STATENS MASKIN-PROVNINGAR

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)
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TEST BULLETIN: OECD No. 1016

Date of approval 1986-08-06

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

AGRICULTURAL TRACTOR VALMET 405-4

Manufactured by: Valmet OY, Jyväskylä, Finland

Test No. 7191

Test bulletin: OECD No. 1016

Agricultural tractor Valmet 405-4



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

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* All specified dimensions refer to the tyre sizes 11.2--24 at front, 13.6 R 36 at rear and the track width 1624 mm at front and 1500 mm at rear.

Tractor manufacturer's name and address:	Valmet OY, Tourula Works, Jyväskylä, Finland
Submitted for test by:	Scantrac AB, Box 1102 S-631 80 Eskilstuna, Sweden
Selected for test by:	The manufacturer in agreement with the testing station.
Place of running-in:	Jyväskylä, Finland
Duration of running-in:	100 hours

Specification of tractor

Tractor

Make	Valmet
Trade name	Valmet[1]
Model	405-4
Type	Four wheel driven, unit construction
Serial No.	300876
First serial No.	300001

Engine

Make	Valmet
Model	TD27 DS 4
Type	Turbocharged, 4-stroke, direct injection, diesel engine, water cooled
Serial No.	57948
Cylinder No.	3
Disposition	Vertical in-line
Bore/stroke	100 mm/114 mm
Capacity	2.700 dm^3
Compression ratio	17:1
Arrangement of valves	Overhead
Cylinder liners	Wet, replaceable

Supercharging

Make	Holset
Model	H1
Type	Exhaust type turbo-supercharger
Pressure	90 kPa

Fuel system

Type of fuel feed	Mechanical, piston type fuel feed pump, Bosch FP/HSG
Make and type of fuel filter	Bosch replaceable cartridge filter and Lucas CAV SS 5836 B 12 U fuelstrainer
Fuel tank capacity	73 dm^3
Make, model and type of injection pump	Bosch PES 3 A in-line type

[1] Up to January 1st, 1986 the trade name was Volvo BM Valmet. The tractor is also available with two wheel drive.

Serial No.	04087.302
Manufacturer's production setting of injection pump	78–80 mm^3 per stroke at 700 rev/min of the pump at full injection rate
Flow rate injection timing	21° before T.D.C.
Make and type of injectors	Bosch, multihole
Manufacturer's production setting	20 MPa

Governor

Make	Bosch
Type	Mechanical, incorporated in fuel injection pump
Model	RSV 125 115 JA 2 C 2178-1
Range of engine speed	Governed range of engine speed 650 to 2650–100 rev/min
Rated engine speed	2350 rev/min

Air cleaner

Pre-cleaner

Make	Valmet
Type	Cyclon
Location of air intake	In front of radiator

Main

Make	Valmet
Type of cleaner	Dry paper air cleaner including replaceable paper element and replaceable safety element
Maintenance indicator	None

Exhaust system

Make	Valmet
Type	Muffler, expansion chamber type
Location	Vertical on left hand-side, debouch 2.64 m above ground

Lubrication system

Type of feed pump	Forced feed from gear type pump with metal strainer in oil sump
Number and type of filter	One full flow oil filter with replaceable paper element

Cooling system

Type	Water cooled, impeller assisted by centrifugal pump 410 mm dia 6-blade belt driven fan
Coolant capacity	10 dm^3
Means for temperature control	Thermostat
Over pressure	40 kPa

Starting system

Make	Lucas CAV
Model and type	MSO Electrical, solenoid starting motor, 3 kW
Cold starting aids	Lucas CAV Thermostart system 357-8
Safety device	Starter interlock with clutch pedal

Electrical system	
Voltage	12 V
Generator	
Make	Lucas
Type/Model	Alternator/A 114
Power	460 W
Battery	1 accumulator
Capacity	130 Ah at 20 h rating
Transmission	
Clutch (only for travelling)	
Make	Fitchel and Sachs
Type	Dry, double plate, with organic friction material
Model	DUT295-280/280
Diameter	280 mm
Method of operation	Foot pedal
Gearbox	
Make	Valmet
Model	220
Type, arrangement	Mechanical, constant mesh. Speed change gear operated by hand lever with 4 speeds combined with hand lever operated high–low–reverse range gear. Speed and range gears are synchronized.
No. of speeds	Totally 8 forward and 4 reverse
Options	Reduction gear to low and reverse group, totally 12+8
Rear axle and final drives	
Make	Valmet
Model	220
Type	Crown wheel and pinion, differential and planetary final drives
Differential lock	Mechanical, five pin dog clutch. Engages and disengages mechanically by hand lever
Front axle and final drive	
Make and model	ZF, APL 325
Type	Centre pivot axle with crown wheel and pinion in central casing and planetary final drives in wheel hubs
Differential lock	Limited slip, self-locking differential. Automatically engaged and disengaged

Total ratio and speeds

Gear	Position		Number of engine revolutions for one revolution of driving wheels	Nominal travelling speed at rated engine speed of 2350 rev/min*	
No.				km/h	m/s
Forward	Gear	Group			
1	1	Low	238.024	2.7	0.74
2	2	L	173.496	3.7	1.02
3	3	L	110.080	5.8	1.60
4	4	L	83.133	7.6	2.12
5	1	High	68.800	9.2	2.56
6	2	H	50.148	12.6	3.52
7	3	H	31.818	19.9	5.54
8	4	H	24.029	26.4	7.34
Reverse					
1	1	R	175.543	3.6	1.00
2	2	R	127.953	5.0	1.38
3	3	R	81.184	7.8	2.17
4	4	R	61.311	10.3	2.88

* Radius index 715 mm (Dynamic), tyre size 13.6 R 36

Power take-off

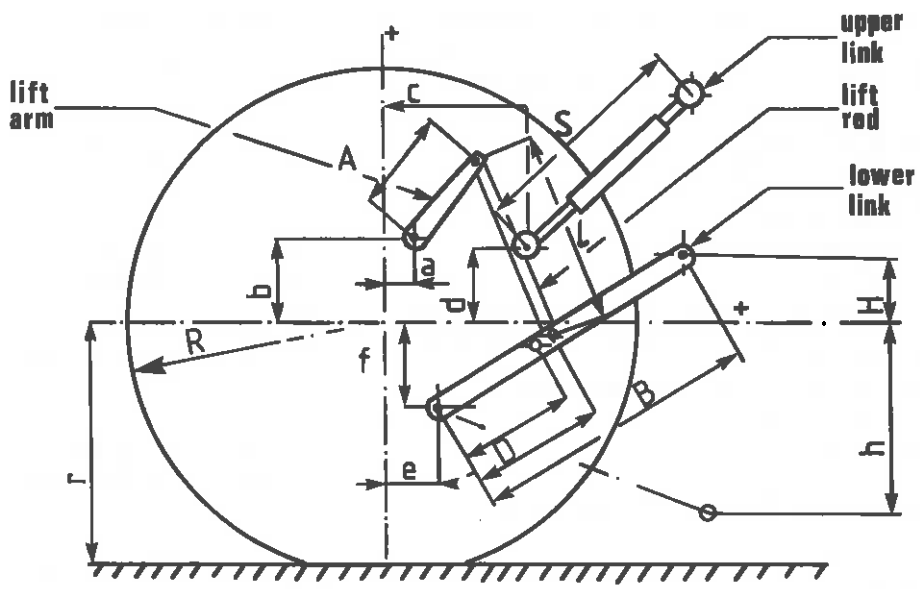
Make	Valmet
Location	At rear of tractor
Type of drive	Independent, driven by second disc of dual disc clutch
Dimensions	According to ISO 500

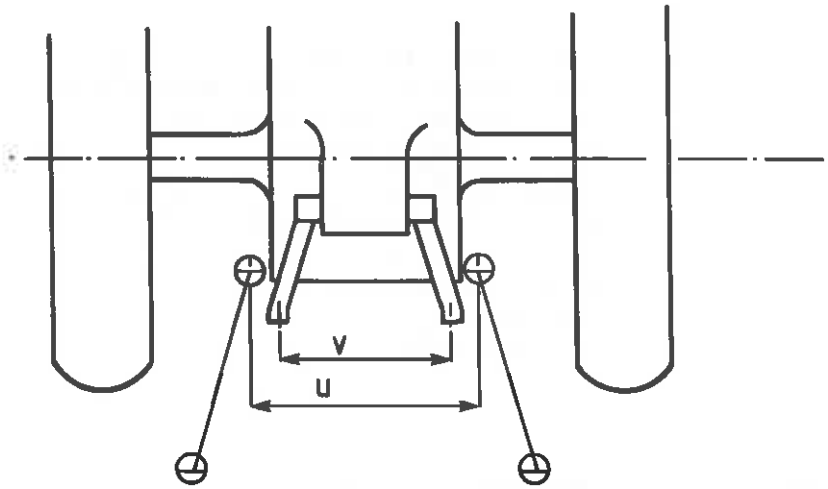
Propotional engine speed p.t.o.

540 rev/min 6 splines/34.8 mm	Height above ground	715 mm
	Distance from the median plane of the tractor	0 mm
	Distance behind rear axle	366 mm
	P.t.o. speed at rated engine speed (2350 rev/min)	671 rev/min
	Engine speed at standard p.t.o. speed	1890 rev/min
	Ratio:	3.500
	Power restriction	None
	Direction of rotation (viewed facing driving end)	clockwise

Power lift

Make	Valmet
Type	One cylinder, single acting. Gear type pump driven from the engine by gear
Relief valve pressure setting	21 MPa
Safety valve	29 MPa opening pressure
Site of oil reservoir	On top of rear axle housing
Filter	Downstream the pump one full flow replaceable, paper element filter. Upstream the pump one woven wire meshiny filter
Implement linkage	Category 2, with top link sensing. Draught and position control 2 operating levers. Dimensons according to ISO 730
External tappings	2 double acting attached to the hydraulic tank situated on top of rear axle housing. Both can be switched to single acting
Oil capacity available for external use:	24 dm^3


lift arm
upper link
lift rod
lower link
A
c
S
l
L
a
b
d
H
R
f
B
D
e
r
h


v
u

Dimensions of the implement linkage when connected to the standard frame (mm)

Rear tyres (size 13.6 R 36) loaded radius index	(R)		715
Front tyres (size 11.2–24) loaded radius index	(r)		510
Length of lift arms	(A)		275
Lenght of lower links	(B)		900
Distance of lift arm pivot point from rear wheel centre line			
horizontally	(a)		95 behind
vertically	(b)		365 above
Horizontal distance between the 2 lower link points	(u)		450
Horizontal distance between the 2 lift arm end points	(v)		630
Length of upper link	(S)	643	from 595 to 785
Distance of upper link pivot point from rear wheel centre line			
horizontally	(c)	368	from 343 to 368
vertically	(d)	222	from 222 to 360
Distance of lower link pivot point from rear wheel centre line			
horizontally	(e)		118
vertically	(f)		193
Distance of lower link pivot point to lift rod pivot points on lower links	(D)	425	from 360 to 425
Length of lift rods	(l)	646	from 550 to 710
Height of lower hitch points:			
– in low position	(h)	–	from 360 to 760 below
– in high position	(H)	–	from –10 to 390 above

Drawbar

Swinging drawbar. Height above ground 409 mm.
Horizontal distance from rear axle 576/616 and 721/766 mm. Vertical distance relative to p.t.o. 306 mm.
Horizontal distance relative to p.t.o. 210/250 and 355/400 mm.
Lateral adjustment 235 mm from centre position.
Pivot position relative to rear wheel centre 207 mm behind.
Diameter drawbar pin hole 33 mm.
Permissible vertical load 23, 15, 10 and 8.5 kN.

Hitch

Pick-up hitch

Height above ground 475 mm.
Horizontal distance from rear axle 416 mm.
Vertical distance relative to p.t.o. 240 mm below.
Horizontal distance relative to p.t.o. 50 mm behind.
Permissible vertical load 30 kN.
Dimensions according to ISO 6489/1 (tractor) and ISO 5692 (hitch ring).

Steering

Make and model	Danfoss, Orbitrol OSPC 100 ON 150 N
or	ZF 8472 955 208.
type	Hydrostatic power assisted.
	Gear type pump integrated with hydraulic pump.
	Single cylinder acting on right and left steering arm.
	Working pressure 9 MPa.

Brakes

Service brake

Make	Girling (Inter med. disc).
	Hörbiger (Friction disc).
	Valmet (Actuating disc).
Type	Oil-immersed multi-plate disc on rear axle, planetary shafts. Organic lining material.
Method of operation	Mechanically by two pedals independent or combined operated.
Trailer braking take-off	Hydraulic on option.

Parking brake

Type	Handoperated, mechanically connected to both service brakes.

Wheels

Steering and driving wheels	Two at front.
	Type: Pneumatic, diagonal tyres 11.2-24, 8 ply rating.
	Maximum permissible load on each tyre 12.0 kN at 240 kPa pressure.
	Track width 1430–1624 mm, changed by reversing wheel disc and rim.
	Radius index 515 mm.
Driving wheels	Two at rear.
	Type: Pneumatic, radial tyres 13.6 R 36, 8 ply rating.
	Maximum permissible load on each tyre 18.2 kN at 200 kPa pressure.
	Track width 1400–1704 mm, changed by reversing wheel disc and rim.
	Radius index 715 mm.

Wheelbase 2255 mm.

Seat

Make and model	Grammer DS 85H/3
Type	Mechanical suspension, adjustable to driver's mass.
	Damping by hydraulic shock absorber.
	Range of adjustment 150 mm horizontally and 60 mm vertically.

Protective cab

OECD approval number	CSD 1004/2
Make and model	Valmet H 305 . . . 405
Manufacturer's name and address	Tourula Works, Jyväskylä, Finland

Oils and lubrication
Capacity and change

	Capacity dm^3	Oil change h	Filter change h
Engine	7	200	200
Gear box, rear axle and final drive	23	800	400
Front axle	4,5+0,5×2	800	– –
Hydraulic system	35	800	400

Overall dimensions

	Length, m	Width, m	Height, m	
			exhaust silencer	cab
With ballast	4.03	1.96	2.64	2.54
Without ballast	3.88	1.96	2.64	2.54

Minimum ground clearance 360 mm to underside of drawbar frame.

Lighting The lighting system is in accordance with the national Swedish regulations for road traffic.

	Height above ground of centre mm	Size mm	Distance from outside edge of tractor to centre mm
Head lights	1040	145×90	820
Side lights	1560	85×60	210
Rear lights	1550	85×60	240
Reflectors lower	850	Ø 75	670
upper	1340	180×40	180

Repairs during test None

Conditions During test

Masses	Tractor without driver but with tanks full		
Without ballast	Part of mass on front wheels		1120 kg
	Part of mass on rear wheels		1880 kg
	Total mass		3000 kg
With ballast	Part of mass on front wheels		1360 kg
	Part of mass on rear wheels		2540 kg
	Total mass		3900 kg
Ballast	Front: Frame and front weights	total	240 kg
	Rear: Weights	total	320 kg
	Liquid	total	340 kg

Track setting Front: 1624 mm
Rear: 1500 mm

Fuel and lubricants used in tests

Fuel	Diesel fuel to Swedish Standard SS 155432. Density at 15°C 0.840 g/cm^3. Viscosity at 20°C 3.2 mm^2/s (cSt) Cetane number 49.

Oils	**Recommended**	**Used during test**
Engine oil		
– Viscosity	10W/30	10W/30
– Classification	CD	CD
Transmission oil		
– Viscosity	10W/30	10W/30
– Classification	GL 4	GL 4
Hydraulic fluid and steering oil		
– Viscosity	5W/20–40	STOU 10W/30
– Classification	SMR SH-46	SE-CD
Type of grease	Universal	Universal
Number of grease points:		18

Compulsory tests

1. Main power take-off performance

Date and location of tests: 1986-04-30, Ultuna, Uppsala, Sweden
Type of dynamometer: Eddy current, make Zöllner

Power	Speed rev/min		Fuel consumption				Specific energy	
kW	Engine	p.t.o.	l/h	kg/h	g/MJ	kg/kWh	MJ/l	kWh/l
Maximum power At 2-hour test								
40.4	2350	671	12.8	10.8	74.1	0.267	11.34	3.15
Varying loads. The governor hand lever in the position corresponding to maximum power at full load.								
(1) Maximum power								
40.4	2348	671	12.8	10.8	73.9	0.266	11.37	3.16
(2) 85% of the load at max. power rated speed								
35.0	2390	683	11.6	9.7	77.3	0.278	10.87	3.02
(3) 75% of the load defined in (2)								
26.5	2426	693	9.6	8.0	84.0	0.302	10.00	2.78
(4) 50% of the load defined in (2)								
18.0	2471	706	7.4	6.3	96.4	0.347	8.71	2.42
(5) 25% of the load defined in (2)								
9.1	2506	716	5.5	4.6	139.7	0.503	6.01	1.67
(6) Unloaded								
0.2	2527	722	3.8	3.2	– –	– –	– –	– –
Varying loads. The governor hand lever in the position corresponding to standard p.t.o. speed (540 rev/min).								
(1) Maximum power								
37.4	1890	540	11.0	9.2	68.3	0.246	12.30	3.42
(2) 85% of the load at max. power								
32.7	1939	554	9.6	8.1	68.7	0.247	12.22	3.40
(3) 75% of the load defined in (2)								
24.8	1967	562	7.7	6.5	72.2	0.260	11.63	3.23
(4) 50% of the load defined in (2)								
16.9	2009	574	6.0	5.0	82.9	0.298	10.13	2.82
(5) 25% of the load defined in (2)								
8.6	2040	583	4.2	3.6	114.9	0.414	7.31	2.03
(6) Unloaded								
0.2	2065	590	2.6	2.2	– –	– –	– –	– –

Standard specific fuel consumption:	77.3 (0.278)/96.4 (0.347) 68.7 (0.247)/82.9 (0.298) g/MJ (kg/kWh)		
No load maximum engine speed	2527 rev/min		
Torque at maximum power corresponding to 2 hour test	164 Nm		
Torque corresponding to maximum power at varying loads	164 Nm		
Maximum torque	202 Nm at 1410 rev/min engine speed		
Mean atmospheric conditions:	Temperature	18	°C
	Pressure	101.9	kPa
	Rel. humidity	43	%
Maximum temperatures:	Coolant	88	°C
	Engine oil	108	°C
	Fuel	24	°C
	Engine air intake	30	°C

2. Drawbar performance

Date of tests: 1986-06-11/12/16/18
Type of track: Tarmac
Height of drawbar above ground:

unballasted	395 mm
ballasted	395 mm

Tyre inflation pressure:

unballasted	rear	100 kPa, front 100 kPa
ballasted	rear	120 kPa, front 100 kPa

Results see Table 1.

Engine oil consumption during ten hours duration of test (iii) and (iv) was 18 g/h. Test (iv) was carried out with additional ballast. Power, speed, slip and fuel consumption do not correspond to test (ii) gear 1 L.

Table 1. Drawbar performance

Gear	Power	Draw-bar pull	Speed		Engine speed	Wheel slip	Spec. fuel consumption		Spec. energy		Temperature			
											Coo-lant	Fuel	Engine oil	Transm. oil
	kW	kN	m/s	km/h	rev/min	%	g/MJ	kg/kWh	MJ/l	kWh/l	°C	°C	°C	°C
(i) Maximum power (unballasted tractor)														
1L	17.6	27.7	0.64	2.29	2425	15.5	118.4	0.426	7.10	1.97	83	29	96	45
2L	24.0	27.7	0.87	3.13	2403	15.4	106.2	0.382	7.90	2.20	84	30	100	50
3L	32.7	23.2	1.41	5.08	2350	10.8	91.7	0.330	9.16	2.54	88	36	104	58
4L	33.0	17.0	1.94	7.00	2350	6.4	90.9	0.327	9.24	2.57	85	27	81	37
1H	35.0	14.7	2.38	8.57	2350	5.8	85.6	0.308	9.81	2.72	85	38	105	65
2H	34.6	10.3	3.36	12.10	2350	3.4	86.7	0.312	9.69	2.69	83	38	105	66
3H	33.8	6.4	5.30	19.10	2350	3.2	88.7	0.319	9.47	2.63	84	38	105	66
(ii) Maximum power (ballasted tractor)														
1L	21.1	33.5	0.63	2.27	2416	15.7	111.9	0.403	7.50	2.08	83	29	101	55
2L	28.2	32.9	0.85	3.09	2390	15.9	101.4	0.365	8.28	2.30	84	28	100	54
3L	32.8	22.8	1.44	5.19	2351	8.3	91.4	0.329	9.19	2.55	84	27	98	50
4L	32.8	16.7	1.96	7.07	2346	5.9	91.6	0.330	9.17	2.55	82	25	93	45
1H	33.9	14.1	2.40	8.65	2350	4.7	88.4	0.318	9.50	2.64	83	31	96	56
2H	34.3	10.2	3.36	12.10	2355	3.2	87.5	0.315	9.52	2.64	84	31	100	59
3H	33.1	6.2	5.36	19.30	2350	1.6	90.5	0.326	9.27	2.57	84	32	102	63
(iii) Five hour test at 75% pull at maximum power														
4L	25.8	12.5	2.06	7.42	2402	3.2	92.8	0.334	9.05	2.51	84	43	106	95
(iv) Five hour test corresponding to 15% wheelslip														
1L	22.4	33.5	0.67	2.41	2399	9.6	– –	– –	– –	– –	84	– –	107	88

Atmospheric conditions

	Temperature	Relative humidity	Pressure
	°C	%	kPa
Maximum power			
unballasted tractor	23–28	44	101.5
ballasted tractor	17–21	57	101.9
Five hour tests			
at 75% pull at max. power	16–25	65	101.9
at max. pull	20–30	46	102.5

3. Turning space and turning circle

Details of wheel equipment: As in specification without ballast

	With brakes*		Without brakes*	
	Left-hand m	Right-hand m	Left-hand m	Right-hand m
Radius of turning circle	3.50 (3.55)	3.54 (3.54)	4.71 (4.11)	4.55 (4.05)
Radius of turning space	3.65 (3.70)	3.69 (3.69)	4.86 (4.16)	4.70 (4.20)

* Figures in brackets indicate front wheel drive disengaged

4. Location of centre of gravity

Height above ground	912 mm
Distance forward from the vertical plane containing the axis at rear wheels	837 mm
Distance from the median plane	3 mm (to the left)

5. Braking

Date of tests: 1986-05-13, 1986-07-07.
Tractor masses during brake tests:

Front kg	Rear kg	Total kg
2050	3800	5850 (ballasted)
1140	1930	3070 (unballasted)

Type 0, cold service braking device performance test

Speed before application of brakes:

ballasted tractor	unballasted tractor
25.9 km/h	27.6 km/h

Ballasted	Braking device control force,	N	600*	465	375	285	190
	Mean deceleration,	m/s^2	3.70	3.00	2.50	2.00	1.50
Unballasted	Braking device control force,	N	300*	220	175	135	95
	Mean deceleration,	m/s^2	3.80	3.00	2.50	2.00	1.50

* Locked

Type I, fade test

Braking device control force,	N	600**	420	340	255	175
Mean deceleration,	m/s^2	3.80	3.00	2.50	2.00	1.50

** Not locked

The brakes were heated by self propelled tractor.
Comments on deviation and vibration: None

Parking brake device test

		18 per cent slope		12 per cent slope with trailer of 3000 kg	
		Up	Down	Up	Down
Braking device control force,	N	470	535	300	310

The service brake system and hand brake system have the linkage in common. When the foot pedal is used the parking braking device control force is reduced to approx. 120 N.

6. Measurement of external noise level

Date of test: 1986-06-17
Type of sound level meter: Brüel & Kjær 2204
Type of track: Tarmac

Result of tests:

Gear: 4H
Travelling speed before acceleration: 20.7 km/h
Sound level: 87 dB(A)

7. Noise measurement at the driver's ear

Date of test: 1986-06-18
Type of sound level meter: Brüel & Kjær 2204
Type of track: Tarmac
Cab fitted: Yes

Result of tests

Gear	Drawbar pull at which the tractor develops the maximum sound level	Measured travelling speed		Sound level	
	kN	m/s	km/h	dB(A)	N
4L*	11.3	2.06	7.42	82.5	– –
1H	12.5	2.42	8.71	83	80.5
4L*	light load	2.25	8.10	81	– –
4H	light load	7.71	27.74	81.5	– –

* 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: 1986-05-23

Hydraulic fluid

Make and type: STOU 10 W/30 SE-CD
Viscosity: Min. 5.7 mm^2/s (cSt) at 100°C

Power lift

	Height above ground in down position	Vertical movement	Maximum force exerted through full range	Corresponding pressure of hydraulic fluid	Moment about rear axle	Tilt angle of mast*
	mm	mm	kN	MPa	kNm	degrees
At the hitch points	233	650	15.4	19.0	15.7	– –
On the frame	198	774	12.4	19.0	20.2	12

Temperature of hydraulic fluid at start of test 50°C

* Tilt angle of mast from vertical position to uppermost position: 9°

Lifting heights relative to the horizontal plane including the lower link pivot points.

mm	−324	−300	−289	−200	−100	+−0	+100	+200	+300	+361	+400	+450
Lifting forces at the hitch points												
kN	– –	– –	15.4	16.8	17.2	17.7	17.7	17.2	18.1	18.1	– –	– –
Lifting forces at the test frame												
kN	15.0	15.0	– –	15.4	15.4	15.0	14.1	13.7	13.2	– –	12.8	12.4

Hydraulic pump performance

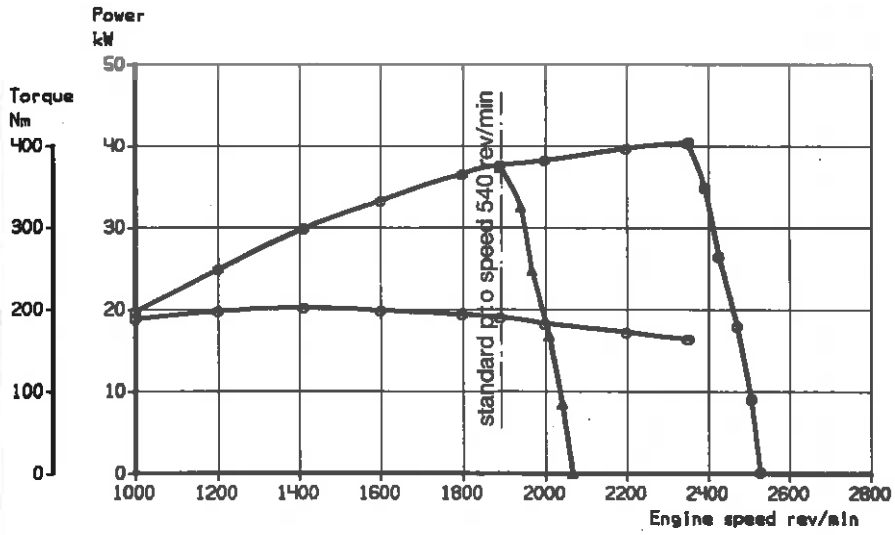
Tapping point	Double acting external tapping
Opening pressure of the relief valve	20.1 MPa
Sustained pressure with relief valve open	21.1 MPa
Pump delivery rate at rated engine speed:	
at minimum pressure	0.61 l/s (36.6 l/min)
Hydraulic power at:	
90 per cent of relief valve setting	10.0 kW
corresponding delivery rate	0.55 l/s (32.8 l/min)
pressure	19.0 MPa
maximum hydraulic power:	10.8 kW
corresponding delivery rate	0.54 l/s (32.3 l/min)
pressure	20.1 MPa
Temperature of hydraulic fluid	61 – 70°C

Table 2. Linkage geometry when connected to the standard frame

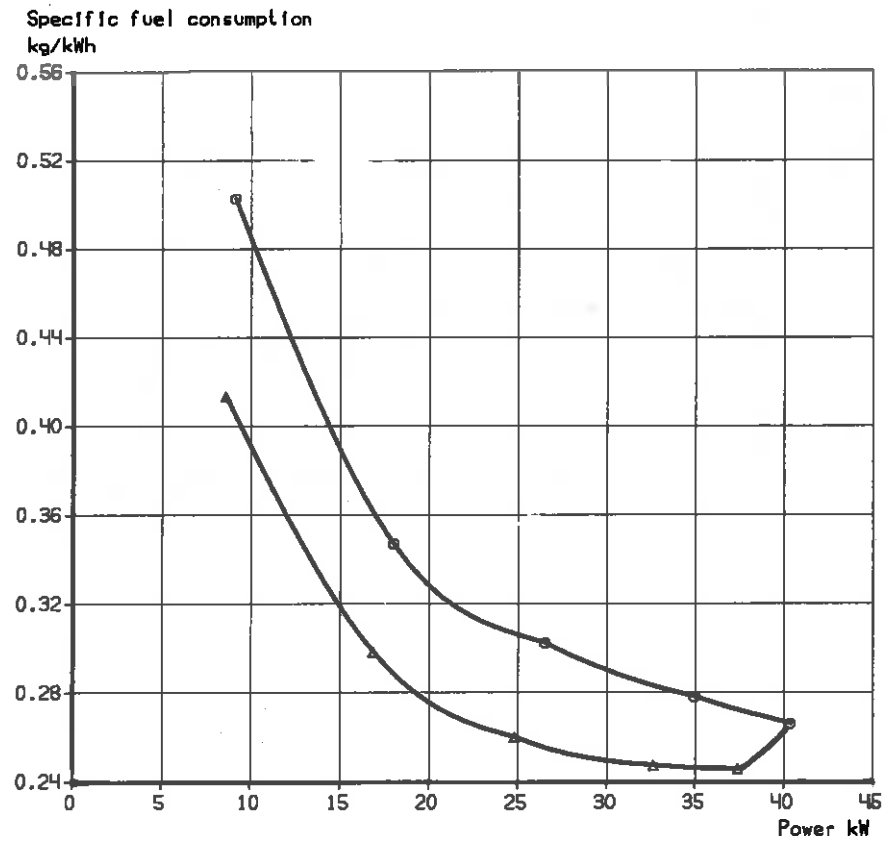
Projected length in side view		
Lower links	900 mm	
Lift arms	275 mm	
Lift rods	646 mm	
Upper link	643 mm	
Distance of lift rod connection point from pivot point of lower link	425 mm	
The following dimensions are given to the rear wheel centre line, situated 715 mm above the ground level		
Lower link pivot point	118 mm behind	193 mm below
Upper link pivot point	368 mm behind	222 mm above
Lift arm pivot point	95 mm behind	365 mm above
Maximum and minimum height of lower link hitch points	168 mm above	482 mm below
Height of lower link hitch points when locked in transport position	– –	

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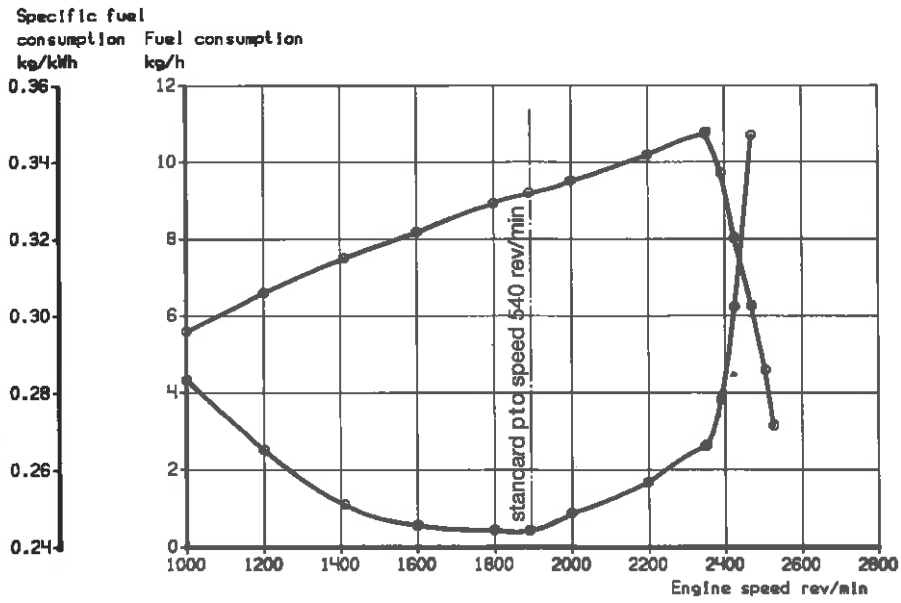
National Machinery Testing Institute	**Power take-off test Valmet 405-4**	Figure 1



National Machinery Testing Institute	**Power take-off test Valmet 405-4**	Figure 2



National Machinery Testing Institute	**Power take-off test Valmet 405-4**	Figure 3



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