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

FORD 7600 TRACTOR



Test No.: R77/7932/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:	140 hours

Tractor

Make:	Ford
Model:	7600
Type:	Four wheel, rear-wheel driven, unit construction
Serial number:	B272865

Engine

Make:	Ford
Model:	7600
Type:	Turbocharged, 4-stroke, direct injection diesel
Serial number:	FO 38054
Cylinders:	4 cylinders, vertical, in-line, 111·8 mm (4·4 in) dia bore × 106·7 mm (4·2 in) stroke, capacity 4190 cm^3 (256 in^3), compression ratio 15·6:1, monobloc construction, overhead valves
Fuel system:	Simms mechanical fuel feed pump; C.A.V. twin paper element filters with sediment bowl and water trap; fuel tank capacity 75·5:1 (16·6 UK gal); C.A.V. type P5319/1 in-line injection pump, Serial No. 3675; manufacturer's production setting: maximum fuel delivery 17·9 kg/h (39·5 lb/h) at 2100 rev/min engine speed and fuel temperature 30-35°C (86-95°F) using fuel of 0·821-0·842 specific gravity at 32°C (90°F); C.A.V. type BDLL 150S 6667 injector nozzles, injection pressure 22·1-22·6 MPa (218-223 atm), injection pump delivery starts at 23° before T.D.C. (measured statically)
Governor:	C.A.V., mechanical, incorporated in fuel injection pump, governed range of engine speed 600 to 2375 rev/min, rated engine speed 2100 rev/min
Air cleaner:	Rockwell International, dry paper element, situated forward of radiator, centrifugal pre-cleaner above bonnet
Turbocharger:	Schwitzer 3LDA 168, exhaust driven
Lubrication system:	Force feed from eccentric rotor pump with metal strainer in sump; water oil-cooler integral with radiator; full flow replaceable paper element filter; total oil capacity 8·5 1 (15·0 pt), recommended oil Series 3 quality, viscosity 65 cSt at 50°C (122°F), change period 100 hours
Cooling system:	Water cooled, pressurised at 50kPa (7 lb/in^2), centrifugal pump, 432mm (17·0 in) dia 7-blade fan, thermostat for temperature control, cooling water capacity 13·3 1 (23·4 pt)

Starting system: Electrical, Lucas M50G solenoid-engaged starter motor, operable only when high-low selector gear is in neutral position; excess fuel device on injection pump for cold starting

Electrical system

Voltage: 12, negative earth

Generator: Lucas, alternator type 18 ACR

Battery: Ford, lead acid, 120-128 Ah at 20-hour rating

Transmission

Clutch: Borg and Beck, single plate, dry, pedal-operated, 330 mm (13·0 in) dia

Gearbox: Ford, constant mesh, 16 forward and 4 reverse speeds, comprising hydraulically operated dual power epicyclic gear and 4 forward and 1 reverse speed gearbox with high-low range selector

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

Oil capacity: Gearbox, rear axle and final drive 56·37 l (99·2 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 2100 rev/min rated speed of engine*, km/h*	*(mile/h)*
Forward			
Low 1 P	280·63	2·01	(1·25)
2 P	224·85	2·50	(1·55)
1	218·26	2·58	(1·60)
2	174·88	3·22	(2·00)
3 P	128·74	4·37	(2·72)
3	100·13	5·62	(3·49)
4 P	93·66	6·01	(3·73)
High 1 P	78·16	7·20	(4·47)
Low 4	72·85	7·73	(4·80)
High 2 P	62·62	8·99	(5·59)
1	60·79	9·26	(5·75)
2	48·71	11·56	(7·18)
3 P	35·86	15·70	(9·76)
3	27·89	20·18	(12·54)
4 P	26·09	21·57	(13·40)
4	20·29	27·74	(17·24)
Reverse			
1 P	195·22	2·88	(1·79)
1	151·83	3·71	(2·31)
2 P	54·37	10·35	(6·43)
2	42·29	13·31	(8·27)

*Calculated with tyre rolling radius of 711 mm (28·0 in)
P=Dual power in power position

Power take-off At rear of tractor, in vertical centre plane, 34·9 mm (1⅜ in) dia, optional 6 or 21 spline stub shafts, to I.S.O. standard, when stub shaft is fitted in position the correct speed ratio is selected, engaged by hand lever, hydraulic clutch, independent of main clutch, height above ground 702 mm (27·6 in), 6 spline shaft: proportional engine speed, 596 rev/min at 2100 rev/min rated engine speed, 540 rev/min (standard p.t.o. speed) at 1902 rev/min engine speed, 21 spline shaft: proportional engine speed, 1020 rev/min at 2100 rev/min rated engine speed, 1000 rev/min (standard p.t.o. speed) at 2059 rev/min engine speed, direction of rotation clockwise viewed from driving end

Power lift Ford, hydraulic, Plessey 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, assister ram 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 394 mm (15·5 in) and 492 mm (19·4 in), changed by inverting drawbar, distance from rear axle centre 864 mm (34·0 in), 813 mm (32·0 in) and 660 mm (26·0 in) to rear, position relative to p.t.o. 413 mm (16·3 in), 362 mm (14·3 in) and 210 mm (8·3 in) to rear, lateral adjustment 508 mm (20·0 in), 483 mm (19·0 in) and 394 mm (15·5 in), pivot position in line with rear wheel centre, drawbar pin hole 27 mm (1·1 in) dia

Steering Power steering, single drop arm and drag link, oil supplied from Plessey gear-driven pump

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

Wheels

Steering wheels: Two at front, Goodyear Super Rib 7·50—18 cross-ply tyres, 8-ply rating, maximum permissible mass on each tyre 948 kg (2090 lb) at 290 kPa (42 lb/in^2), track width 1346 mm (53·0 in) by 102 mm (4·0 in) steps to 2060 mm (81·1 in), changed by extending axle and reversing wheels

Driving wheels: Two at rear, Goodyear Traction Sure Grip 16·9/14-34 cross-ply tyres, 6-ply rating, maximum permissible mass on each tyre 1870 kg (4123 lb) at 110 kPa (16 lb/in^2), track width 1626 mm (64·0 in) by 102 mm (4·0 in) steps to 2034 mm (80·1 in), changed by reversing wheels and offset lug rims

Wheelbase: 2223 mm (87·5 in)

Lighting

Unrestricted beam angle of headlights in plan view 153°

	Height above ground of centre, *mm*	*(in)*	*Size,* *mm*	*(in)*	*Distance from outside edge of tractor at 1626 mm (64·0 in) wheel track, to centre,* *mm*	*(in)*
Headlights	1207	(47·5)	127	(5·0) dia	670	(26·4)
Side lights	1638	(64·5)	70 × 70	(2·8) × (2·8)	337	(13·3)
Rear lights	1588	(62·5)	70 × 70	(2·8) × (2·8)	321	(12·6)
Reflectors	1588	(62·5)	70 × 57	(2·8) × (2·2)	391	(15·4)

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	987	(2176)	1784	(3933)	2771	(6109)
With ballast	987	(2176)	3410	(7518)	4397	(9694)

Ballast

	Number of weights	*Total mass, kg* (*lb*)	*Water, kg* (*lb*)
Rear wheels	18	907 (2000)	719 (1585)

Track setting during tests

Front: 1346 mm (53·0 in)
Rear: 1626 mm (64·0 in)

Overall dimensions

	Length	*Width*	*Height*
With ballast	3·689 m (145·2 in)	2·584 m (101·7 in)	2·537 m (99·9 in)
Without ballast	3·689 m (145·2 in)	2·051 m (80·7 in)	2·546 m (100·2 in)

Overall height measured to top of exhaust pipe

Seat Grammer, upholstered cushion and back rest, tension spring suspension with pneumatic damping, adjustable for driver's weight, range of adjustment 111 mm (4·4 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 121A

Transmission oil: Ford, ESEN/M2C 86A

COMPULSORY TESTS

1. Main power take-off performance

Date and location of tests: 22nd September 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.*	1/h (*UKgal/h*)	*kg/h* (*lb/h*)	*kg/kWh* (*lb/hph*)	*kWh/1* (*hp h/UKgal*)
Maximum power—2 hour test						
63·3 (84·9)	2131	605	21·07 (4·63)	17·76 (39·15)	0·281 (0·462)	3·00 (18·3)
Standard p.t.o. speed (540 rev/min)						
60·8 (81·5)	1902	540	18·98 (4·18)	16·00 (35·27)	0·263 (0·432)	3·20 (19·5)
The speed recommended by the manufacturer for drawbar work						
63·2 (84·8)	2100	596	21·01 (4·62)	17·71 (39·04)	0·280 (0·460)	3·01 (18·4)
Part loads						
(1) 85% of the torque obtained at maximum power						
56·4 (75·6)	2215	629	19·73 (4·34)	16·63 (36·66)	0·295 (0·485)	2·86 (17·4)
(2) Unloaded						
0	2342	665	7·08 (1·56)	5·97 (13·16)	—	—
(3) Half the load defined in (1)						
29·0 (38·9)	2279	647	13·55 (2·98)	11·42 (25·18)	0·394 (0·648)	2·14 (13·0)
(4) Maximum power						
63·3 (84·9)	2131	605	21·07 (4·63)	17·76 (39·15)	0·281 (0·462)	3·00 (18·3)
(5) One quarter of the load defined in (1)						
14·6 (19·6)	2300	653	10·17 (2·24)	8·57 (18·89)	0·587 (0·965)	1·44 (8·8)
(6) Three-quarters of the load defined in (1)						
43·0 (57·7)	2250	639	16·62 (3·66)	14·01 (30·89)	0·326 (0·536)	2·59 (15·8)

No load, maximum engine speed		2342 rev/min
Equivalent crankshaft torque at maximum power		283·5 Nm (209·1 lb ft)
Maximum equivalent crankshaft torque		326·0 Nm (240·4 lb ft) at 1480 rev/min engine speed
Mean atmospheric conditions:	temperature	16°C (61°F)
	pressure	1013 m bar (29·91 in Hg)
	relative humidity	56%
Maximum temperature:	coolant	91°C (196°F)
	engine oil	108°C (226°F)
	fuel	38°C (100°F)
	air intake	29°C (84°F)

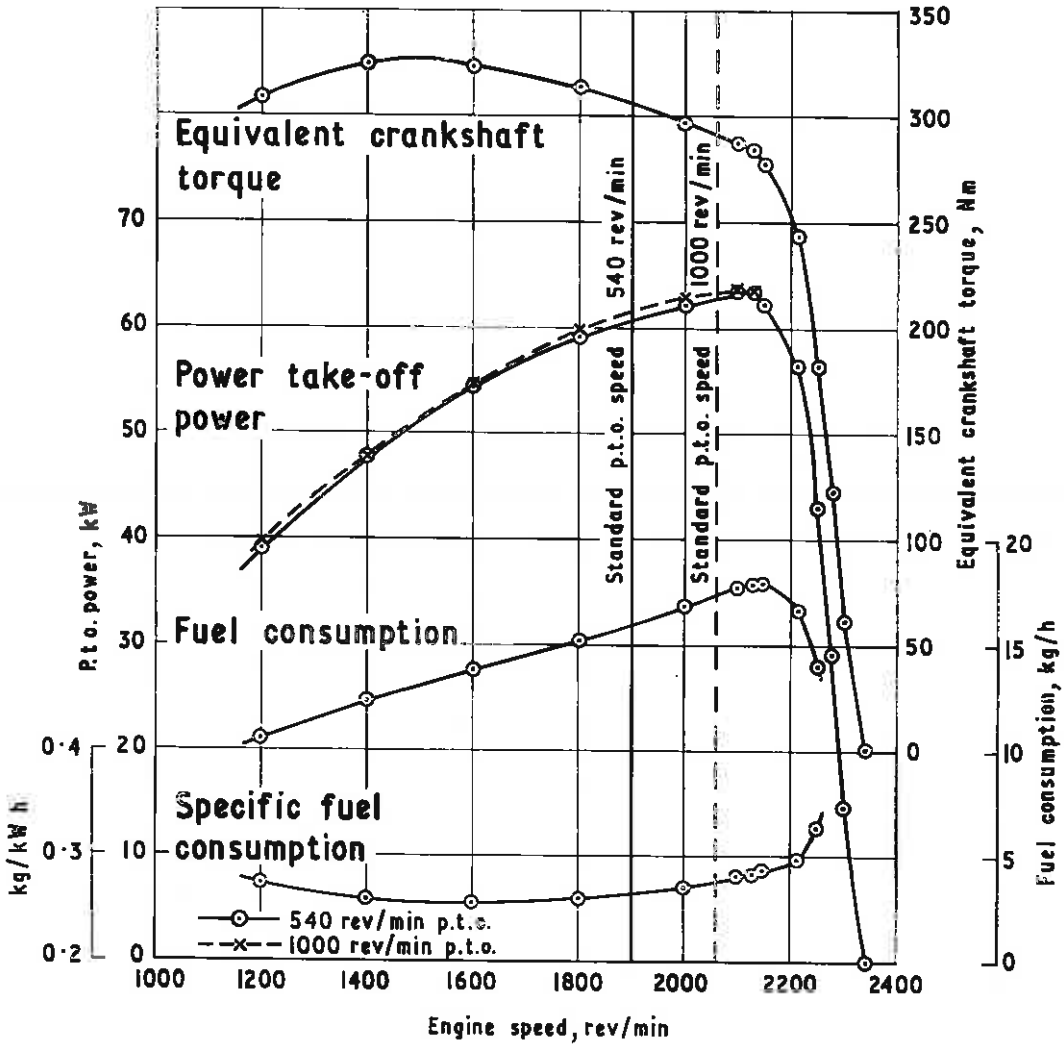


Fig. 1. Power take-off test

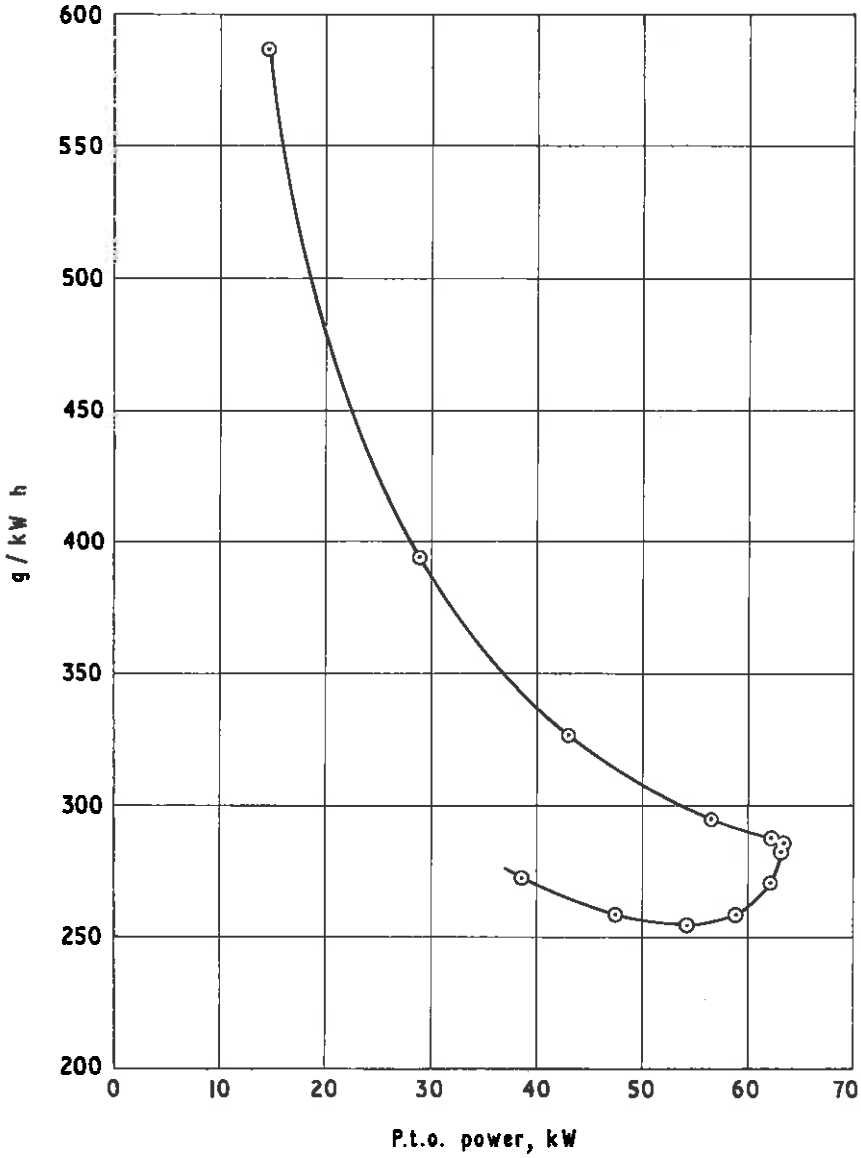


Fig. 2. Power take-off test

2. Drawbar performance

Date of tests: 5th November 1976-17th January 1977 Type of track: Concrete Height of drawbar above ground: 406 mm (16·0 in)

Gear	Power, kW (hp)	Drawbar pull, kN (lb)	Speed, km/h (mile/h)	Engine speed, rev/min	Wheel-slip, %	Specific fuel consumption kg/kW h (lb/hp h)	Specific fuel consumption kW h/l (hp h/UKgal)	Temperature, °C (°F) Coolant	Fuel	Engine oil	Atmospheric conditions Temperature, °C (°F)	Relative humidity, %	Pressure, mbar (in Hg)
(i) Maximum power (ballasted)													
L1 P	19·3* (25·9)	36·8 (8270)	1·89 (1·17)	2290	15·0	0·560 (0·921)	1·51 (9·2)	76 (169)	23 (73)	91 (196)	12 (54)	76	1002 (29·59)
L2 P	24·2* (32·5)	36·8 (8270)	2·37 (1·47)	2273	15·0	0·486 (0·799)	1·73 (10·5)	77 (171)	27 (80)	96 (205)	12 (54)	76	1002 (29·59)
L1	24·7* (33·1)	36·8 (8270)	2·42 (1·50)	2268	15·0	0·484 (0·796)	1·74 (10·6)	76 (169)	27 (80)	94 (201)	12 (54)	76	1002 (29·59)
L2	30·3* (40·6)	36·8 (8270)	2·96 (1·84)	2250	15·0	0·428 (0·704)	1·97 (12·0)	77 (171)	30 (86)	97 (207)	12 (54)	76	1002 (29·59)
L3 P	41·8* (56·1)	36·8 (8270)	4·09 (2·54)	2223	15·0	0·378 (0·621)	2·23 (13·6)	78 (172)	31 (88)	99 (210)	12 (54)	76	1002 (29·59)
L3	51·1 (68·5)	35·9 (8070)	5·12 (3·18)	2186	14·0	0·346 (0·569)	2·44 (14·9)	79 (174)	32 (90)	102 (216)	12 (54)	76	1002 (29·59)
L4 P	54·0 (72.4)	35·4 (7960)	5·49 (3·41)	2180	13·3	0·337 (0·554)	2·50 (15·2)	80 (176)	31 (88)	99 (210)	13 (55)	70	1002 (29·59)
H1 P	54·7 (73·4)	29·8 (6700)	6·61 (4·11)	2130	11·1	0·318 (0·523)	2·65 (16·2)	81 (178)	38 (100)	102 (216)	12 (54)	69	1002 (29·59)
L4	55·7 (74·7)	27·9 (6270)	7·19 (4·47)	2130	9·9	0·319 (0·524)	2·64 (16·1)	81 (178)	35 (95)	102 (216)	12 (54)	69	1002 (29·59)
H2 P	56·4 (75·6)	24·0 (5400)	8·46 (5·26)	2130	8·4	0·306 (0·503)	2·75 (16·8)	79 (174)	41 (106)	99 (210)	13 (55)	70	1002 (29·59)
H1	56·6 (75·9)	23·1 (5190)	8·82 (5·48)	2130	7·8	0·316 (0·519)	2·67 (16·3)	79 (174)	24 (75)	96 (205)	12 (54)	81	999 (29·50)
H2	54·7 (73·4)	17·6 (3960)	11·19 (6·95)	2130	6·0	0·316 (0·519)	2·67 (16·3)	79 (174)	43 (109)	101 (214)	11 (52)	72	1002 (29·59)
(ii) Five hour test at 75% of pull at maximum power													
L4	44·9 (60·2)	20·9 (4700)	7·74 (4·81)	2223	6·9	0·392 (0·644)	2·15 (13·11)	74 (165)	29 (84)	95 (203)	8 (46)	86	1003 (29·62)
(iii) †Five hour test at pull corresponding to 15% wheelslip in test (i)													
L3	—	36·8 (8270)	5·17 (3·21)	2166	—	—	—	79 (174)	40 (104)	104 (219)	10 (50)	80	1002 (29·59)

Total oil consumption during ten hours duration of tests (ii) and (iii) 116·1 g/h (0·256 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

Gear	Power, kW (hp)	Drawbar pull, kN (lb)	Speed, km/h (mile/h)	Engine speed, rev/min	Wheel-slip, %	Specific fuel consumption kg/kW h (lb/hp h)	Specific fuel consumption kW h/l (hp h/UKgal)	Temperature, °C (°F) Coolant	Fuel	Engine oil	Atmospheric conditions Temperature, °C (°F)	Relative humidity, %	Pressure, mbar (in Hg)
(iv) Maximum power (unballasted)													
L3	40·3* (54·0)	27·6 (6200)	5·25 (3·26)	2233	15·0	—	—	76 (169)	24 (75)	92 (198)	4 (39)	92	1021 (30·15)
L4 P	42·7* (57·3)	27·6 (6200)	5·57 (3·46)	2236	15·0	—	—	77 (171)	21 (70)	96 (205)	4 (39)	92	1021 (30·15)
H1 P	48·7* (65·3)	27·2 (6110)	6·44 (4·00)	2212	15·0	—	—	78 (172)	24 (75)	98 (208)	3 (37)	91	1022 (30·18)
L4	52·7 (70·7)	26·9 (6050)	7·05 (4.38)	2172	14·3	—	—	78 (172)	22 (72)	92 (198)	4 (39)	92	1021 (30·15)
H2 P	55·6 (74·6)	24·2 (5440)	8·27 (5·14)	2128	12·0	—	—	78 (172)	18 (64)	97 (207)	3 (37)	91	1022 (30·18)
H1	55·9 (75·0)	23·5 (5280)	8·56 (5·32)	2130	11·8	—	—	78 (172)	21 (70)	92 (198)	3 (37)	91	1022 (30·18)
H2	57·2 (76·7)	18·5 (4160)	11·14 (6·92)	2125	7·9	—	—	78 (172)	16 (61)	98 (208)	3 (37)	91	1022 (30·18)

*Maximum power available at 15% wheelslip

3. Turning space and turning circle

Details of wheel equipment: As in specification, without ballast

Track of wheels: front—1346 mm (53·0 in)
rear—1626 mm (64·0 in)

	With brakes		*Without brakes*	
	Right-hand	*Left-hand*	*Right-hand*	*Left-hand*
Radius of turning space, m (in)	3·23 (127)	3·39 (133)	3·52 (139)	3·71 (146)
Radius of turning circle, m (in)	3·12 (123)	3·28 (129)	3·41 (134)	3·60 (142)

4. Location of centre of gravity

Height above ground, mm (in)	932	(36·7)
Distance forward from the vertical plane containing the axis of the rear wheels, mm (in)	775	(30·5)
Distance from the median plane of the tractor	0	

5. Braking

Date of tests: 23rd-26th November, 1976

Type of track: Concrete

Type of decelerometer: Moto Meter, recording type

Weight of ballasted tractor: 4397 kg (9694 lb)

Cold brakes

	Tractor without ballast		*Tractor ballasted*	
Travelling speed of the tractor, km/h (mile/h)	25·0	(15·5)	25·0	(15·5)
Maximum deceleration, m/s² (ft/s²)	4·7	(15·4)	5·2	(17·1)
Stopping distance, m (ft)	6·2	(20·3)	5·9	(19·4)
Force on brake pedal, N (lb)	310	(70)	450	(101)
Force exerted on the brake pedal to achieve a deceleration of 2·5 m/s² (8·2 ft/s²), N (lb)	130	(29)	210	(47)

Brake fade characteristics (hot tests, ballasted tractor)

Maximum deceleration hot/maximum decleration cold × 100: 106%

Stopping distance cold/stopping distance hot × 100: 105%

Force on pedal cold/force on pedal hot × 100: 100%

Efficacy of handbrake: Satisfactory facing up and down 16% slope

Pull on handbrake: 200 N (45 lb)

6. Measurement of ambient noise emitted by the tractor

Date of tests:	26th January 1977
Type of sound level meter:	Bruel and Kjaer 2204
Type of track:	Concrete
Results of tests:	
Gear:	H4
Travelling speed before acceleration:	22·5 km/h (14·0 mile/h)
Sound level:	88 dBA

7. Noise measurement at the driver's ear level

Date of tests:	26th January 1977
Type of sound level meter:	Bruel and Kjaer 2204
Type of track:	Concrete

Gear	*Travelling speed, km/h (mile/h)*	*dBA*
H1 P	7·2 (4·5)	98

8. Power lift and hydraulic pump performance

Date of tests:	18th and 21st January 1977
Hydraulic fluid	
Make and type:	Ford S.A.E. 80 Mild E.P.
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 figures):	19·6-20·3 MPa (2840-2940 lb/in²)
Pump characteristics	
(i) Opening pressure of relief valve:	15·9 MPa (2310 lb/in²)
Sustained pressure of the open relief valve:	18·1 MPa (2630 lb/in²)
(ii) Pump delivery rate at minimum pressure and rated engine speed:	36·4 l/min (8·0 gal/min)
(iii) Pump delivery rate at maximum hydraulic power:	35·5 l/min (7·8 gal/min)
Delivery pressure:	15·9 MPa (2310 lb/in²)
Power:	9·4 kW (12·6 hp)

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

	Maximum mechanical advantage		*Minimum mechanical advantage*	
Projected length in side view				
lower links	914	(36·0)	914	(36·0)
lift arms	229	(9·0)	229	(9·0)
lift rods	787	(31·0)	787	(31·0)
top link	680	(26·8)	684	(26·9)
Distance of lift rod connection point from pivot point of lower link	514	(20·2)	413	(16·3)
The following dimensions are given relative to the rear wheel centre line, situated 711 mm (28·0 in) above the ground level				
lower link pivot point	102 (4·0) behind,	229 (9·0) below	102 (4·0) behind,	229 (9·0) below
top link pivot point	337 (13·3) behind,	203 (8·0) above	337 (13·3) behind,	146 (5·7) above
lift arm pivot point	102 (4·0) forward,	340 (13·4) above	102 (4·0) forward,	340 (13·4) above
maximum and minimum height of lower link hitch points	197 (7·8) above,	368 (14·5) below	146 (5·7) above,	587 (23·1) below
height of lower link hitch points when locked in transport position	Any height within lift range		Any height within lift range	

Power lift performance

Lifting heights in relation to a horizontal line through the lower link pivoting point		*mm* (*in*)	−381 (−15)	−356 (−14)	−305 (−12)	−229 (−9)	−152 (−6)	−127 (−5)	−76 (−3)	0	+76 (+3)	+152 (+6)	+229 (+9)	+305 (+12)	+330 (+13)	+381 (+15)	+406 (+16)	+432 (+17)
Lifting force with the pressure at maximum hydraulic horsepower (15·9 MPa (2310 lb/in²)) calculated from measurements made at maximum pressure (18·1 MPa (2630 lb/in²)), kN (lb)	At the hitch points	max. mech. advantage						*33·88 (7617)	35·72 (8030)	36·65 (8239)	37·05 (8329)	37·51 (8433)	37·31 (8388)	37·07 (8334)		35·54 (7990)	35·24 (7922)	
		min. mech. advantage		*22·86 (5139)	24·42 (5490)	25·35 (5699)	26·86 (6038)		28·03 (6301)	29·12 (6546)	29·91 (6724)	30·31 (6814)	30·55 (6868)	30·03 (6751)	29·83 (6706)			
		Force at which front of tractor is calculated to lift with maximum allowable front ballast is in excess of the measured values																
	On the frame	max. mech. advantage					35·32 (7940)		35·61 (8005)	35·06 (7882)	34·21 (7691)	33·03 (7425)	31·58 (7100)	29·64 (6663)		27·31 (6140)		*26·24 (5899)
		min. mech. advantage	26·14 (5877)		25·97 (5838)	25·71 (5780)	25·55 (5744)		25·25 (5676)	24·90 (5598)	24·46 (5499)	23·79 (5348)	23·16 (5207)	22·28 (5009)		21·04 (4730)		*20·32 (4568)
		Force at which front of tractor is calculated to lift with maximum allowable front ballast 25·42 kN (5715 lb)																

*Maximum force exerted throughout whole range

Repairs and adjustments during tests	A new turbocharger shaft and blade assembly was fitted after the shaft broke during the drawbar test
Remarks	The manufacturer states that the material of the turbocharger shaft has been changed to increase its resistance to fatigue failure

Officer in charge: D. W. Smith

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