from power take-off shaft ends:		
. Vertically:	230 mm - 285 mm	256 mm
. Horizontally:	257 mm - 408 mm	25 mm
Lateral adjustment (centre of clevis):		
. Right-hand:	130 mm - 255 mm	None
. Left-hand:	130 mm - 255 mm	None
Distance of pivot point from rear axles horizontally:	176 mm - 376 mm	--
Width of clevis:	66 mm	--
Diameter of drawbar pin hole:	27 mm	--
Maximum vertical permissible load - drop down type:	2182 kg	2722 kg

Trailer Hitch

Type: Not fitted

Linkage Drawbar

Type: Not fitted

Front Towing Hitch

Type: Clevis in front weight frame

Height of clevis: 893 mm

Width of clevis: 60 mm

Diameter of pin hole: 34 mm

Steering

Make:	Ford New Holland
Model:	None
Type:	Hydrostatic
Method of operation:	
. Pump:	Sauer Sundstrand
. Motor:	Danfoss OSPC-150-OR
. Ram:	Double acting balanced cylinder acting on both steering arms
. Filter:	Replaceable paper element filter, integral with pump
Working pressure:	17.0 mPa - 17.8 mPa

Brakes

Service brake

. Make:	Girling
. Model:	None
. Type:	Oil-immersed multiplate discs
Method of operation:	Independent or combined pedal, hydraulically actuated
Trailer braking take-off:	Hydraulic connector to ISO 5676

Parking brake

Type:	Mechanical linkage coupled via cables to service brakes
Method of operation:	Hand lever with ratchet

Wheels

Number: 4

. Front: 2 steering and driving

. Rear: 2 driving

Wheelbase: 2362 mm

Track width adjustment:

	Minimum, mm	Maximum, mm	Adjustment method
Front	1392	2142	Reversing wheels and offset lug rims
Rear	1528	2028	Reversing wheels and offset lug rims

PROTECTIVE STRUCTURE

Make: Ford New Holland

Model: 582 Mk SK90

Type: Cab safety frame

Manufacturer's name and address: Sicurcab SRL, Torino, Italy

Protective device:

. Rollguard: Safety Cab

. Tiltable/Not tiltable: Non tiltable

OECD approval number: CSS 1329/27

DRIVER'S SEAT

Make/Model/Type: Grammer DS85H/90A

Type of suspension: Low frequency scissor, mechanical

Type of damping: Double acting, hydraulic

Range of adjustment:

. Longitudinal: ± 75 mm

. Vertical: ± 40 mm

LIGHTING

Unrestricted beam angle of headlight in plan view: 140°

	Height above ground of centre, mm	Size, mm	Distance from outside edge to median plane of tractor, mm
Headlight	1203	150 x 100	227
Sidelights	1730	115 x 30	769
Rear lights	1718	165 x 35	984
Axle reflectors	800	120 x 40	591
Cab reflectors	1618	165 x 30	984

II. TEST CONDITIONS

Overall dimensions (overall width at 1706 measured front track, 2156mm)

Length mm	Width		Height at top of	
	Minimum mm	Maximum mm	Protective structure mm	Exhaust pipe mm
4073	2036	2547	2741	2866

Ground clearance (unballasted tractor) 407 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	1701	1716	2140	2155
Rear	2522	2582	2708	2768
Total	4223	4298	4848	4923

* 3 weights per rear wheel and 8 front frame weights.

Ballast

	Weights		Water, kg
	Number	Total mass, kg	
Front	8	323	None
Rear	6	302	None
Optional	None	None	None

Tyres and track width specification

	Front	Rear
Tyres		
. dimensions	13,6 R 28	16.9 R 38
. ply rating	123A8	141A8
. type	Radial	Radial
Maximum load (tyre manufacturer's), kg	1660	2760
maximum load (tractor manufacturer's), kg	1660	2760
inflation pressure (tyre manufacturer's), bar	1.6	1.6
dynamic radius index, mm	610	795
. Chosen track width (manufacturer's nominal), mm	1706	1727

Oils and lubrication

Capacity and change interval

	Capacity ℓ	Oil change h	Filter change h
Engine	11.4	300	300
Front axle	6.2	1200	None
Final drive (front)	3.0	1200	None
Rear axle	56.8	1200	300
Brakes	0.5	Top up	None
Gearbox Hydraulic system Final drives (rear) Steering	Integral with rear axle		

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 g/cm^3 at 15°C

Oils	Recommended	Used during test
Engine oil		
Type:	SAE 15W/40	As recommended
Viscosity:	11.5 cSt at 100°C	
Classification:	L-2104-C	
Transmission oils		
Type:	SAE 80W	As recommended
Viscosity:	9 cSt at 100°C	
Classification:	L-2105	
Rear final drives		
Type:	SAE 80W	As recommended
Viscosity:	9 cSt at 100°C	
Classification:	L-2105	
Front differential and final drives		
Type:	SAE 80W	As recommended
Viscosity:	9 cSt at 100°C	
Classification:	L-2105	
Hydraulic brakes	Ford ESN-M6C59-A	
Type:	No equivalent	As recommended
Viscosity:	6 cSt at 100°C	
Classification:	No equivalent	
Hydraulic fluid		
Type:	SAE 80W	As recommended
Viscosity:	9 cSt at 100°C	
Classification:	L-2105	
Steering oil		
Type:	SAE 80W	As recommended
Viscosity:	9 cSt at 100°C	
Classification:	L-2105	
Recommended grease:	Lithium based	As recommended
Number of lubrication points:	12	

III. TEST RESULTS

A. COMPULSORY TEST RESULTS

1. MAIN POWER TAKE-OFF

Date and location of tests: 13 June 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						
57.4	2170	1031	14.07	16.79	245	3.42
1.2 POWER AT RATED ENGINE SPEED						
57.4	2170	1031	14.07	16.79	245	3.42
1.3 STANDARD POWER TAKE-OFF SPEED (1000 ± 10 rev/min)						
57.0	2108	1002	13.65	16.29	239	3.50
1.4 PART LOADS 1.4.1 The torque corresponding to maximum power at rated engine speed						
57.4	2170	1031	14.07	16.79	245	3.42
1.4.2 85% of the torque defined in 1.4.1						
49.2	2205	1048	12.38	14.77	252	3.33
1.4.3 75% of the torque defined in 1.4.2						
37.5	2222	1056	10.47	12.49	279	3.00
1.4.4 50% of the torque defined in 1.4.2						
25.1	2240	1065	8.19	9.78	327	2.56
1.4.5 25% of the torque defined in 1.4.2						
13.1	2253	1071	6.33	7.56	483	1.73
1.4.6 Unloaded						
0	2300	1093	4.08	4.87	--	--

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	
1.5 PART LOADS AT STANDARD POWER TAKE-OFF SPEEDS (1000 ± 10 rev/min)						
1.5.1 The torque corresponding to maximum power						
57.0	2108	1002	13.65	16.29	239	3.50
1.5.2 85% of the torque obtained in 1.5.1						
49.0	2142	1018	12.08	14.42	246	3.40
1.5.3 75% of the torque obtained in 1.5.2						
37.3	2163	1028	10.05	11.99	269	3.11
1.5.4 50% of the torque obtained in 1.5.2						
25.1	2180	1037	7.63	9.11	304	2.75
1.5.5 25% of the torque obtained in 1.5.2						
12.5	2201	1046	6.05	7.22	484	1.73
1.5.6 Unloaded						
0	2229	1059	3.93	4.69	--	--

No load, maximum engine speed: 2300 rev/min

Torque (equivalent crankshaft) at maximum power: 252.2 Nm

Maximum torque (equivalent crankshaft)
(engine speed 1237 rev/min): 306.8 Nm

Mean atmospheric conditions:

- Temperature 27°C
- Pressure 1022 m bar
- Relative humidity 41%

Maximum temperatures:

- Coolant 86°C
- Engine oil 107°C
- Fuel 56°C
- Engine air intake 30°C

2. HYDRAULIC POWER AND LIFTING FORCE

Date of tests: 18 June 1992

2.1 Hydraulic power test

Sustained pressure with relief valve open: 18.2 MPa

Pump delivery rate at minimum pressure: 37.4 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	32.0	16.4	8.8
Flow rate and hydraulic pressure corresponding to maximum hydraulic power	31.7	17.0	9.0

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	190 mm	190 mm
Vertical movement	655 mm	855 mm
Maximum corrected force exerted through full range	29.6 kN	21.9 kN
Corresponding pressure of hydraulic fluid	16.4 MPa	16.4 MPa
Moment about rear-wheel axis	30.1 kNm	35.6 kNm
Maximum tilt angle of mast from vertical	--	12 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	-466	-376	-266	-116	0	84	134	184	234	279	389
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	--	29.6	31.3	32.7	34.1	34.3	34.2	34.0	33.7	33.4	--
Corresponding pressure: 16.4 MPa											
at the frame kN	24.2	24.7	25.2	25.2	24.9	24.4	24.2	23.8	23.4	23.0	21.9
Corresponding pressure: 16.4 MPa											

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

Date and location of tests: 9 July 1992
Silsoe Research Institute
Wrest Park
Silsoe

Type of track: Concrete

	Tyre inflation pressure (kPa)	
Height of drawbar above ground	Front	Rear
440 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	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													
3L*	35.9	36.9	3.50	2218	15.2	347	2.41	58	84	103	24	59	100.5
1M*	41.4	37.3	4.00	2204	15.1	333	2.52	58	86	105	24	63	100.6
4L	47.0	29.4	5.75	2170	7.8	302	2.77	53	84	104	23	61	100.6
2M	48.6	27.9	6.27	2168	7.0	294	2.85	54	85	106	19	80	100.8
3M	48.7	20.1	8.70	2170	5.0	293	2.86	54	85	104	19	77	100.8
1H	49.7	18.3	9.77	2173	4.6	286	2.93	54	85	104	19	77	100.8
4M	47.4	12.5	13.69	2175	3.3	297	2.82	56	83	107	18	80	100.8
3.2 FUEL CONSUMPTION 3.2.1 In selected gear, at maximum power at rated speed													
1H	49.7	18.3	9.77	2173	4.6	286	2.93	54	85	104	19	77	100.8
3.2.1.1 75% of pull at maximum power at rated speed													
1H	38.5	13.7	10.13	2230	3.6	315	2.66	53	85	105	19	78	100.8
3.2.1.2 50% of pull at maximum power at rated speed													
1H	26.3	9.3	10.31	2248	2.7	372	2.26	55	84	105	19	77	100.8
3.2.1.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.1													
4M	38.5	13.8	10.02	1610	3.6	276	3.03	51	83	94	21	67	100.6
3.2.1.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.2													
4M	26.6	9.3	10.20	1620	2.8	297	2.82	51	82	97	21	68	100.8
3.2.2 In selected gear nearest to 7.5 km/h, at maximum power at rated engine speed													
2M	48.6	27.9	6.27	2168	7.0	294	2.85	54	85	106	19	80	100.8
3.2.2.1 75% of pull at maximum power at rated speed													
2M	38.1	20.9	6.59	2231	5.1	312	2.69	54	84	105	19	78	100.8
3.2.2.2 50% of pull at maximum power at rated speed													
2M	26.3	14.0	6.75	2250	3.7	367	2.28	54	84	105	19	77	100.8
3.2.2.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.1													
3M	38.1	20.8	6.60	1649	5.1	277	3.03	51	83	97	22	67	100.6
3.2.2.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.2													
3M	26.2	14.0	6.73	1653	3.6	297	2.87	52	83	97	23	60	100.6

* Maximum power limited by wheelslip.

TEST RESULTS

B. SUPPLEMENTARY TEST RESULTS

B.1. MAIN POWER TAKE-OFF (Optional 540 rev/min shaft)

Date and location of tests: 11 June 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						
57.4	2173	620	14.03	16.74	245	3.42
1.2 POWER AT RATED ENGINE SPEED						
57.4	2173	620	14.03	16.74	245	3.42
1.3 STANDARD POWER TAKE-OFF SPEED (540 ± 10 rev/min)						
53.6	1887	539	12.69	15.14	237	3.54
1.4 PART LOADS 1.4.1 The torque corresponding to maximum power at rated engine speed						
57.4	2173	620	14.03	16.74	245	3.42
1.4.2 85% of the torque defined in 1.4.1						
49.5	2199	628	12.71	15.17	257	3.26
1.4.3 75% of the torque defined in 1.4.2						
37.0	2214	632	10.45	12.47	283	2.97
1.4.4 50% of the torque defined in 1.4.2						
25.1	2233	638	8.32	9.93	332	2.52
1.4.5 25% of the torque defined in 1.4.2						
12.7	2257	645	6.43	7.67	506	1.65
1.4.6 Unloaded						
0	2300	657	4.17	4.98	--	--

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 (540 ± 10 rev/min)						
1.5.1 The torque corresponding to maximum power						
53.6	1887	539	12.69	15.14	237	3.54
1.5.2 85% of the torque obtained in 1.5.1						
46.4	1921	548	11.09	13.24	239	3.51
1.5.3 75% of the torque obtained in 1.5.2						
35.2	1946	556	9.18	10.96	260	3.22
1.5.4 50% of the torque obtained in 1.5.2						
23.9	1973	563	7.11	8.49	298	2.81
1.5.5 25% of the torque obtained in 1.5.2						
12.1	1994	569	5.16	6.16	428	1.96
1.5.6 Unloaded						
0	2030	580	3.33	3.97	--	--

No load, maximum engine speed: 2300 rev/min

Torque (equivalent crankshaft) at maximum power: 252.2 Nm

Maximum torque (equivalent crankshaft) *

Mean atmospheric conditions:

- Temperature 25°C
- Pressure 1022 m bar
- Relative humidity 44%

Maximum temperatures:

- Coolant 86°C
- Engine oil 108°C
- Fuel 55°C
- Engine air intake 27°C

* Maximum torque not measurable within limits of test equipment. Speed for maximum torque measured on 1000 rev/min shaft was 1237 rev/min.

B.2. HYDRAULIC POWER AND LIFTING FORCE

Date of tests: 7 August 1992

B2.1. Hydraulic power test

Sustained pressure with relief valve open: 18.2 MPa

Pump delivery rate at minimum pressure: 36.6 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	27.2	16.4	7.4
Flow rate and hydraulic pressure corresponding to maximum hydraulic power	26.2	17.0	7.4

Tapping point used for test: Remote hydraulic port

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

B.2.2 Power lift tests - (To ISO 730-1:1990, alternative rear tyre size 13.6 R34)

	At the hitch point	On the frame
Height of lower hitch points above ground in down position	200 mm	200 mm
Vertical movement	624 mm	855 mm
Maximum corrected force exerted through full range	30.8 kN	21.6 kN
Corresponding pressure of hydraulic fluid	16.4 MPa	16.4 MPa
Moment about rear-wheel axis	31.3 kNm	35.1 kNm
Maximum tilt angle of mast from vertical	--	15 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	-406	-320	-266	-116	0	34	134	184	234	304	449
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	--	30.8	31.6	33.4	34.4	34.4	34.4	34.4	34.3	33.7	--
Corresponding pressure: 16.4 MPa											
at the frame kN	24.6	25.2	25.6	25.6	25.4	25.2	24.6	24.2	23.9	23.3	21.6
Corresponding pressure: 16.4 MPa											

B.2.3 Power lift tests - (To manufacturers lift rod setting and original tyres)

	At the hitch point	On the frame
Height of lower hitch points above ground in down position	510 mm	510 mm
Vertical movement	500 mm	640 mm
Maximum corrected force exerted through full range	39.8 kN	25.7 kN
Corresponding pressure of hydraulic fluid	16.4 MPa	16.4 MPa
Moment about rear-wheel axis	40.5 kNm	41.8 kNm
Maximum tilt angle of mast from vertical	--	15 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	-66	-56	0	34	84	134	234	284	384	444	574
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	--	41.0	41.6	42.1	42.1	42.1	41.7	41.3	40.6	39.8	--
Corresponding pressure: 16.4 MPa											
at the frame kN	36.5	36.6	36.8	36.3	35.7	35.1	33.4	32.3	30.1	28.6	25.7
Corresponding pressure: 16.4 MPa											

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

Date and location of tests: 17 July 1992
Silsoe Research Institute
Wrest Park
Silsoe

Type of track: Concrete

	Tyre inflation pressure (kPa)	
Height of drawbar above ground	Front	Rear
440 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	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													
1L+	20.6	41.6	1.79	2246	15.3	434	1.93	59	83	100	27	50	100.9
2L*	31.5	43.9	2.58	2226	15.2	363	2.31	58	85	102	25	56	101.0
3L*	42.0	43.5	3.48	2207	15.0	331	2.53	56	84	105	25	54	101.0
1M*	41.6	37.5	3.99	2206	15.3	326	2.57	56	85	105	24	57	100.6
4L	47.0	29.4	5.75	2170	7.8	302	2.77	53	84	104	23	61	100.6
2M	48.4	27.6	6.32	2166	5.8	292	2.87	59	86	106	24	63	101.0
3M	48.4	19.9	8.75	2176	4.3	295	2.84	56	84	103	23	66	101.0
1H	49.0	18.0	9.77	2167	3.8	291	2.88	55	85	104	24	61	101.0
4M	46.6	12.2	13.72	2177	2.8	307	2.73	56	85	105	23	69	101.0
3.2 FUEL CONSUMPTION 3.2.1 In selected gear, at maximum power at rated speed													
1H	49.0	18.0	9.77	2167	3.8	291	2.88	55	85	104	24	61	101.0
3.2.1.1 75% of pull at maximum power at rated speed													
1H	37.9	13.4	10.14	2230	3.4	316	2.65	59	84	101	27	51	100.9
3.2.1.2 50% of pull at maximum power at rated speed													
1H	25.5	8.9	10.32	2249	2.3	376	2.23	59	84	101	26	51	100.9
3.2.1.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.1													
4M	37.9	13.4	10.14	1615	3.1	278	3.01	57	84	100	25	55	100.9
3.2.1.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.1.2													
4M	25.2	8.8	10.31	1627	2.3	307	2.73	57	83	100	25	57	100.9
3.2.2 In selected gear nearest to 7.5 km/h, at maximum power at rated engine speed													
2M	48.4	27.6	6.32	2166	5.8	292	2.87	59	86	106	24	63	101.0
3.2.2.1 75% of pull at maximum power at rated speed													
2M	38.1	20.8	6.58	2228	4.6	318	2.64	57	83	101	27	50	100.9
3.2.2.2 50% of pull at maximum power at rated speed													
2M	25.8	13.7	6.75	2245	3.2	372	2.25	59	84	101	26	50	100.9
3.2.2.3 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.1													
3M	38.3	20.9	6.60	1645	4.6	278	3.01	57	85	99	25	57	100.9
3.2.2.4 Next higher gear at reduced engine speed; same pull and travelling speed as in 3.2.2.2													
3M	25.9	13.8	6.75	1652	3.3	302	2.77	57	83	97	26	56	100.9

Maximum power limited by wheelslip(*), and bounce (+)

REPAIRS AND ADJUSTMENTS DURING TESTS: Assy-hydraulic lift unload (priority) valve - Part No E9NN R947BB. Replaced as it was faulty

REMARKS: None

Test carried out by: E Nigro

Officer in charge: P C Seward

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

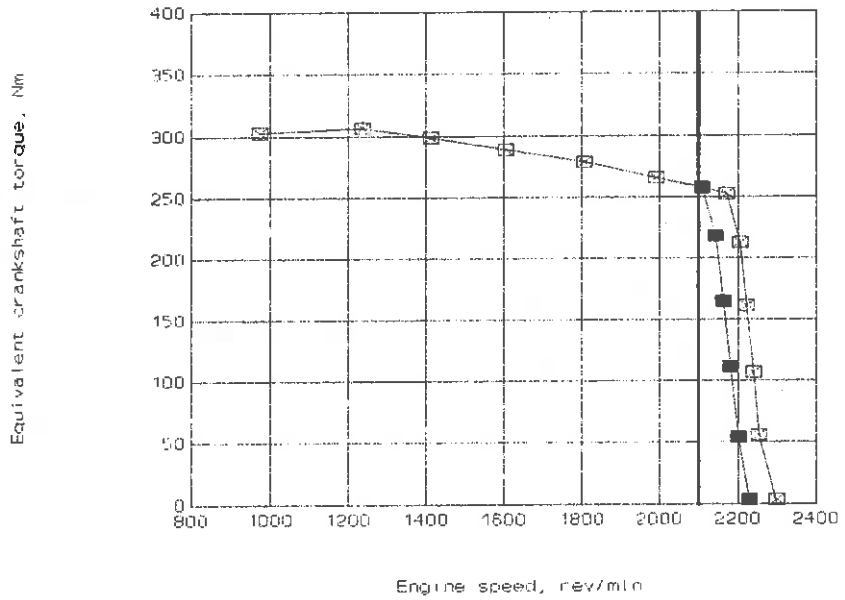
H M R Proctor — for the Director

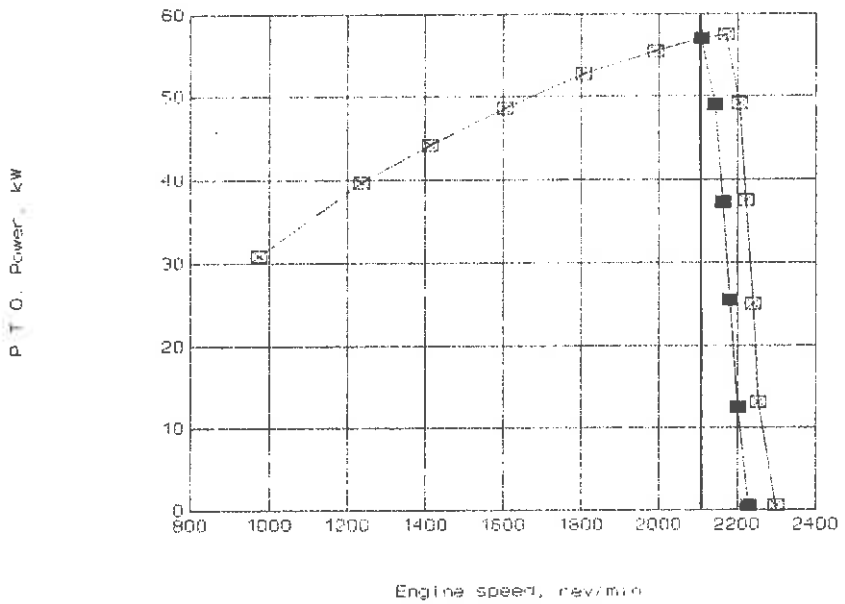
Date: 2/10/92

ANNEX I MAIN POWER TAKE OFF CURVES

P.T.O. POWER TEST - FORD 6640, 4 WHEEL DRIVE (1000 REV/MIN SHAFT)

Governor set for maximum power at rated speed ⊠
Governor set for maximum power at pto speed ■

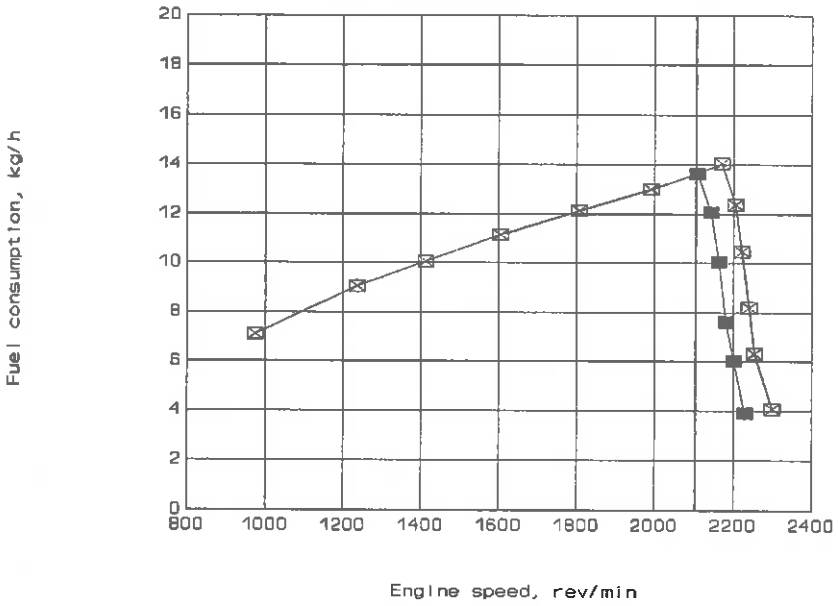


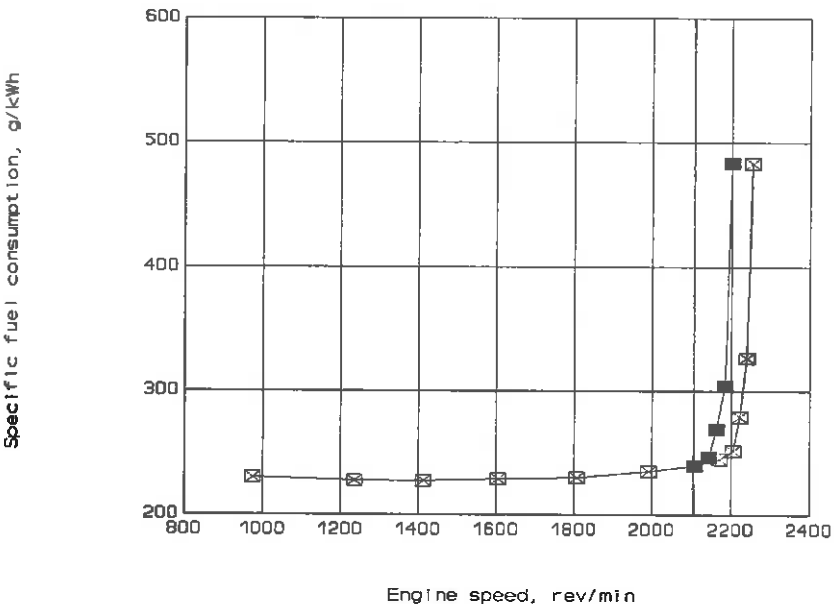


ANNEX I MAIN POWER TAKE OFF CURVES

P.T.O. POWER TEST - FORD 6640, 4 WHEEL DRIVE (1000 REV/MIN SHAFT)

Governor set for maximum power at rated speed ⊠
Governor set for maximum power at pto speed ■

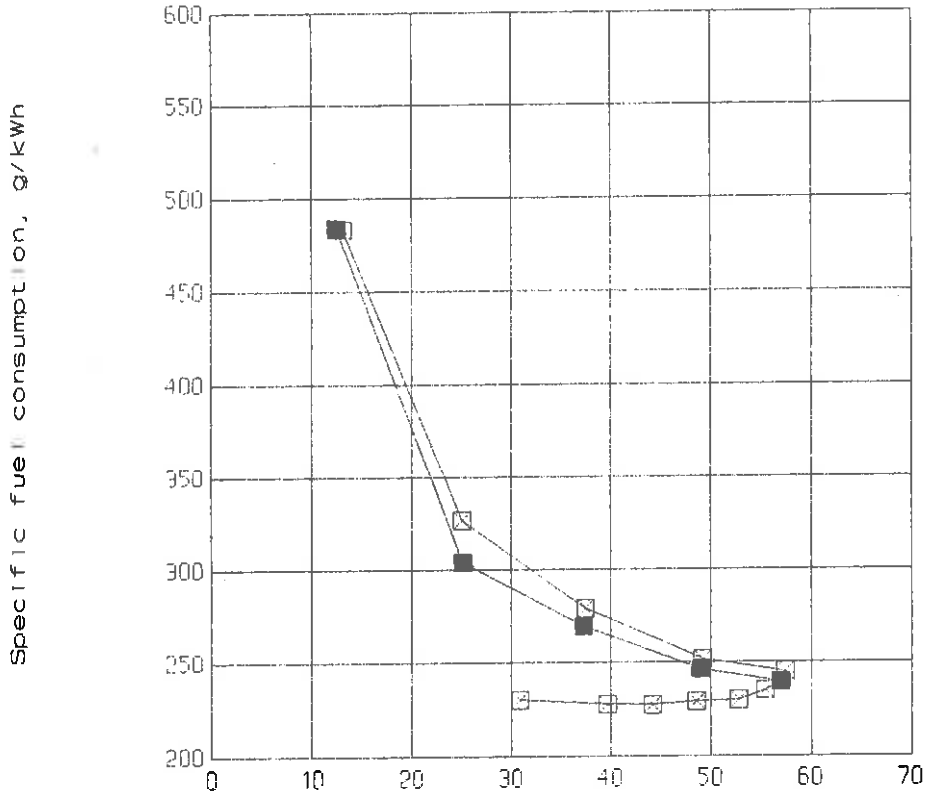




ANNEX I MAIN POWER TAKE OFF CURVES

P.T.O. POWER TEST - FORD 6640, 4 WHEEL DRIVE (1000 REV/MIN SHAFT)

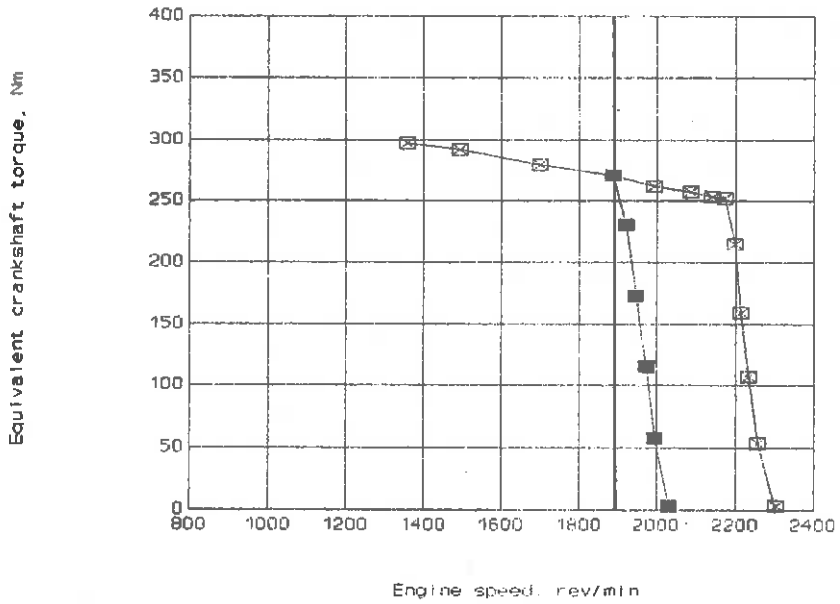
Governor set for maximum power at rated speed ⊠
Governor set for maximum power at pto speed ■

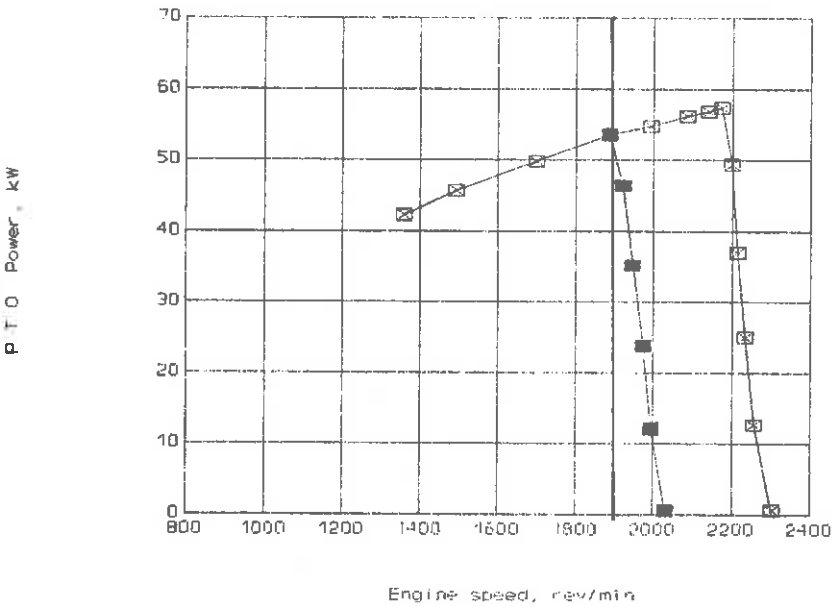


ANNEX II SUPPLEMENTARY POWER TAKE OFF CURVES

P.T.O. POWER TEST - FORD 6640, 4 WHEEL DRIVE (540 REV/MIN SHAFT)

Governor set for maximum power at rated speed ⊠
Governor set for maximum power at pto speed ■

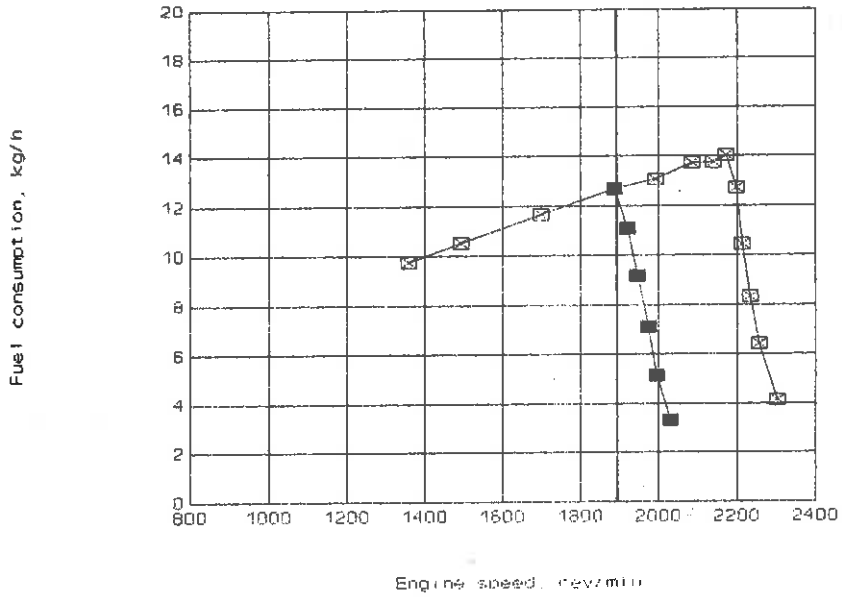


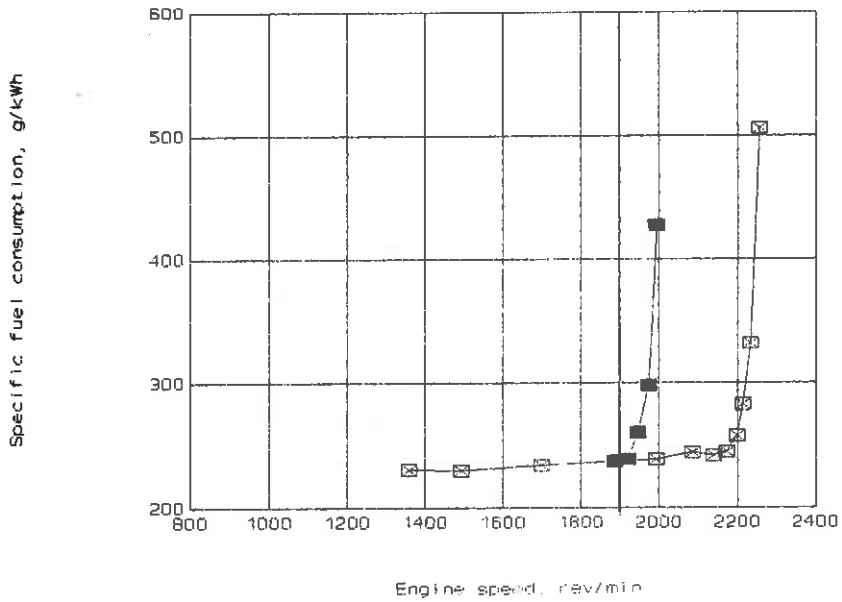


ANNEX II SUPPLEMENTARY POWER TAKE OFF CURVES

P.T.O. POWER TEST - FORD 6640, 4 WHEEL DRIVE (540 REV/MIN SHAFT)

Governor set for maximum power at rated speed ⊠
Governor set for maximum power at pto speed ■





ANNEX II SUPPLEMENTARY POWER TAKE OFF CURVES

P.T.O. POWER TEST - FORD 6640, 4 WHEEL DRIVE (540 REV/MIN SHAFT)

Governor set for maximum power at rated speed ⊠
Governor set for maximum power at pto speed ■

