



NATIONAL MACHINERY TESTING INSTITUTE

Head office S-750 07 Uppsala, Sweden

Testing stations:

S-750 07 Uppsala	(Central Sweden)
S-230 53 Alnarp	(South Sweden)
S-901 11 Umeå	(North Sweden)

TEST BULLETIN: OECD No. 887

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**REPORT ON TEST IN ACCORDANCE WITH OECD TEST CODE FOR
THE OFFICIAL TESTING OF AGRICULTURAL TRACTORS**

AGRICULTURAL TRACTOR VOLVO BM VALMET 705-4

Manufactured by: Valmet OY, Tourula Works, Jyväskylä, Finland

Test No. 6202

Agricultural Tractor Volvo BM Valmet 705-4



This Bulletin is based on engineering tests in accordance with OECD Tractor Code.
It does not contain an evaluation of the performance of the tractor on practical farm work.

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Tractor manufacturer's name and address:	Valmet OY, Tourula Works, Jyväskylä, Finland
Submitted for test by:	The manufacturer
Selected by:	The manufacturer with the agreement of the testing Institute
Place of running in:	Valmet, Jyväskylä, Finland
Duration of running in:	65 hours

Specification of tractor

Make	VOLVO BM VALMET
Model	705-4
Type	Four wheel driven, unit construction
Serial No.	500035

Engine	
Make	Valmet
Model	TD44DS7
Type	4-stroke, direct injection, turbocharged diesel engine, water cooled
Serial No.	39603
Cylinder Number	4
Disposition	Vertical in-line
Bore/Stroke	108 mm/120 mm
Capacity	4397 cm ³
Compression ratio	16:1
Arrangement of valves	Overhead
Cylinder liners	Wet, replaceable

Fuel system

Type of fuel feed	Mechanical fuel feed pump Bosch FP/KE
Make, type and model of fuel filters	Lucas CAV fuelstrainer and Bosch replaceable cartridge filter
Fuel tank capacity	180 dm ³
Make, type and model of injection pump	Bosch in line, PES 4A 95D 320RS
Manufacturer's production setting	14.3 kg/h at 2100 rev/min and full load, using fuel of density 0.84 at 17°C fuel inlet temperature, injection timing 21° before T.D.C. (automatic retardation at start)

Make, type and model of injectors	Bosch 4 hole, 150S 804
Manufacturer's setting	20 MPa

Governor

Make	Bosch
Type	Mechanical, incorporated in fuel injection pump, RSV 325 1050 A2B2178-1R
Range of engine speed	Governed range of engine speed 650—2300 rev/min
Rated engine speed	2100 rev/min

Air cleaner

Make

Type and model of
cleaner

Valmet

Dry paper air cleaner including replaceable paper element and
replaceable safety element Pre-cleaner, Make Valmet, type cyclon**Exhaust silencer**

Expansion chamber type

Dimensions: 77/130/1200 mm

Vertical on left hand-side, debouch 2.70 m above ground

Lubrication system

Type

Make and Type of filter

Oil capacity

Changing period

Recommended oil

Forced feed from gear type pump

1 Full flow spin-on type paper filter, changing period 200 h
12 dm³

200 h

Engine oil according to API-CD SAE 10W/30

Cooling system

Type

Water cooled by centrifugal pump 430 mm dia 6-blade belt driven
fan

Coolant capacity

15.5 dm³Means for temperature
control

Thermostat

Pressure

Over pressure 40 kPa

Starting system

Make

Electrical

Lucas CAV

Type

M50 12V 3 kW

Cold starting aids

Lucas CAV Thermostart System 357-8

Electrical system

Voltage

12 V

Generator

Make

Lucas

Type

Alternator A 133/65, 870 W

Battery

Make

Tudor

Type

4232 Lead-acid, 1 battery 12V

Capacity

160 Ah at 20 h rating

Transmission

Clutch

Make

LUK

Type and diameter of disc

Single plate dry clutch, 310 mm dia with organic friction material

Method of operation

Foot pedal (only for travelling)

Gear box

Make

Own

Constant mesh synchronized speed change gear with 4 gears. Con-
stant mesh synchronized range gear with low, high and reverse.
High-low power shift

No. of speeds

Totally 16 forward and 8 reverse

Rear axle and final drive

Make

Own

Type

Crown wheel and pinion, differential and planetary final drive. Multidisc differential lock. Not selfdisengaging. Operation electro hydraulically by means of a pressbutton and internal low pressure hydraulic circuit

Oil capacity

Gearbox, rear axle and final drive: 48 dm³. Change period 800 hours. Filter with replaceable cartridge, changing period 400 h
Recommended oil: API GLASTOUSAE 10W/30

Front axle and final drive

Driven by universal joint shaft on the left hand side of the gear box. Dog clutch to be operated by hand lever. Crown wheel and pinion, differential and planetary final drives in wheel hubs

Oil capacity

Differential 4 dm³ and final drive 1 dm³ each. Change period 800 hours.
Recommended oil: API GL4 SAE 10W/30

Gear number	Number of engine revolutions for one revolution of driving wheels	Nominal travelling speed at rated engine speed**	
		km/h	m/s
Forward			
1 L low*	241.588	2.51	0.70
1 L high	192.347	3.15	0.88
1 L l	172.844	3.51	0.97
2 L h	137.614	4.41	1.22
3 L l	121.776	4.98	1.38
3 L h	96.956	6.25	1.74
4 L l	97.225	6.24	1.73
4 L h	77.408	7.83	2.18
1 H l	71.582	8.47	2.35
1 H h	56.992	10.64	2.96
2 H l	51.213	11.84	3.29
2 H h	40.775	14.87	4.13
3 H l	36.082	16.81	4.67
3 H h	28.728	21.11	5.86
4 H l	28.807	21.05	5.85
4 H h	22.936	26.44	7.34
Reverse			
1 R l	151.585	4.00	1.11
1 R h	120.689	5.02	1.40
2 R l	108.451	5.59	1.55
2 R h	86.346	7.02	1.95
3 R l	76.409	7.94	2.20
3 R h	60.835	9.97	2.77
4 R l	61.004	9.94	2.76
4 R h	48.570	12.49	3.47

* Power shift low has a 20 % speed reduction

** With tyre rolling radius index of 766 mm (Tyres 18.4—34)

Power take off**Make**

Own

Location

At rear of tractor

Type of drive

Independent p.t.o. Engaged by hand lever electrohydraulically operated multi disc clutch

Dimensions

According to ISO 500

No. of splines

6 (dia. 34.9 mm)

Height above ground

770 mm in tractor's median plane, distance to the rear axle 470 mm

540 rev/min p.t.o.**speed**

610 rev/min at rated engine speed. Standard p.t.o. speed 540 rev/min at 1860 rev/min engine speed.

Direction of rotation clockwise viewed facing driving end.

Belt pulley

(Not fitted for test)

Power lift**Make**

Own

Type

Single acting. Gear type pump. Independent pump drive from p.t.o. intermediate shaft. Working pressure 17 MPa. Oil supplied from rear axle housing to ram cylinders. Oil capacity: 48 dm³. Hydraulic filter with replaceable cartridge, changing period 400 h. Oil capacity available for external use 20 dm³*. Category 2 implement linkage according to ISO 730 with lower link sensing. For dimensions see page 15 Draught, mixed and position control. Two operating levers. External tappings: 1 single acting and 1 double acting.

Drawbar

Swinging drawbar.

Height above ground 400 mm.

Horizontal distance from rear axle 720/870 mm.

Position relative to p.t.o. 250/400 mm.

Lateral adjustment 120/260 mm from centre position. Pivot position relative to rear wheel centre 170/320 mm forward. Coupling pin diameter 32 mm.

Hitch

Height above ground 510 mm, horizontal distance from rear axle 496 mm, position relative to p.t.o. 260 mm below 26 mm behind. Permissible vertical load 29.4 kN.

Steering**Make**

Danfoss Orbitrol

Type

Hydrostatic, single cylinder acting on right steering arm. Hydraulic pump independent driven from p.t.o. intermediate shaft. Oil supplied from rear axle housing.

Brakes**Make**

Girling

Type

Hydraulically actuated. Oil-immersed multi-plate disc on rear axle planetary shafts. Independent or combined pedal operated. Handoperated parking brake mechanically connected to both service brakes.

* 30 dm³ temporary after filling up 10 dm³

Wheels

Steering and driving wheels

Two at front. Type: Pneumatic, 13.6-24/6-ply rating, cross-ply tyres. Maximum permissible mass on each tyre 1340 kg at 160 kPa pressure. Track width 1690 mm.

Driving wheels

Two at rear. Type: Pneumatic, 18.4-34/8-ply rating, cross-ply tyres. Maximum permissible mass on each tyre 2565 kg at 140 kPa pressure. Track width 1500, 1600, 1700, 1800, 1900, 2000, 2100 mm changed by reversing wheel centres and off-set lugs on rims.

Wheelbase

2315 mm

Seat

Make

Grammer, model DS85H90

Type

Mechanical suspension, adjustable to driver's mass. Damping by hydraulic shock absorber. Range of adjustment 180 mm forward and backwards and 60 mm up and down.

Protective cab

Make

Own

Type

H 505-805

Number of grease points

Whole tractor

21

Overall dimensions

	Length, m	Width, m	Height, ¹ m
With ballast	4.70	—	2.70
Without ballast	4.40	1.94–2.54	2.70

Minimum ground clearance 320 mm to underside of drawbar frame.

¹ Measured to top of exhaust pipe.**Lighting**

The Lighting system is in accordance with the national Swedish regulations (FK 20§)

	Height above ground of centre mm	Size mm	Distance from outside edge of tractor to centre ¹ mm
Head lights	1130	90×145	920
Side lights	1710	65× 85	400
Rear lights	1750	65× 85	450

¹ With track width of 1700 mm Rear wheels
1690 mm Front wheels

Conditions During test

Masses		Tractor without driver but with tanks full	
Without ballast	Part of mass on front wheels		1 610 kg
	Part of mass on rear wheels		2 140 kg
	Total mass		3 750 kg
With ballast	Part of mass on front wheels		2 420 kg
	Part of mass on rear wheels		3 330 kg
	Total mass		5 750 kg
Ballast	Front: Frame and front weights	total	390 kg
	Rear: Weights	total	640 kg
	Liquid	total	970 kg
Tracksetting		Front: 1 690 mm	
		Rear: 1 700 mm	

Fuel and lubricants used in tests

Diesel fuel to Swedish standard SS 155432. Density at 15°C 0.840 g/ cm³. Viscosity at 20°C 3.2 mm²/s. Cetane number 49.
Engine oil SAE 10W/30 Api GL-4 STOU
Transmission oil SAE 10W/30 API GL-4 STOU
Power lift, steering and front axle drive oil SAE10W/30 API GL-4 STOU.

Compulsory tests

1. Main power take-off performance

Date and location of tests: 1983-03-29, Ultuna, Uppsala, Sweden

Type of dynamometer: Eddy current, make Zöllner

Power kW	Speed rev/min		Fuel consumption				Specific energy	
	Engine	p.t.o.	l/h	kg/h	g/MJ	kg/kWh	MJ/l	kWh/l
Maximum power — 2 hours test								
59.3	2100	610	17.16	14.42	67,5	0.243	12.44	3.46
Varying loads at rated engine speed								
(1) 85 % of the torque obtained at maximum power								
52.4	2180	633	15.74	13.22	70.1	0.252	11.98	3.33
(2) Unloaded								
0.4	2321	674	5.01	4.21	—	—	—	—
(3) 50 % of of the load defined in (1)								
27.1	2256	655	10.40	8.74	89.6	0.322	9.38	2.61
(4) Maximum power								
60.5	2101	610	17.22	14.47	66.4	0.239	12.65	3.51
(5) 25 % of the load defined in (1)								
13.8	2301	668	7.66	6.43	129.0	0.464	6.51	1.81
(6) 75 % of the load defined in (1)								
40.3	2235	649	13.12	11.02	76.0	0.273	11.05	3.08
Varying loads, the governor hand lever in the position corresponding to the standard p.t.o. speed at full load (540 rev/min)								
(1) 85 % of the torque obtained at maximum power								
50.1	1943	564	14.17	11.90	66.0	0.238	12.73	3.53
(2) Unloaded								
0.3	2056	597	3.86	3.24	—	—	—	—
(3) 50 % of the load defined in (1)								
25.8	1998	580	9.00	7.56	81.5	0.294	10.31	2.86
(4) Maximum power								
57.4	1860	540	15.80	13.27	64.2	0.231	13.08	3.64
(5) 25 % of the load defined in (1)								
13.1	2036	591	6.34	5.33	113.0	0.406	7.43	2.07
(6) 75 % of the load defined in (1)								
38.2	1974	573	11.61	9.75	71.0	0.255	11.83	3.29

Standard specific fuel consumption: g/MJ (kg/kWh)

- a) 70.1 (0.252)
- b) 89.6 (0.322)
- c) 66.0 (0.238)
- d) 81.5 (0.294)

No load, maximum engine speed	2321 rev/min
Equivalent crankshaft torque at maximum power	270 Nm
Maximum equivalent crankshaft torque	318 Nm at 1400 rev/min engine speed
Mean atmospheric temperature	17°C
pressure	101.3 kPa
relative humidity	26 %
Maximum temperature coolant	88°C
engine oil	106°C
fuel	17°C
air intake	25°C

2. Drawbar performance

Date of tests: 1983-08-19, 08-24 – 26

Type of track: Tarmac

Height of drawbar
above ground: 425 mm

Tyre inflation pressure:		Unballasted	Ballasted
	Front	150 kPa	160 kPa
	Rear	100 kPa	130 kPa

Results see Table 1

Engine oil consumption during ten hours duration of test iii) and i v) was 78 g/h. Test i v) was carried out with additional ballast. Power, slip and fuel consumption do not correspond to test ii) gear 2 L*.

Table 1. Drawbar performance

Gear	Power kW	Draw- bar pull kN	Speed m/s	km/h	Engine speed		Wheel slip %	Specific fuel consumption		Specific energy MJ/l	kWh/l	Temperature			
					rev/s	rev/ min		g/MJ	kg/kWh			Coo- lant °C	Fuel °C	Engine oil °C	Transm. oil °C
i) Maximum power, unballasted tractor															
3L	33.2	25.5	1.30	4.68	37.0	2222	15.5	100.6	0.362	8.24	2.29	87	25	87	63
3L	41.1	25.2	1.63	5.86	36.5	2190	15.4	94.7	0.341	8.78	2.44	87	26	90	66
4L	40.3	25.2	1.60	5.76	36.3	2180	15.8	96.5	0.347	8.60	2.39	87	30	88	67
4L	43.8	21.8	2.01	7.23	35.0	2100	12.0	90.7	0.326	9.14	2.54	86	32	91	70
1H	45.3	20.8	2.18	7.84	35.0	2100	10.2	88.8	0.320	9.36	2.60	87	32	91	74
1H	45.8	16.2	2.83	10.18	35.0	2100	7.1	87.2	0.314	9.50	2.64	87	33	94	76
2H	48.0	15.1	3.18	11.44	35.0	2100	5.8	83.9	0.302	9.90	2.75	87	34	92	78
2H	47.2	11.6	4.07	14.65	35.0	2100	4.4	84.7	0.305	9.79	2.72	87	35	94	79
ii) Maximum power, ballasted tractor															
1L	24.8	37.6	0.66	2.37	37.7	2260	15.5	113.0	0.407	7.0	1.95	84	27	86	72
1L	31.4	38.3	0.82	2.95	37.4	2243	15.5	103.5	0.372	8.1	2.25	85	28	86	76
2L	35.0	38.5	0.91	3.27	37.1	2227	15.8	97.5	0.351	8.6	2.38	88	28	87	77
2L	43.0	38.4	1.12	4.03	36.6	2194	15.7	92.4	0.332	9.1	2.52	87	28	88	78
3L	45.9	37.6	1.22	4.39	35.0	2100	15.1	87.8	0.316	9.6	2.66	88	29	90	79
3L	48.3	30.0	1.61	5.79	35.0	2100	9.5	83.4	0.300	10.1	2.80	87	29	91	80
4L	48.3	30.2	1.60	5.76	35.0	2100	10.0	82.7	0.298	10.1	2.80	87	29	90	80
4L	47.8	23.1	2.07	7.45	35.0	2100	6.6	84.2	0.303	10.0	2.77	87	30	83	70
1H	50.0	22.2	2.25	8.10	35.0	2100	6.0	80.6	0.290	10.4	2.88	86	30	85	71
1H	49.3	17.1	2.88	10.36	35.0	2100	5.0	81.8	0.294	10.3	2.86	87	30	87	72
2H	50.1	15.5	3.23	11.62	35.0	2100	4.3	80.4	0.290	10.4	2.88	87	30	88	73
2H	49.9	12.2	4.09	14.72	35.0	2100	3.0	80.2	0.288	10.5	2.91	87	30	90	74
iii) Five hour test at 75 % pull at maximum power															
1H	40.0	16.6	2.41	8.67	36.8	2206	4.2	87.0	0.313	9.66	2.68	88	32	95	90
iv) Five hour test corresponding to 15 % wheelslip															
2L	36.3	38.6	0.94	3.38	36.7	2203	8.7	—	—	—	—	88	—	99	114

3. Turning space and turning circle

Details of Wheel equipment: As in specification without ballast
 Track of wheels: Front 1690 mm
 Rear 1700 mm

	With brakes		Without brakes	
	Left hand m	Right hand m	Left hand m	Right hand m
Front wheel drive engaged				
Radius of turning space	3.84	3.76	4.75	4.82
Radius of turning circle	3.65	3.57	4.56	4.63
Front Wheel drive disengaged				
Radius of turning space	3.98	3.98	4.47	4.39
Radius of turning circle	3.79	3.79	4.28	4.20

4. Location of centre of gravity

Height above ground	937	mm
Distance forward from the vertical plane containing the axis at rear wheels	974	mm
Distance from the median plane	3	mm (to the right)

5. Braking

Date of tests: 1983-08-18 and 08-29

Tractor masses during brake tests:

Front kg	Rear kg	Total kg
2680	5000	7680

Type 0 (ordinary cold service braking device performance) test

Speed before application of brakes:

ballasted tractor 28.1 km/h, unballasted tractor 30.0 km/h

Ballasted	Force on pedal N	560	500	400	370
	Mean deceleration m/s ²	3.6	3.3	2.7	2.5
Unballasted	Force on pedal N	310	250	200	150
	Mean deceleration m/s ²	4.3	3.6	3.1	2.5

Type I (fade) test

Force on pedal	N	520	450	400	340
Mean deceleration	m/s ²	3.6	3.3	2.9	2.5

The brakes were heated by towing

Comments on deviation and vibration: None

Parking braking device test

		18 percent slope		12 percent slope with trailer of 3000 kg	
		Up	Down	Up	Down
Braking device					
control force	N	335	355	235	245

6. Measurement of external noise level

Date of test: 1983-08-19

Type of sound level meter: Brüel & Kjaer 2204

Type of track: Tarmac

Results of test

Gear 4 High

Travelling speed before acceleration: 6.25 m/s (22.5 km/h)

Sound level: 88 dB(A)

7. Noise measurement at the driver's ear

Date and location of test: 1983-08-19, Ultuna, Uppsala, Sweden

Type of sound level meter: Brüel & Kjaer 2204

Type of track: Tarmac

Cab fitted: Yes

Results of test

Gear	Drawbar pull at which the tractor develops the maximum sound level kN	Measured travelling speed		Sound level dB(A)
		m/s	(km/h)	
all openings closed				
4L h*	18.3	2.17	(7.81)	84
4L h*	Light load	2.47	(8.89)	83.5
Top gear	Light load	8.17	(29.4)	83

* Gear corresponding to the nominal travelling speed nearest to 2.08 m/s (7.5 km/h).

8. Power lift and hydraulic pump performance

Date of test: 1983-01-17, 1983-03-08

Hydraulic fluid

Make and type: The same as transmission

Viscosity: 51 cSt at 50°C

Type of linkage lock for transport: Hydraulic

Power lift

	Height above ground in down position mm	Vertical movement mm	Maximum force exerted through full range kN	Corre- sponding pressure of hydraulic fluid MPa	Moment about rear axle kNm	Tilt angle of mast degrees
At hitch point	233	612	40.6	16.2	44.5	—
On the frame	225	621	31.3	16.2	53.4	2*

Temperature of hydraulic fluid at start of test 29°C.

* Tilt angle of mast from vertical position to uppermost position 4°.

Hydraulic pump performance

Tapping point:	Double acting external tapping
Opening pressure of the relief valve:	15.0 MPa
Sustained pressure with relief valve open:	17.5 MPa
Pump delivery rate at minimum pressure	48.0 l/min
at 90 % of opening pressure of the relief valve (13.5 MPa)	46.0 l/min
Hydraulic power at 90 % of opening pressure he relief valve	10.4 kW
Temperature of hydraulic fluid	65°C

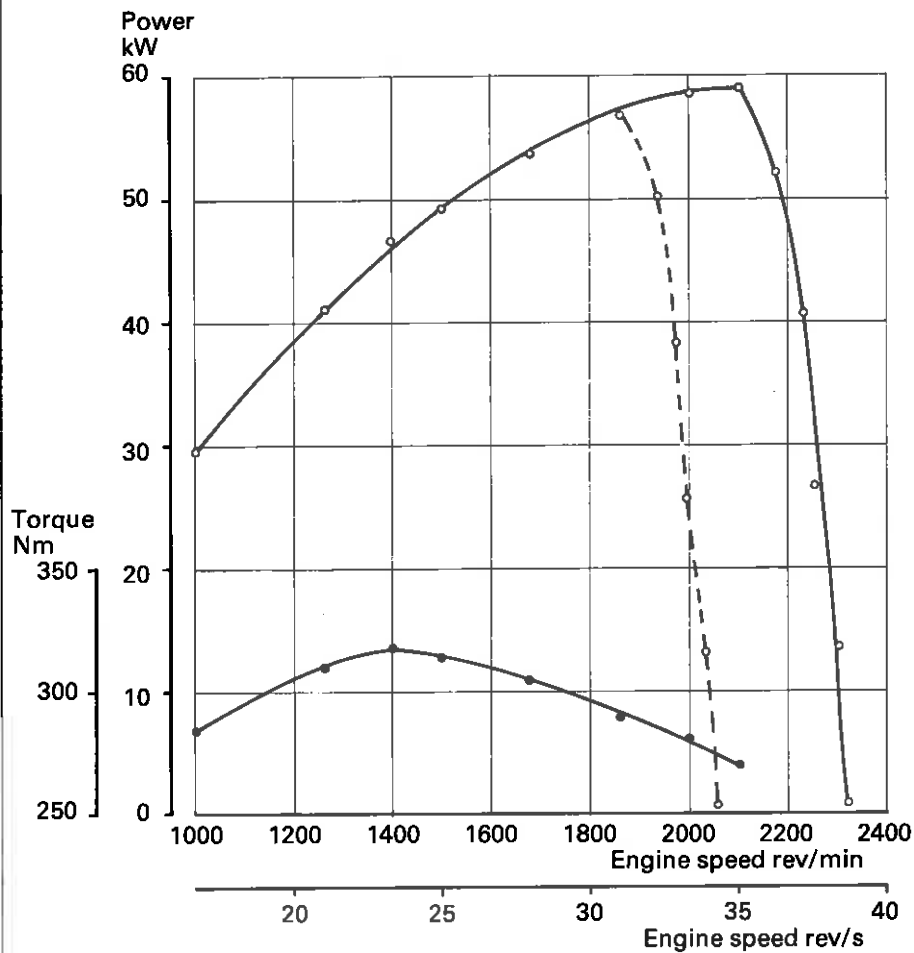
Table 2. Linkage geometry when connected to the standard frame

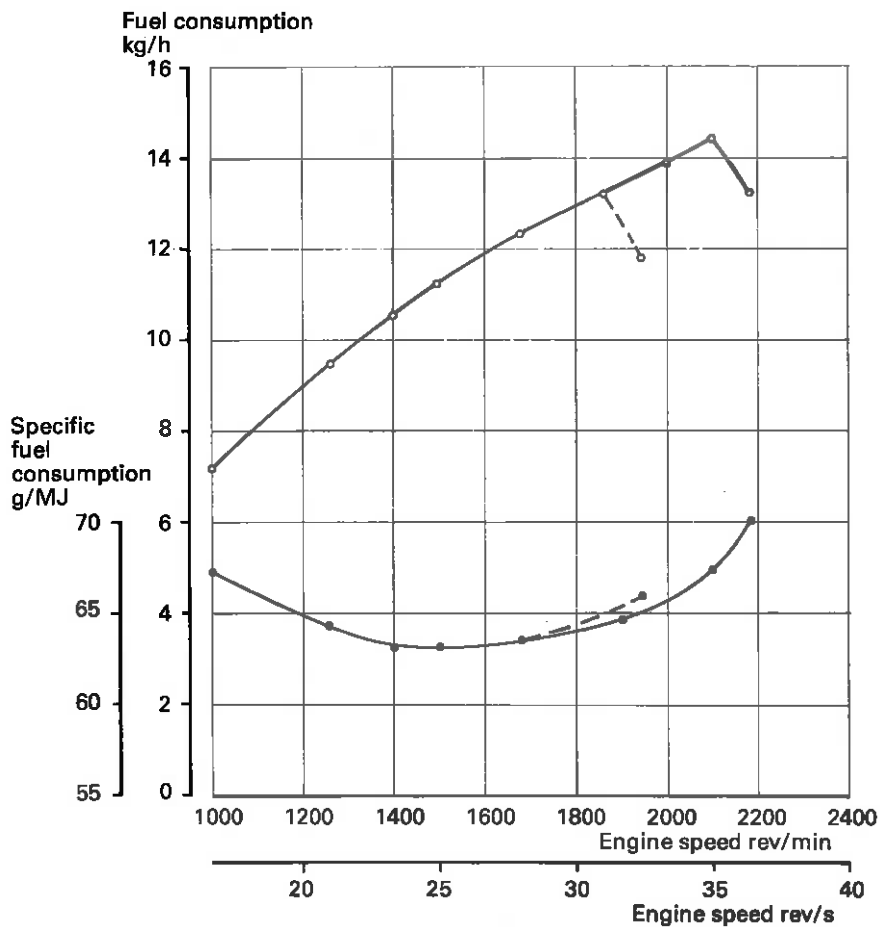
Projected length in side view

Lower links	900 mm
Lift arms	310 mm
Lift rods	653 mm
Top-link	618 mm
Distance of lift rod connection point from pivot point of lower link	425 mm

The following dimensions are given relative to the rear
wheel centre line, situated 766 mm above the ground level.

Lower link pivot point	196 mm behind	258 mm below
Top link pivot point	478 mm behind	245 mm above
Lift arm pivot point	108 mm behind	278 mm above
Maximum and minimum height of lower link hitch points	79 mm above	533 mm below
Height of lower link hitch points when locked in transport position	79 mm above	





Specific fuel consumption
g/MJ

