VAKOLA

PPA 1
SF-03400 VIHTI
FINLAND
+358 0 224 6211

VALTION MAATALOUSTEKNOLOGIAN TUTKIMUSLAITOS
STATE RESEARCH INSTITUTE OF ENGINEERING IN AGRICULTURE AND FORESTRY

TEST BULLETIN: O.E.C.D. No. 1369 RESTRICTED CODE

Report on Test in Accordance with O.E.C.D. Restricted Standard Code
for the Official Testing of Agricultural Tractors



VALMET 6400 (4WD)

Manufactured by: Valmet Tractors Inc.
SF-44200 Suolahti, Finland

Date of approval: 30th June 1992
Serial No. 1369 RESTRICTED CODE

This bulletin is based on engineering tests in accordance with the OECD Restricted Standard Code for the Official Testing of Agricultural Tractors Performance. It does not contain on evaluation of the performance of the tractor on practical farm work.

This report has been approved by the OECD Co-ordinating Centre (CEMAGREF France) as being in accordance with the OECD Restricted Standard Code for the Official Testing of Agricultural Tractors.

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Tractor manufacturer's name and address	Valmet Tractor Inc. SF-44200 Suolahti, Finland
Location of tractor assembly	Suolahti, Finland
Submitted for test by	The manufacturer
Selected for test by	The manufacturer
Place of running-in	Valmet Corporation, Tourula
Duration of running-in	50 h
Location of test	VAKOLA, Finland

I. SPECIFICATIONS OF TRACTOR

TRACTOR

Make/Model/Type	Valmet/6400/Four wheel drive, unit construction
Number of driving wheels	4
Serial number	651857
First serial number	651857

ENGINE

Make/Model/Type	Valmet/TD 420 DS/water cooled direct injection diesel engine, turbocharged
Serial number	95612

Cylinders

Number	4
Disposition	Vertical, in line
Bore/Stroke	108 mm/120 mm
Capacity	4400 cm^3
Compression ratio	16,5:1
Arrangement of valves	Overhead
Cylinder liners	Wet

Supercharging

Make/Model	Schwitzer S1A
Pressure	0,14 MPa

Fuel system

Fuel feed system	Mechanical piston type feed pump
Fuel filters	Bosch (paper)
Capacity of fuel tank	165 dm^3
Injection pump	Bosch PES 4A, in line
Serial number of injection pump	06227341

Manufacturer's production setting of injection pump	86 mm^3/stroke at rated engine speed and full load[x]
Flow rating at rated engine speed and full load	19,2 dm^3/h
Timing	21° before TDC
Injectors	Stanadyne NBS 770620, multihole
Injection pressure	23 MPa
Governor	
Make/Model/Type	Bosch RSV centrifugal
Governed range of engine speed	From 750 to 2450 rev/min
Rated engine speed	2225 rev/min
Air cleaner	
Pre-cleaner	
Make/Model/Type	Valmet/cyclon
Location of air intake	Above engine hood
Main cleaner	
Make/Model/Type	Valmet/dry cleaner with safety element
Location of air intake	Above engine hood
Maintenance indicator	Electrical
Lubrication system	
Type of pump	Gear pump
Type of filters	One full flow oil filter with replaceable paper element
Number	1
Cooling system	
Type of coolant	Anti-freeze
Type of pump	Centrifugal
Number of fan blades	6
Fan diameter	483 mm
Coolant capacity	16 dm^3
Type of temperature control	Thermostat
Superpressure system	50 kPa
Starting system	
Make/Model/Type	Lucas/electrical solenoid starting motor
Starter motor power rating	3 kW
Cold starting aid	Thermostart, automatic fuel exess and injection delay

x) The given figure is based on fuel pump bench test according to ISO 4010, for actual fuel consumption see the test results, main power take-off test

Safety device	Only operable when clutch pedal is pressed
Electrical system	
Voltage	12 V
Generator	
Make/Model/Type	Magnetti Marelli/A127-65
Power	870 W
Battery	
Battery	1
Rating	158 Ah at 20 hours
Exhaust system	
Make/Model/Type	Valmet/Ebersprächer/muffler, expansion chamber type
Location	Vertical on the right hand side, debouch 2840 mm above ground.
TRANSMISSION	
Clutch (travel alone)	
Make/Model/Type	Fichtel & Sachs 330 WGSZX/dry
Number of plates	1
Diameter of plates	330 mm
Method of operation	Mechanical pedal operated
Gear box	
Make/Model/Type	Valmet/GL 300/constant mesh fully synchronized with shuttle gear
Arrangement	Synchromesh gear box with 4 speeds, synchromesh group gear with 2 ranges (M and H), LL with dog clutch and directional shift
Number of gears	12 forward, 12 reverse
Available options	40 km/h transmission
Rear axle and final drives	
Make/Model/Type	Valmet/crown wheel and pinion differential, planetary final drives
Differential lock	
Type	Multidisc
Method of engagement	Electrohydraulically by a press button
Method of disengagement	Electrohydraulically by a press button

Front axle and final drives

Make/Model/Type	Sige/CS 17 SD 01/crown wheel and pinion differential
Differential lock	
Type	Limit slip
Method of engagement	Automatic
Method of disengagement	Automatic

Total ratios and travelling speeds

Gear	Group	Number of engine revolutions for one revolution of the driving wheels		Nominal travelling speed[1] at rated engine speed of 2225 rev/min, km/h	
		forward	reverse	forward	reverse
1	LL	838.533	818.246	0.8	0.8
2	LL	588.161	573.931	1.1	1.2
3	LL	418.555	408.428	1.6	1.6
4	LL	296.061	288.898	2.3	2.3
1	M	198.272	193.480	3.4	3.4
2	M	139.071	135.710	4.8	4.9
3	M	98.968	96.570	6.7	6.9
4	M	70.004	68.310	9.5	9.8
1	H	63.545	62.010	10.5	10.8
2	H	44.571	43.490	15.0	15.3
3	H	31.718	30.950	21.0	21.5
4	H	22.436	21.890	29.7	30.4

1) 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	1,3906

POWER TAKE-OFF

Main power take-off

Type	Independent
Method of engagement	Hand lever operated electrohydraulical wet multiplate clutch together with a collar shifter
Number of shafts	1
Method of changing power take-off shaft ends	Changeable shaft and speed changing happens with a collar shifter

Power take-off proportional to engine speed
540 rev/min

Location	At the rear of the tractor

Diameter of power take-off shaft end	34,8 mm
Number of splines	6, in conformity with ISO 500/1979
Height above ground	760 mm
Distance from the median plane of the tractor	0 mm
Distance behind rear-wheel axis	428 mm
PTO speed at rated engine speed (2225 rev/min)	641 rev/min
Engine speed at standard PTO speed 540 rev/min	1874 rev/min
Ratio of rotation speeds (engine speed/PTO speed)	3,471
Power restriction and maximum torque	None
Direction of rotation (viewed from behind tractor)	Clockwise
1000 rev/min	
Location	At the rear of the tractor
Diameter of power take-off shaft end	34,8 mm
Number of splines	6, in conformity with ISO 500/1979, additional: 21, in conformity with ISO 500/1979
Height above ground	760
Distance from the median plane of the tractor	0 mm
Distance behind rear-wheel axis	428 mm
PTO speed at rated engine speed (2225 rev/min)	1070 rev/min
Engine speed at standard PTO speed 1000 rev/min	2080 rev/min
Ratio of rotation speeds (engine speed/PTO speed)	2,080
Direction of rotation	Clockwise
Power take-off proportional to ground speed	
PTO shaft	Optional together with 540 and 1000
Travelling distance for one revolution of power take-off shaft	160,7 mm[x)]
Number of power take-off shaft revolutions for one revolution of (rear) driving wheels	31,08[x)]

x) The proportional to ground speed power take-off is not connected to pto speeds 540 or 1000, but is independent from those, lever in a third position

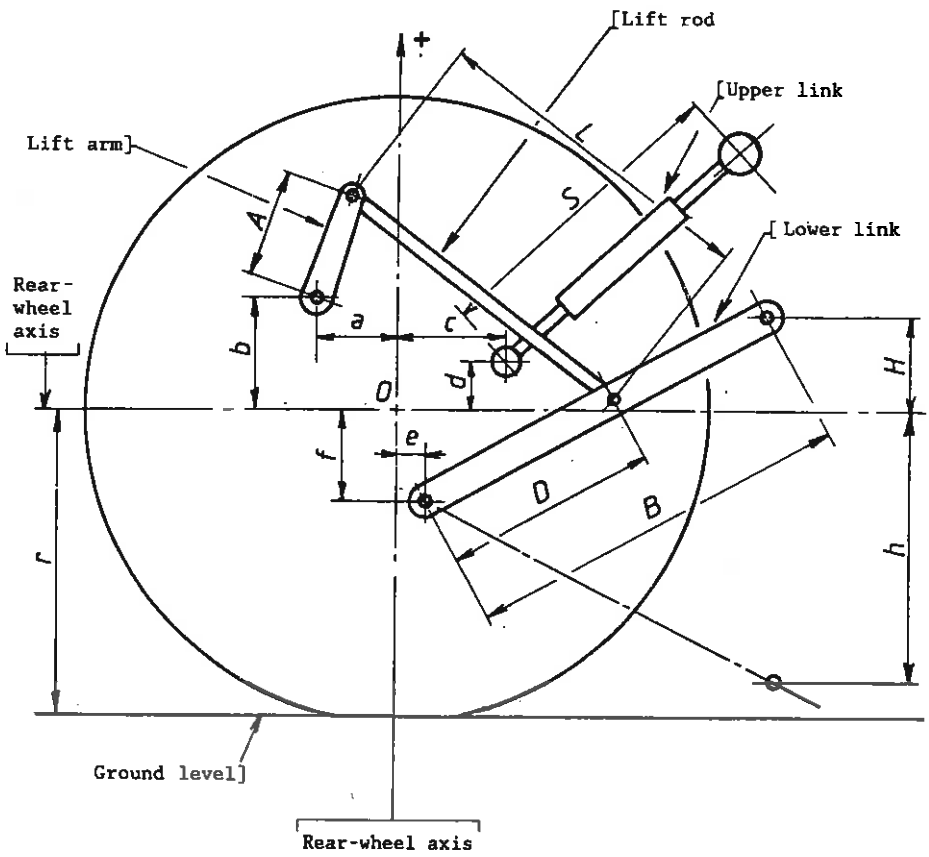
Direction of rotation with forward gear engaged	Clockwise

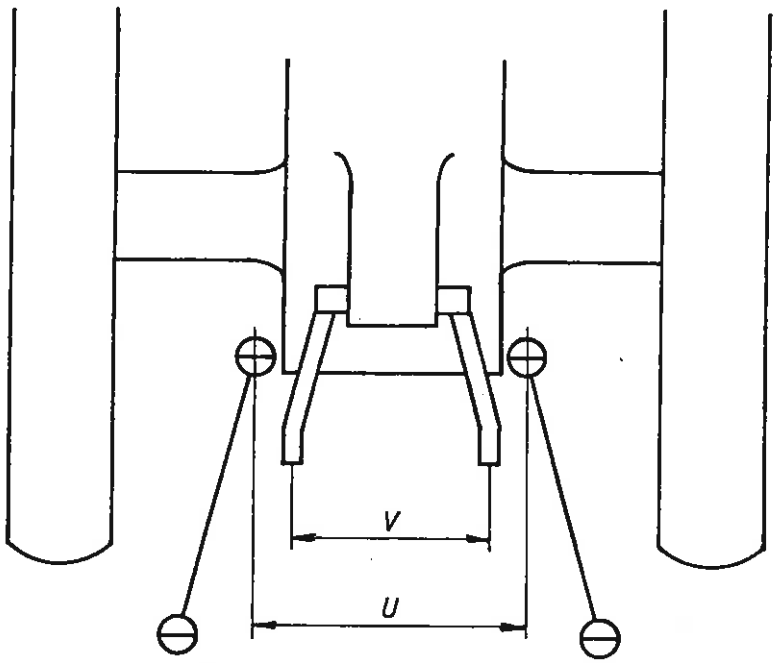
POWER LIFT

Make/Model/Type	Valmet/50 kN
Type of hydraulic system	Open centre
Type and number of cylinders	Two single acting
Type of linkage lock for transport	Electric
Relief valve pressure setting	18 + 0.8 MPa
Opening pressure of cylinder safety valve	20 MPa
Lift pump type	Gear pump
Transmission between pump and engine	Gears
Type and number of filters	Suction strainer and pressure filter
Site of oil reservoir	In the gearbox
Type, number and location of tapping points	Push-pull, 4, at the rear of the tractor
Maximum volume of oil available to external cylinders	15 dm^3, 30 dm^3 with extra filling

Three point linkage

Category	2, in conformity with ISO 730/1-1977
Category adapter	None


Lift rod
Upper link
Lift arm
Lower link
Rear-wheel axis
A
L
S
a
b
c
d
e
f
O
H
D
B
r
h
Ground level
Rear-wheel axis


V
U

		Dimension or range mm	Settings used in test mm
Length of lift arms	(A)	350	350
Length of lower links	(B)	900	900
Distance of lift arm pivot point from rear-wheel axis : horizontally : vertically	(a) (b)	-118 282	-118 282
Horizontal distance between the 2 lower link point	(u)	610	610
Horizontal distance between the 2 lift arm end points	(v)	597	597
Length of upper link	(S)	from 565 to 795	660
Distance of upper link pivot point from rear wheel axis : horizontally : vertically	 (c) (d)	 422, 432, 442 306, 233, 160	 422 306
Distance of lower link pivot point from rear wheel axis : horizontally : vertically	 (e) (f)	 191 255	 191 255
Distance of lower link pivot points to lift rod pivot points on lower links	(D)	316, 355, 422	422
Length of lift rods	(L)	from 560 to 710	640
Height of lower hitch points relative to the rear-wheel axis : in low position : in high position	(h) (H)	from 387 to 749 from 400 to -7	595 120
Height above ground of lower hitch points when locked in transport position (*)		46-1195	

(*) Assuming r = 795 mm tyre dynamic radius index of ISO 4251/1-1984.

Table 1.1 Dimensions of linkage geometry

TRAILER HITCH

Type	Hitch-hook
Hook diameter	47 mm
Height above ground	545 mm
Distance of hitch point from rear-wheel axis, horizontally	470 mm
Distance of hitch point from power take-off shaft end:	
- vertically	215 mm
- horizontally	42 mm behind
Maximum vertical permissible load	53 kN

STEERING

Make/Model/Type	Danfoss/Orbitrol A80/ hydrostatic
Method of operation	Independent hydraulic circuit for steering
Cylinders	Single central cylinder acting on both steering arms
Working pressure	14 + 1 MPa

BRAKES

Service brake

Make/Model/Type	Valmet/oil immersed disc brakes
Method of operation	Two pedals hydraulically actuated independent or combined operation
Trailer braking take-off	Additional (not on tested tractor)

Parking brake

Type	Mechanical, coupled to both service brakes
Method of operation	Hand lever with ratchnet

WHEELS

Number	
- front	Two driving and steering wheels
- rear	Two driving wheels
Wheelbase	2326 mm

Track width adjustment:

	Minimum mm	Maximum mm	Adjustment method
Front	1520	1975	Offset lug rims and reversing wheel centres
Rear	1505	2100	

PROTECTIVE STRUCTURE

Make/Model/Type	T 888/2
Manufacturer's name and address	Valmet Corporation Tractor Works, 44200 Suolahti, Finland
Protective device	Protective cab, not tiltable
OECD approval number	CSS 0164/3

DRIVER'S SEAT

Make/Model/Type	Grammer DS 85 H/90 A
Type of suspension	Mechanical spiral spring
Type of damping	Hydraulic damper

Range of adjustment

- longitudinal	200 mm
- vertical	60 mm

MISCELLANEOUS

Additional seat

- location	To the left of the driver
- number of places	1

LIGHTNING

	Height above ground of centre mm	Size mm	Distance from outside edge of lights to median plane of tractor mm
Headlights	1170	100 x 160	228
Sidelights	1800	60 x 80	695
Rearlights	1760	60 x 80	790
Reflector	1540	40 x 180	888

II. TEST CONDITIONS

Overall dimensions

Length mm	Width		Height at top of	
	Minimum mm	Maximum mm	Protective structure mm	Exhaust silencer mm
4408	1985	2585	2735	2840

Ground clearance	460 mm
Clearance limiting part	Hitch-hook

Tractor mass
(with cabs and tanks full)

	Without driver kg	With driver kg
Front	1710	1720
Rear	2370	2435
Total	4080	4155

Tyres and track width specifications

	Front	Rear
Tyres:		
- dimensions	13.6 R 28	16.9 R 38
- load index	123	141
- type	radial	radial
- maximum load (tyre manufacturer's)	15,5 kN	25.75 kN
- inflation pressure (tyre manufacturer's)	160 kPa	160 kPa
- dynamic radius index	610 mm	795 mm
Chosen track width	1665 mm	1700 mm

Oils and lubrication (Capacity and change interval)

	Capacity dm^3	Oil change h	Filter change h
Engine	12	200	200
Gear box (*)	43	800	400
Front axle	8	800	-
Final drive (front axle)	2 x 1	800	-

(*) Includes rear axle, final drive (rear), hydraulic system and steering

	Recommended	Used during test
Engine oil		Neste Delta Tractor Super
- Type	10W/30 +30-20°C	
- Viscosity	5W/20 -10..-30°C	10 W 30
- Classification	API CD	API GL 5
Transmission oils		Neste Delta Tractor Super
- Type	10W/30, 5W/30	
- Viscosity	5W/20 -10..-30°C	10 W 30
- Classification	API - GL 4(STOU)	API GL 5
Front axle		Texaco Hypoid
- Type		
- Viscosity	80W/90	80 W/90
- Classification	API GL-5 (EP)	EP

Grease — Universal grease

Number of lubrication points — 29

Fuel

Type — Dieseloil, in conformity with national standards

Density at 15 °C — PTO test 841 g/dm^3
Drawbar power test 835 g/dm^3

REPAIRS — None

REMARKS — None

III. TEST RESULTS

COMPULSORY TEST RESULTS

1. MAIN POWER TAKE-OFF

- Date and location of tests: Vihti 21.8.1990
- Type of dynamometer: Schenk W 400

Power	Speed		Fuel consumption			Specific energy
	Engine	P.T.O.	Hourly		Specific	
kW	rev/min		kg/h	l/h	g/kWh	kWh/l
1.1 MAXIMUM POWER - TWO HOUR TEST						
64.7	2079	1000	14.5	17.3	225	3.74
1.2 POWER AT RATED ENGINE SPEED						
63.5	2225	1070	15.0	17.9	237	3.55
1.3 STANDARD POWER TAKE-OFF SPEED (1000 REV/MIN)						
64.7	2079	1000	14.5	17.3	225	3.74
1.4 PART LOADS 1.4.1 The torque corresponding to maximum power at rated engine speed						
63.5	2225	1070	15.0	17.9	237	3.55
1.4.2 85 % of torque obtained in 1.4.1						
55.1	2270	1092	13.5	16.0	244	3.44
1.4.3 75 % of torque defined in 1.4.2						
41.5	2287	1100	11.0	13.0	264	3.18
1.4.4 50 % of torque defined in 1.4.2						
28.0	2304	1108	8.9	10.6	317	2.65
1.4.5 25 % of torque defined in 1.4.2						
14.1	2333	1122	6.3	7.5	447	1.88
1.4.6 Unloaded						
0	2353	1132	3.9	4.6	-	-
1.5 PART LOADS AT STANDARD POWER TAKE-OFF SPEED (1000 REV/MIN) 1.5.1 The torque corresponding to maximum power						
64.7	2079	1000	14.5	17.3	225	3.74
1.5.2 85 % of torque obtained in 1.5.1						
56.5	2135	1027	13.2	15.7	233	3.61
1.5.3 75% of torque defined in 1.5.2						
42.6	2143	1031	10.5	12.5	246	3.42
1.5.4 50 % of torque defined in 1.5.2						
28.6	2156	1037	8.6	10.2	300	2.79
1.5.5 25 % of torque defined in 1.5.2						
14.5	2183	1050	5.7	6.8	395	2.12
1.5.6 Unloaded						
0	2204	1060	3.5	4.2	-	-

- No load maximum engine speed	2353 rev/min
- Torque[1] at maximum power	297 Nm
- Maximum torque[1]	330 Nm
at engine speed	1480 rev/min
- Mean atmospheric conditions	
- Temperature	23 °C
- Pressure	100.2 kPa
- Relative humidity	46 %
- Maximum temperatures	
- Coolant	86 °C
- Engine oil	123 °C
- Fuel	47 °C
- Engine air intake	36 °C

2. HYDRAULIC POWER AND LIFTING FORCE

2.1 Hydraulic power test

Date of tests	20.6.1991
Sustained pressure with relief valve open	22.6 MPa
Pump delivery rate at minimum pressure	63.3 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	46.9	20.3	15.9
Flow rate and hydraulic pressure corresponding to maximum hydraulic power	63.0	18.0	18.9

Tapping point used for test external tapping

2.2 Power lift test

	At the hitch point	On the frame
Height of lower hitch points above ground in down position	200 mm	200 mm
Vertical movement	650 mm	640 mm
Maximum corrected force exerted through full range	44.4 kN	30.1 kN
Corresponding pressure of hydraulic fluid	18.0 MPa	18.0 MPa
Moment about rear-wheel axis	48.4 kNm	51.2 kNm
Maximum tilt angle of mast from vertical	- degrees	14 degrees

1) Equivalent crankshaft torque

Lifting heights relative to the horizontal plane including the lower link pivot points									
mm	-310	-300	-200	-100	0	100	200	300	340
Lifting forces (the values measured are corrected to correspond to a hydraulic pressure equivalent to 90% of the actual relief valve pressure setting or to maximum power delivered by the hydraulic system, whichever is lower)									
At the hitch points kN	46.7		46.4	46.3	45.7	45.5	45.3	45.1	44.4
Corresponding pressure:	18.0 MPa								
At the frame kN		43.4	42.0	40.1	38.3	36.6	34.4	31.4	30.1
Corresponding pressure:	18.0 MPa								

3. DRAWBAR POWER AND FUEL CONSUMPTION

Date of tests 11.-12.9.1990

Type of track Tarmacadam

		Tyre inflation presssure	
	Height of drawbar above ground	Front	Rear
Unballasted	515 mm	100 kPa	100 kPa

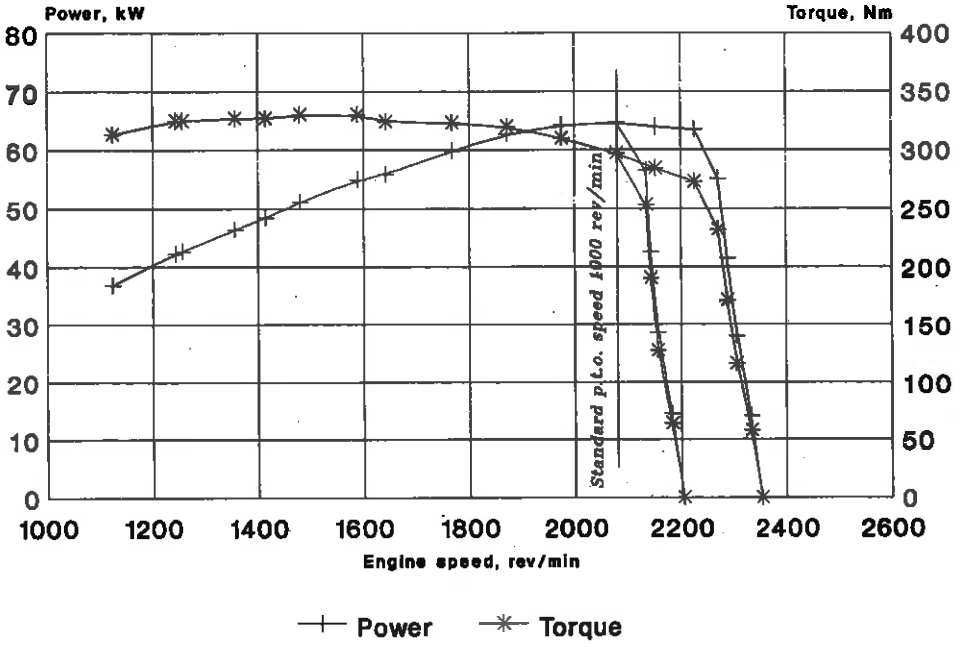
Gear and range	Power	Drawbar pull	Speed	Engine speed	Slip of wheels	Specific fuel consumption	Specific energy	Temperature			Atmospheric conditions		
								Fuel	Coolant	Engine Oil	Temperature	Relative humidity	Pressure
	kW	kN	km/h	rev-/min	%	g/kWh	kWh/l	°C	°C	°C	°C	%	kPa
3.1 MAXIMUM POWER IN TESTED GEARS													
LL 3	14.4	34.7	1.5	2321	15.0	519	1.61	37	77	98	10	55	101.3
LL 4	20.0	33.9	2.1	2329	14.7	436	1.92	36	77	96	11	55	101.3
M 1	28.9	33.2	3.1	2300	14.8	358	2.34	36	77	95	11	55	101.3
M 2	42.0	34.2	4.4	2294	14.9	322	2.60	37	77	95	11	55	101.3
M 3	52.0	33.4	5.6	2054	14.8	284	2.94	45	77	94	19	55	101.3
M 4	53.0	22.4	8.5	2060	8.9	282	2.97	44	77	94	16	55	101.3
H 1	53.2	19.9	9.6	2089	7.6	276	3.02	44	77	94	15	55	101.3
H 2	51.4	13.3	13.9	2074	4.9	290	2.88	46	76	93	18	55	101.3
H 3	45.6	8.2	20.1	2092	3.8	319	2.62	43	77	91	12	55	101.3

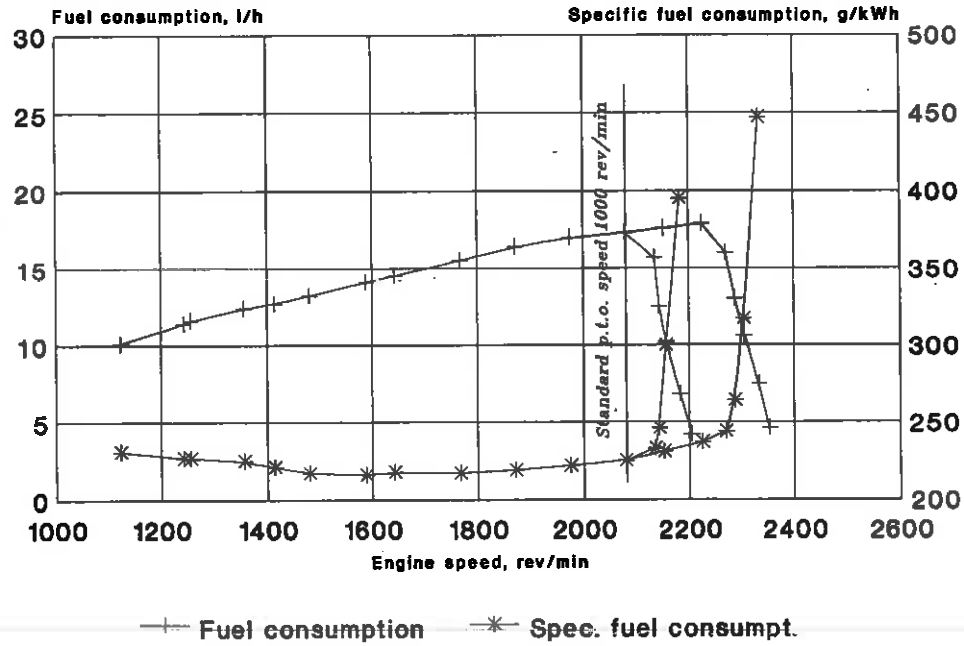
3.2 FUEL CONSUMPTION

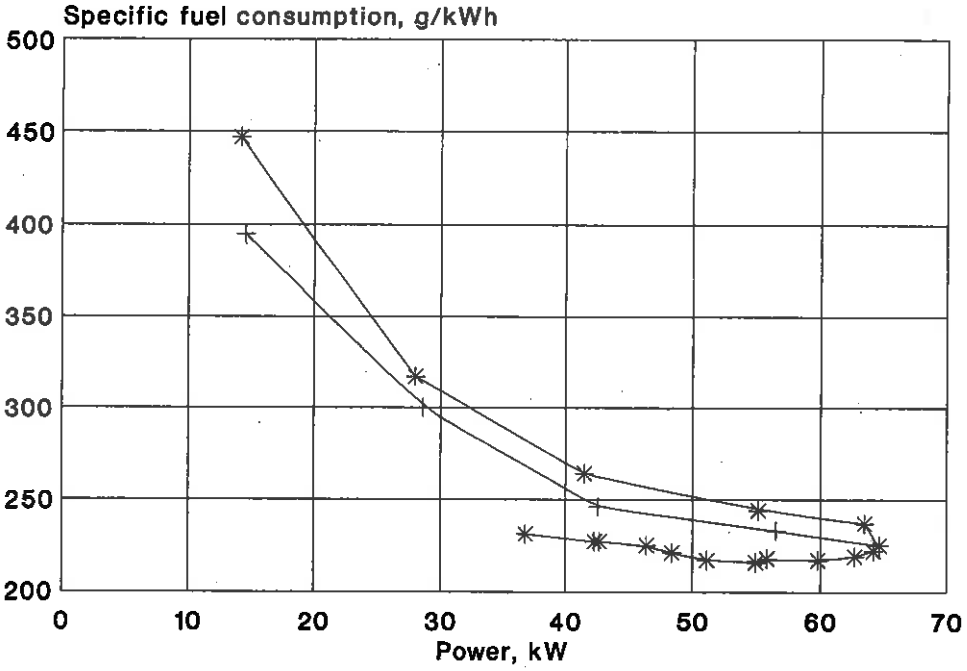
Gear and range	Power	Drawbar pull	Speed	Engine speed	Slip of wheels	Specific consumption	Specific energy	Temperature			Atmospheric conditions		
								Fuel	Coolant	Engine Oil	Temperature	Relative humidity	Pressure
	kW	kN	km/h	rev-/min	%	g/kWh	kWh/l	°C	°C	°C	°C	%	kPa
3.2.1 In selected gear at maximum power													
H 1	53.2	19.9	9.6	2089	7.6	276	3.02	44	77	94	15	55	101.3
3.2.1.1 75 % of pull at maximum power at rated speed													
H 1	44.0	14.8	10.7	2277	5.8	316	2.64	39	76	88	14	46	101.4
3.2.1.2 50 % of pull at maximum power at rated speed													
H 1	30.2	9.9	11.0	2296	4.1	369	2.27	38	77	89	12	46	101.4
3.2.1.3 Next higher gear at reduced engine speed, same pull and travelling speeds as in 3.2.1.1													
H 2	43.9	14.8	10.7	1594	5.4	277	3.01	40	75	90	14	46	101.4
3.2.1.4 Next higher gear at reduced engine speed, same pull and travelling speeds as in 3.2.1.2													
H 2	30.4	9.9	11.0	1621	3.8	293	2.85	39	76	88	13	46	101.4

Gear and range	Power	Drawbar pull	Speed	Engine speed	Slip of wheels	Specific consumption	Specific energy	Temperature			Atmospheric conditions		
								Fuel	Coolant	Engine Oil	Temperature	Relative humidity	Pressure
	kW	kN	km/h	rev/min	%	g/kWh	kWh/l	°C	°C	°C	°C	%	kPa
3.2.2 In selected gear nearest to 7.5 km/h													
M 3	52.0	33.4	5.6	2054	14.8	284	2.94	45	77	94	19	55	101.3
3.2.2.1 75 % of pull at maximum power at rated speed													
M 3	46.0	25.1	6.6	2280	9.4	310	2.69	37	77	92	12	46	101.4
3.2.2.2 50 % of pull at maximum power at rated speed													
M 3	31.7	16.7	6.8	2283	6.5	353	2.37	38	77	92	11	46	101.4
3.2.2.3 Next higher gear at reduced engine speed, same pull and travelling speeds as in 3.2.2.1													
M 4	45.3	25.0	6.5	1596	9.8	267	3.12	39	76	88	17	46	101.4
3.2.2.4 Next higher gear at reduced engine speed, same pull and travelling speeds as in 3.2.1.2													
M 4	31.8	16.7	6.9	1618	6.5	290	2.88	36	76	87	13	46	101.4

Valmet 6400 (4WD)







STATE RESEARCH INSTITUTE OF ENGINEERING IN AGRICULTURE AND FORESTRY

Vihti, July 3rd 1992

Director Henrik Sarin

Test engineer Ari Lemminkäinen

Valtion maatalousteknologian tutkimuslaitos

PAINORASTERI OY 1992