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REPORT OF TEST IN ACCORDANCE WITH O.E.C.D. TEST CODE FOR AGRICULTURAL TRACTORS

FORD 4600 TRACTOR



Test No.: R/76/7930/O.E.C.D.

Manufacturer: Ford Motor Company Limited,
Basildon,
Essex.

NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING

Wrest Park . Silsoe . Bedford MK45 4HS

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SPECIFICATION OF TRACTOR

Manufacturer:	Ford Motor Company Limited, Basildon, Essex
Submitted for test by:	The manufacturer
Selected for test by:	The manufacturer with the agreement of the testing station
Place of running-in:	Basildon
Duration of running-in:	120 hours

Tractor

Make:	Ford
Model:	4600
Type:	Four-wheel, rear-wheel driven, unit construction
Serial No.:	B 277430

Engine

Make:	Ford
Model:	4600
Type:	4-stroke, direct-injection diesel
Serial No.:	D 053634
Cylinders:	3 cylinders, vertical, in-line, 111·8 mm (4·4 in) dia bore × 111·8 mm (4·4 in) stroke, capacity 3293 cm^3 (201 in^3), compression ratio 16·3 : 1 (nominal), monobloc construction, overhead valves
Fuel system:	Gravity feed; C.A.V. twin-paper element filters with sediment bowl and water trap; fuel tank capacity 60·5 l (13·3 U.K. gal); C.A.V. type 3233 F650 distributor injection pump, Serial No. R309310T, manufacturer's production setting 12·80–13·57 cm^3 for 200 injections at 900 rev/min pump speed (test bench figures); C.A.V. type BDLL 150S6666 injector nozzles, injection pressure 19·4–20·0 MPa (191–197 atm), injectors open 16° before T.D.C.
Governor:	C.A.V., mechanical, incorporated in fuel injection pump, governed range of engine speed 600–2475 rev/min, rated engine speed 2200 rev/min
Air cleaner:	Burgess, oil bath, oil capacity 2·1 l (3·7 pt), situated forward of radiator, centrifugal pre-cleaner above bonnet
Lubrication system:	Forced feed from eccentric rotor pump with metal strainer in sump: full-flow replaceable element filter; total oil capacity 6·65 l (11·7 pt), recommended oil Series 3 quality, viscosity 65 cSt at 50°C (122°F), change period 300 hours
Cooling system:	Water cooled, pressurised at 50 kPa (7 lb/in^2), impeller-assisted with 406 mm (16·0 in) dia belt-driven 4-blade fan, thermostat for temperature control, cooling water capacity 10·4 l (18·3 pt)
Starting system:	Electrical, 12V Lucas M50G solenoid-engaged starter motor, operable only when high–low gear selector lever is in neutral position.

Electrical system

Voltage:	12, negative earth
Generator:	Lucas alternator type 15ACR
Battery:	Ford type C5NN 10655G lead acid, 120–128 Ah at 20-hour rating

Transmission

Clutch: Borg and Beck, single plate, dry, pedal-operated, 279 mm (11·0 in) dia

Gearbox: Ford, constant mesh, 8 forward and 2 reverse speeds, comprising 4 forward and 1 reverse speed gearbox with high–low range selector

Rear axle and final drives: Ford, crown wheel and pinion with differential and epicyclic reduction gear final drives; pedal-operated differential lock

Oil capacity: Gearbox 12·96 l (22·8 pt), final drive 45·8 l (80·6 pt), recommended oil Mild E.P. S.A.E. 80, viscosity 54 cSt at 50°C (122°F), change period 1200 hours

Gear	*Number of engine revolutions for one revolution of driving wheel*	**Nominal travelling speed for 2200 rev/min rated speed of engine, (km/h)*	*mile/h*
Forward			
Low 1	228·11	2·54	(1·58)
2	182·77	3·17	(1·97)
3	104·14	5·57	(3·46)
4	76·51	7·58	(4·71)
High 1	63·85	9·08	(5·64)
2	51·16	11·33	(7·04)
3	29·15	19·89	(12·36)
4	21·41	27·08	(16·83)
Reverse			
1	158·69	3·65	(2·27)
2	44·41	13·05	(8·11)

*Calculated with tyre rolling radius of 699 mm (27·5 in)

Power take-off At rear of tractor in vertical centre plane, 6 spline, 34·9 mm (1⅜ in) dia, to I.S.O. Standard, manually engaged by hand lever, hydraulic clutch, independent of main clutch, height above ground 603 mm (23·7 in), proportional engine speed giving 660 rev/min at 2200 rev/min rated engine speed, 540 rev/min (standard p.t.o. speed) at 1800 rev/min engine speed, direction of rotation clockwise viewed facing driving end

Power lift Ford, hydraulic, gear pump driven from power take-off shaft, independent of main and p.t.o. clutches, oil supplied from rear axle housing to ram cylinder and external tapping; Category 2 implement linkage, top link sensing, draught or position control with auxiliary service control and flow control device

Drawbar Swinging drawbar, vertical height to centre of clevis 337 mm (13·3 in), 432 mm (17·0 in), 470 mm (18·5 in) and 562 mm (22·1 in), changed by inverting drawbar and clevis, distance from rear axle centre 645 mm (25·4 in) and 759 mm (29·9 in) to rear, position relative to p.t.o. 248 mm (9·8 in) and 362 mm (14·3 in) to rear, lateral adjustment 330 mm (13·0 in) and 457 mm (18·0 in), pivot position in line with wheel centre, drawbar pin hole 27 mm (1·1 in) dia

Steering Burman power assisted recirculating ball type with single drop arm and drag link, oil supplied by Plessey gear driven pump

Brakes Oil-immersed multi-plate disc brakes mounted on planetary shafts, independent or combined pedal-operated, hand lever with ratchet operating both brakes for parking

Wheels

Steering wheels: Two at front, Firestone Ribbed Tractor cross-ply 6·00–16 tyres, 6-ply rating, maximum permissible mass on each tyre 619 kg (1365 lb) at 296 kPa (43 lb/in²), track width 1334 mm (52·5 in) by 102 mm (4·0 in) steps to 2048 mm (80·6 in), changed by extending axle and reversing wheels

Driving wheels: Two at rear, Goodyear Traction Sure Grip cross-ply 13·6/12–36 tyres, 6-ply rating, maximum permissible mass on each tyre 1529 kg (3371 lb) at 140 kPa (20 lb/in²), track width 1422 mm (56·0 in) by 102 mm (4·0 in) steps to 2034 mm (80·1 in), changed by reversing wheels and offset lug rims

Wheelbase: 2146 mm (84·5 in)

Lighting

Unrestricted beam angle of headlight in plan view 130°

	Height above ground of centre, *mm*	(*in*)	*Size,* *mm*	(*in*)	*Distance from outside edge of tractor at 1422 mm (56·0 in) wheel track, to centre,* *mm*	(*in*)
Headlights	1238	(48·7)	127 (5·0) dia		505	(19·9)
Side lights	1556	(61·3)	70 (2·8) × 70 (2·8)		219	(8·6)
Rear lights	1540	(60·6)	70 (2·8) × 70 (2·8)		168	(6·6)
Reflectors	1540	(60·6)	70 (2·8) × 57 (2·2)		238	(9·4)

Number of grease points

Whole tractor: 10

CONDITIONS DURING TEST

Masses

Tractor (without driver but with tanks full):

	Front, *kg*	(*lb*)	*Rear,* *kg*	(*lb*)	*Total,* *kg*	(*lb*)
Without ballast	766	(1689)	1424	(3139)	2190	(4828)
With ballast	766	(1689)	2192	(4833)	2958	(6521)

Ballast

	Number of weights	*Total weight,* *kg*	(*lb*)	*Water,* *kg*	(*lb*)
Front wheels	Nil	Nil		Nil	
Rear wheels	6	311	(686)	457	(1008)
Additional	Nil	Nil		Nil	

Track setting during tests

Front:	1334 mm (52·5 in)
Rear:	1422 mm (56·0 in)

Overall dimensions

	Length	*Width*	*Height*
With ballast	3·448 m (135·7 in)	2·022 m (79·6 in)	2·356 m (92·8 in)
Without ballast	3·448 m (135·7 in)	1·772 m (69·8 in)	2·353 m (92·6 in)

Overall height measured to top of exhaust pipe

Seat Sifra, upholstered pan, torsion coupling suspension with rubber plug damping, adjustable for driver's weight, range of adjustment 38 mm (1·5 in) forwards and backwards

FUEL AND LUBRICANTS USED IN TESTS

Fuel:	Diesel oil to Class A2 British Standard 2869 : 1970, specific gravity 0·843 at 15·6°C (60°F), viscosity 2·36 cSt at 50°C (122°F), Cetane No. 54
Engine oil:	Ford ESEN/M2C 88/A
Transmission oil:	Ford ESEN/M2C 85/A for gearbox, 86/A for rear axle

COMPULSORY TESTS

1. Main power take-off performance

Date and location of tests: 6th August 1976, N.I.A.E. Silsoe, Bedford, U.K.

Type of dynamometer: Water brake, Heenan and Froude

Power,	*Speed, rev/min*		*Fuel consumption,*			
kW (hp)	*Engine*	*P.t.o.*	*l/h (UKgal/h)*	*kg/h (lb/h)*	*g/kWh (lb/hp h)*	*kWh/l (hp h/UKgal)*
Maximum power—2 hour test						
39·2 (52·6)	2290	687	13·02 (2·86)	10·98 (24·21)	280 (0·460)	3·01 (18·4)
Standard p.t.o. speed (540 rev/min)						
34·8 (46·7)	1800	540	10·66 (2·34)	8·99 (19·82)	258 (0·424)	3·26 (19·9)
The speed recommended by the manufacturer for drawbar work						
38·7 (51·9)	2200	660	12·49 (2·75)	10·53 (23·21)	272 (0·447)	3·10 (18·9)
Part loads						
(1) 85% of the torque obtained at maximum power						
34·6 (46·4)	2377	713	12·46 (2·74)	10·50 (23·15)	303 (0·498)	2·78 (16·9)
(2) Unloaded						
0	2467	740	4·58 (1·01)	3·86 (8·51)	—	—
(3) 50% of the load defined in (1)						
17·7 (23·7)	2430	729	8·26 (1·82)	6·96 (15·34)	393 (0·646)	2·14 (13·0)
(4) Maximum power						
39·2 (52·6)	2290	678	13·02 (2·86)	10·98 (24·21)	280 (0·460)	3·01 (18·4)
(5) 25% of the load defined in (1)						
8·7 (11·7)	2457	737	6·38 (1·40)	5·38 (11·86)	618 (1·016)	1·36 (8·3)
(6) 75% of the load defined in (1)						
26·2 (35·1)	2400	720	10·36 (2·28)	8·73 (19·25)	333 (0·547)	2·53 (15·4)

No load maximum engine speed: 2467 rev/min

Equivalent crankshaft torque at maximum power: 163·4 Nm (120·5 lb ft)

Maximum equivalent crankshaft torque: 197·2 Nm (145·4 lb ft) at 1200 rev/min engine speed

Mean atmospheric conditions:
- temperature 22°C (72°F)
- pressure 1020 m bar (30·12 in Hg)
- relative humidity 49%

Maximum temperature:
- coolant 88°C (190°F)
- engine oil 105°C (221°F)
- fuel 43°C (109°F)
- air intake 26°C (79°F)

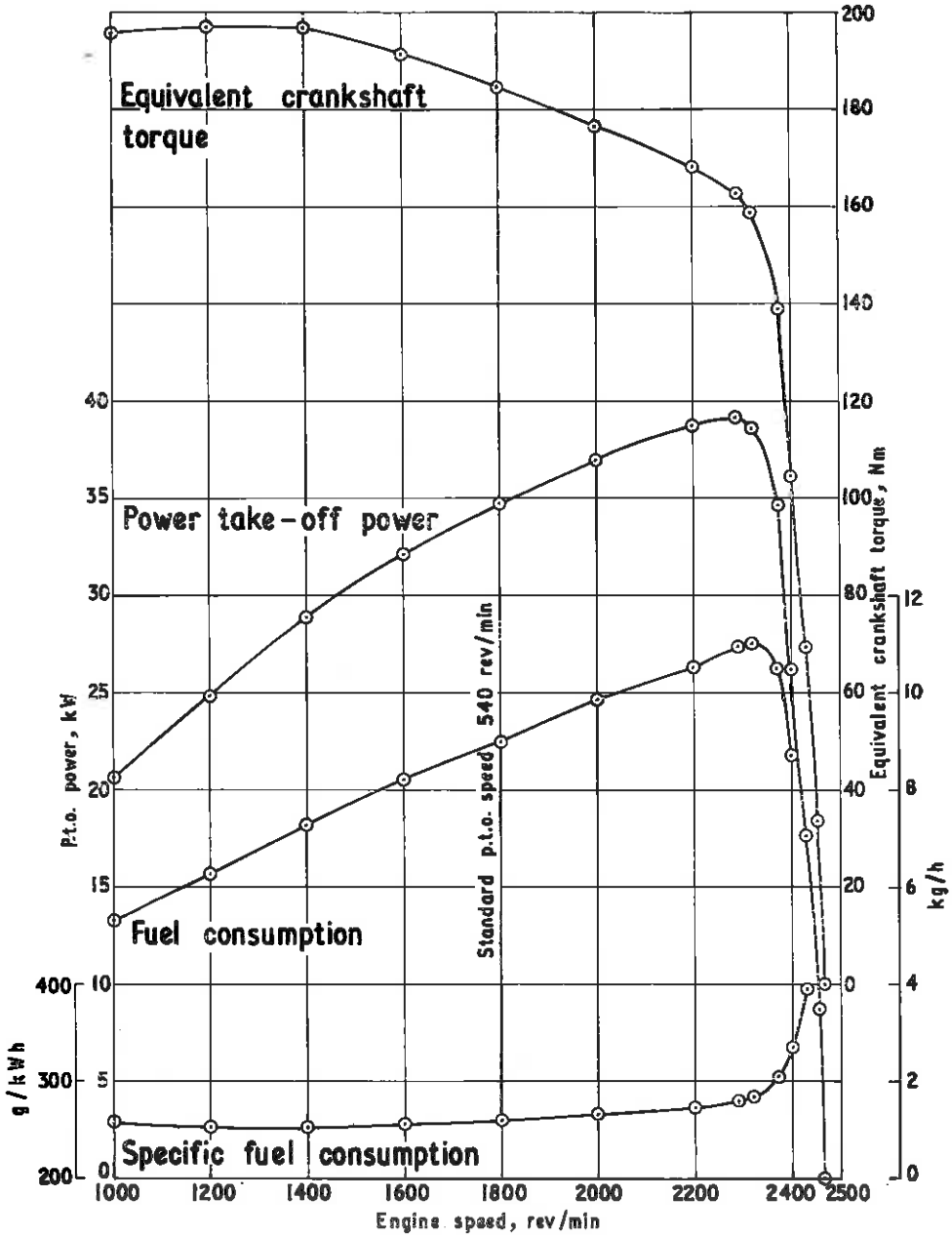


Fig. 1. Power take-off test

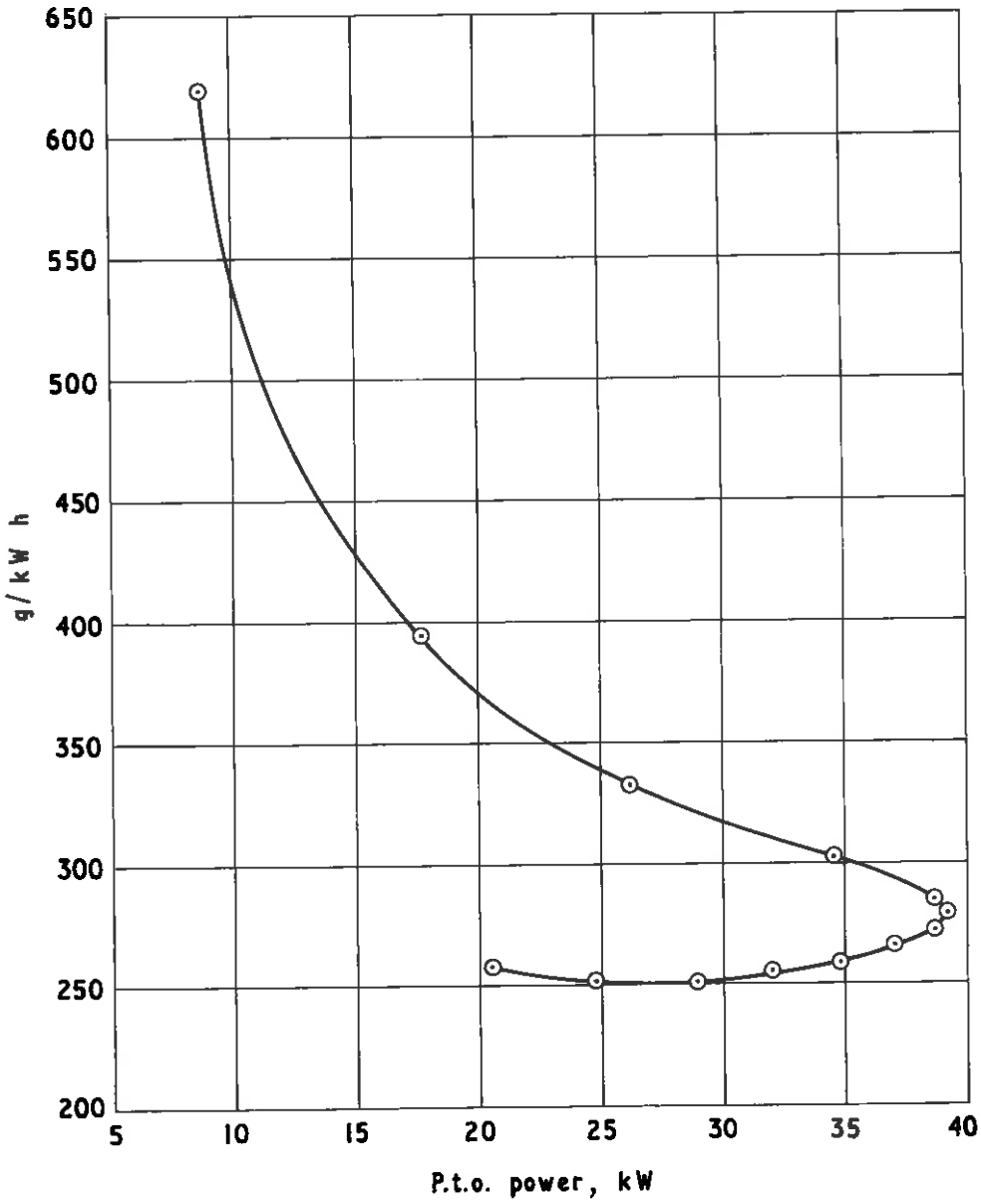


Fig. 2. Power take-off test

2. Drawbar performance

Date of tests: 16th September—7th October 1976 Type of track: Concrete Height of drawbar above ground: 368 mm (14·5 in)

Gear	Power, kW (hp)	Drawbar pull, kN (lb)	Speed, km/h (mile/h)	Engine speed, rev/min	Wheel-slip, %	Specific fuel consumption, kg/kWh (lb/hph)	Specific fuel consumption, kWh/l (hph/UKgal)	Temperature, °C(°F) Coolant	Temperature, °C(°F) Fuel	Temperature, °C(°F) Engine oil	Atmospheric conditions: Temperature, °C (°F)	Atmospheric conditions: Relative humidity, %	Atmospheric conditions: Pressure, mbar (in Hg)
(i) Maximum power (ballasted)													
L1	17·8* (23·9)	27·4 (6160)	2·34 (1·45)	2430	15·0	0·489 (0·804)	1·72 (10·5)	77 (171)	26 (79)	97 (207)	11 (52)	87	1011 (29·86)
L2	22·2* (29·8)	27·4 (6160)	2·92 (1·81)	2412	15·0	0·427 (0·702)	1·97 (12·0)	77 (171)	26 (79)	96 (205)	11 (52)	87	1011 (29·86)
L3	33·4 (44·8)	23·2 (5220)	5·18 (3·22)	2290	9·7	0·325 (0·534)	2·59 (15·8)	79 (174)	32 (90)	89 (192)	13 (55)	82	1011 (29·86)
L4	33·8 (45·3)	16·8 (3780)	7·24 (4·50)	2285	6·7	0·319 (0·524)	2·64 (16·1)	79 (174)	35 (95)	97 (207)	13 (55)	82	1011 (29·86)
H1	33·9 (45·5)	14·0 (3150)	8·72 (5·42)	2280	5·7	0·316 (0·519)	2·67 (16·3)	79 (174)	37 (99)	96 (205)	14 (57)	82	1011 (29·86)
H2	33·8 (45·3)	10·9 (2450)	11·16 (6·93)	2280	4·1	0·319 (0·524)	2·64 (16·1)	79 (174)	36 (97)	93 (199)	16 (61)	73	1011 (29·86)
(ii) Five hour test at 75% of pull at maximum power													
L4	26·5 (35·5)	12·6 (2830)	7·57 (4·70)	2364	5·6	0·358 (0·589)	2·35 (14·3)	79 (176)	42 (108)	104 (219)	22 (72)	61	1018 (30·06)
(iii) †Five hour test at pull corresponding to 15% wheelslip in test (i)													
L2	—	27·4 (6160)	3·01 (1·87)	2382	—	—	—	77 (171)	36 (97)	101 (214)	16 (61)	73	1013 (29·91)
(iv) Maximum power (unballasted)													
L2	16·5* (22·1)	19·7 (4430)	3·02 (1·88)	2420	15·0	—	—	77 (171)	27 (81)	97 (207)	18 (64)	61	1008 (29·77)
L3	27·5* (36·9)	19·7 (4430)	5·03 (3·13)	2358	15·0	—	—	79 (174)	30 (86)	100 (212)	18 (64)	61	1008 (29·77)
L4	33·3 (44·7)	16·8 (3780)	7·14 (4·44)	2286	9·2	—	—	82 (180)	32 (90)	99 (210)	18 (64)	61	1008 (29·77)
H1	34·3 (46·0)	14·1 (3170)	8·76 (5·44)	2284	7·0	—	—	82 (180)	34 (93)	96 (205)	18 (64)	65	1008 (29·77)
H2	34·2 (45·9)	11·1 (2500)	11·09 (6·89)	2289	5·1	—	—	82 (180)	40 (104)	102 (216)	17 (63)	64	1008 (29·77)

Total oil consumption during ten hours duration of tests (ii) and (iii) 28·7 g/h (0·063 lb/h)
*Maximum power available at 15% wheelslip
†Test (iii) was carried out with additional ballast and the results for power, slip and fuel consumption have no practical significance

3. Turning space and turning circle

Details of wheel equipment: As in specification, without ballast

Track of wheels: front—1334 mm (52·5 in)
rear—1422 mm (56·0 in)

	With brakes		*Without brakes*	
	Right-hand	*Left-hand*	*Right-hand*	*Left-hand*
Radius of turning space, m (in)	3·28 (129)	3·20 (126)	3·67 (144)	3·51 (138)
Radius of turning circle, m (in)	3·17 (125)	3·09 (122)	3·56 (140)	3·40 (134)

4. Location of centre of gravity

Height above ground	834 mm (32·8 in)
Distance forward from the vertical plane containing the axis of the rear wheels	762 mm (30·0 in)
Distance from the median plane of the tractor	0

5. Braking

Date of tests: 5th October, 1976
Type of track: Concrete
Type of decelerometer: Moto Meter, recording type
Mass of ballasted tractor: 2958 kg (6521 lb)

Cold brakes

	Tractor without ballast		*Tractor ballasted*	
Travelling speed of tractor, km/h (mile/h)	25·0	(15·5)	25·0	(15·5)
Maximum deceleration, m/s^2 (ft/s^2)	4·9	(16·1)	5·0	(16·4)
Stopping distance, m (ft)	5·8	(19)	6·1	(20)
Force on brake pedal, N (lb)	270	(61)	400	(90)
Force exerted on the brake pedal to achieve a deceleration of 2·5 m/s^2 (8·2 ft/s^2), N (lb)	100	(22)	130	(29)

Brake fade characteristics (hot tests, ballasted tractor)

Maximum deceleration hot/maximum deceleration cold × 100: 106%
Stopping distance cold/stopping distance hot × 100: 100%
Force on pedal cold/force on pedal hot × 100: 100%
Efficacy of handbrake: Satisfactory facing up and down slope
Pull on handbrake: 260 N (58 lb)

6. Measurement of ambient noise emitted by the tractor

Date of tests: 8th October 1976

Type of sound level meter: Bruel and Kjaer 2204

Type of track: Concrete

Results of tests:

Gear: H4

Travelling speed before acceleration: 23·3 km/h (14·5 mile/h)

Sound level: 90 dBA

7. Noise measurement at the driver's ear level

Date of tests: 8th October 1976

Type of sound level meter: Bruel and Kjaer 2204

Type of track: Concrete

Gear	*Travelling speed*, km/h*	*(mile/h)*	*dBA*
L4	7·6	(4·7)	97
L3	5·2	(3·2)	98
H1	9·1	(5·7)	99
H2	11·4	(7·1)	99

*The first gear tested corresponds to the travelling speed nearest to 7·25 km/h

8. Power lift and hydraulic pump performance

Date of tests: 11th October 1976

Hydraulic fluid

Make and type: Ford S.A.E. 80 Mild EP

Viscosity: 54 cSt at 50°C (122°F)

Type of linkage lock for transport: Hydraulic

Opening pressure of the cylinder over pressure relief valve (manufacturer's figure): 19·65–20·34 MPa (2850–2950 lb/in²)

Pump characteristics

(i) Opening pressure of relief valve: 15·2 MPa (2200 lb/in²)
Sustained pressure of the open relief valve: 18·3 MPa (2650 lb/in²)

(ii) Pump delivery rate at minimum pressure and rated engine speed: 32·7 l/min (7·2 gal/min)

(iii) Pump delivery rate at maximum hydraulic power: 32·7 l/min (7·2 gal/min)
Delivery pressure: 15·9 MPa (2310 lb/in²)
Power: 8·7 kW (11·7 hp)

Linkage geometry when connected to the standard frame mm (in)

Projected length in side view		
lower links	864	(34·0)
lift arms	254	(10·0)
lift rods	757	(29·8)
top link	678	(26·7)
Distance of lift rod connection point from pivot point of lower link	480	(18·9)
The following dimensions are given relative to the rear wheel centre line, situated 699 mm (27·5 in) above the ground level		
lower link pivot point	68 (2·7) behind,	203 (8·0) below
top link pivot point	262 (10·3) behind,	153 (6·0) above
lift arm pivot point	203 (8·0) forward,	257 (10·1) above
maximum and minimum height of lower link hitch points	210 (8·3) above,	440 (17·3) below
height of lower link hitch points when locked in transport position	Any height within lift range	

Power lift performance

Lifting heights in relation to a horizontal line through the lower link pivoting point	*mm* (*in*)	−254 (−10)	−229 (−9)	−152 (−6)	−76 (−3)	0	+76 (+3)	+152 (+6)	+229 (+9)	+305 (+12)	+381 (+15)	+457 (+18)	+533 (+21)
Lifting force with the pressure at maximum hydraulic horsepower (15·9 MPa (2310 lb/in²)), calculated from measurements made at maximum pressure (18·3 MPa (2650 lb/in²)), kN (lb)	At the hitch points		13·7* (3080)	14·9 (3350)	16·0 (3600)	17·0 (3820)	17·3 (3890)	18·2 (4090)	18·4 (4140)	18·7 (4200)	19·1 (4290)		
	At the frame	12·7* (2860)	12·7 (2860)	13·3 (2990)	13·6 (3060)	14·1 (3170)	14·2 (3190)	14·2 (3190)	14·0 (3150)	13·6 (3060)	13·2 (2970)	12·9 (2900)	12·8 (2880)

*Maximum force exerted throughout whole range

Force at which front of tractor is calculated to lift with maximum allowable front ballast is in excess of measured values.

Repairs and adjustments during tests None

Remarks None

Officer in charge: D. W. Smith

Head of Tractor and Cultivation Division: J. Matthews

Date: 29th October 1976

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Henry Burt & Son Ltd, College Street, Kempston, Bedford