STÁTNÍ ZKUŠEBNA ZEMĚDĚLSKÝCH,
POTRAVINÁŘSKÝCH
A LESNICKÝCH STROJŮ

163 04 PRAHA 6, ŘEPY

Report on test in accordance with the O. E. C. D. STANDARD CODES
for the Official Testing of Agricultural Tractors

CODE II

Restricted Code

Date of approval: 21st March 1994

O.E.C.D. No. 1515/2



Agricultural Tractor
ZETOR 7320 (2WD)

Manufactured by:
ZETOR a.s.
632 00 Brno, CZ

Report No. 11237
Date of test: November 1993-January 1994

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The JOHN DEERE 2400 (2WD) and ZETOR 7320 (2WD) tractors being mechanically similar, the tests have not been repeated and approval number is valid for the both tractor models.
All tests were carried out on the ZETOR 7320 (2WD).

Tractor manufacturer's name and address:	ZETOR a.s., 632 00 Brno, Czech Republic
Location of tractor assembly:	Brno, Czech Republic
Submitted for test by:	The manufacturer
Selected for test by:	The manufacturer
Place of running-in:	Brno, Czech Republic
Duration of running-in:	60 hours
Location of test:	SZZPLS Praha 6 - Řepy, Czech Republic

I. SPECIFICATIONS OF TRACTOR

TRACTOR

Make:	ZETOR
Model:	7320
Type:	Wheeled, unit construction, rear wheels drive
Number of driving wheels:	2
Serial No.:	001 000
1st Serial No.:	001 000

ENGINE

Make:	ZETOR
Model:	7301
Type:	4-stroke diesel engine, direct injection, water cooled, turbocharged
Serial No.:	036 634

Cylinders

Number/disposition:	4, in-line, vertical
Bore/stroke:	102 mm/120 mm
Capacity:	3922 cm^3
Compression ratio:	17:1

Arrangement of valves:	Overhead
Cylinder liners:	Wet, replaceable
Supercharging	
Make, model and type:	HOLSET, H1D, exhaust driven or KKK, K24-2460 G/5.14, exhaust driven or ČZ, C14, exhaust driven
Pressure:	179 kPa
Fuel system	
Fuel feed system:	Lift pump piston-type, integral with fuel injection pump
Make, model and type of fuel filters:	AUTOBRZDY, 443 741 111 001, one-stage with paper cartridge
Capacity of fuel tank:	95 dm^3
Make, model and type of injection pump:	MOTORPAL, 4M 3137, in-line
Serial No.:	Dk 1802
Manufacturer's production setting of injection pump:	
Flow rate (rated engine speed and full load):	16.95±0.26 dm^3/h
Timing:	$25^{o}+1^{o}$ before TDC
Make, model and type of injection:	MOTORPAL, DOP 160 S 430-1436, 4 holes
Injection pressure:	18.6-0.8 MPa
Governor	
Make, model and type:	MOTORPAL, RV 3M 300/1100-3300, centrifugal, variable speed
Governed range of engine speed:	600-2410 rev/min
Rated engine speed:	2200 rev/min
Air cleaner	
Make, model and type:	DONALDSON, FPG 07-0006, dry paper dual element, integrated cyclon type pre-cleaner
Location of air intake:	Under bonnet forward of radiator
Maintenance indicator:	Warning light on instrument panel

Lubrication system

Type of feed pump:	Gear
Type of filter:	Full flow with replaceable paper element
Number:	1
Oil cooler:	Heat exchanger with engine coolant

Cooling system

Type of coolant:	Water and anti-freeze
Type of pump:	Centrifugal, belt driven
Specification of fan:	Axial, belt driven
Number of blades:	6
Fan diameter:	380 mm
Coolant capacity:	11.6 dm^3
Type of temperature control:	Thermostat
Superpressure system:	40±10 kPa

Starting system

Make, model and type:	PAL, 443 115 144 722, electrical, solenoid engaged
Starter motor power rating:	2.9 kW
Cold starting aid:	None
Safety device:	Clutch pedal to be fully depressed

Electrical system

Voltage:	12 V, negative earth
Generator:	
Make, model and type:	PAL, 443 113 516 651, alternator, belt driven
Power:	770 W
Battery:	
Number:	1
Rating:	150 Ah at 20 hours

Exhaust system

Make, model and type:	ZETOR, 7901 1400, expansion and absorption muffler
Location:	Left-hand side of engine, vertical

TRANSMISSION TO WHEELS

Clutch

Make, model and type:	ZETOR, 7201 1100, dry for travelling and P.T.O.
Number of plates:	2
Diameter of plates:	280 mm
Method of operation:	Hydraulically by pedal for travelling and P.T.O. and pneumatically by hand lever for P.T.O.

Gear box

Make, model and type:	ZETOR, 6011 1900, mechanical
Arrangement:	Partially synchromesh gear box with 5 forward and 1 reverse speeds, group gear box with two speed ranges (T and R) and pneumatically actuated torque multiplier
Number of gears:	20 forward and 4 reverse
Available options:	None

Rear axle and final drives

Make, model and type:	ZETOR, 6211 2800, crown wheel and bevel pinion differential and spur gear final drives
Differential lock:	
Type:	Mechanical
Method of engagement:	Mechanically by pedal
Method of disengagement:	Self-disengaging

Front axle

Make, model and type:	ZETOR, 7211 3300, telescopic with adjustable track

Total ratios and travelling speeds

Gear	Group	Number of engine revolutions for one revolution of the driving wheels	Nominal travelling speed at rated engine speed of 2200 rev/min km/h (*)
1	TM	408.110	1.51
2		313.633	1.97
3		225.061	2.75
4		158.092	3.91
5		115.231	5.36
1	T	310.865	1.99
2		238.900	2.59
3		171.433	3.60
4		120.421	5.13
5		87.774	7.04
1	RM	96.359	6.41
2		74.052	8.34
3		53.139	11.63
4		37.327	16.55
5		27.207	22.71
1	R	73.399	8.42
2		56.407	10.95
3		40.477	15.27
4		28.433	21.73
5		20.724	29.82
R	TM	306.980	2.01
	T	233.833	2.64
	RM	72.481	8.52
	R	55.211	11.19

T: Turtle range, R: Rabbit range, M: Torque multiplier engaged

(*) Calculated with a tyre dynamic radius index of 745 mm (ISO 4251/1-1988).

POWER TAKE-OFF

Main power take-off

Type: Independent, through second plate in main clutch

Method of engagement: Pneumatically operated by hand lever or hydraulically by clutch pedal

Number of shafts: 1

Method of changing power take-off speeds: Manually by exchanging shafts

Power take-off proportional to engine speed

Location: At rear of tractor

P.T.O.	Diameter of power take-off shaft end mm	Number of splines	In conformity with ISO 500/1991
540	34.9	6	Yes
1000	34.9	21	Yes

Height above ground: 752 mm

Distance from the median plane of tractor: 0 mm

Distance behind rear-wheel axis: 263 mm

P.T.O.	P.T.O. speed rev/min	Engine speed rev/min	Ratio of rotation speeds (engine/P.T.O.)	Power restriction kW
540	540	1994	3.6923	None
	596	2200		
1000	1000	2050	2.0500	None
	1073	2200		

Direction of rotation (viewed facing driving end): Clockwise

Power take-off proportional to ground speed

Indicate 540 or 1000 rev/min: The same

P.T.O. and range	Travelling distance for one revolution of P.T.O. shaft m	Number of P.T.O. shaft revolutions for one revol. of (rear) driving wheels
T	0.087	53.6395
R	0.370	12.6649

T: Turtle range, R: Rabbit range

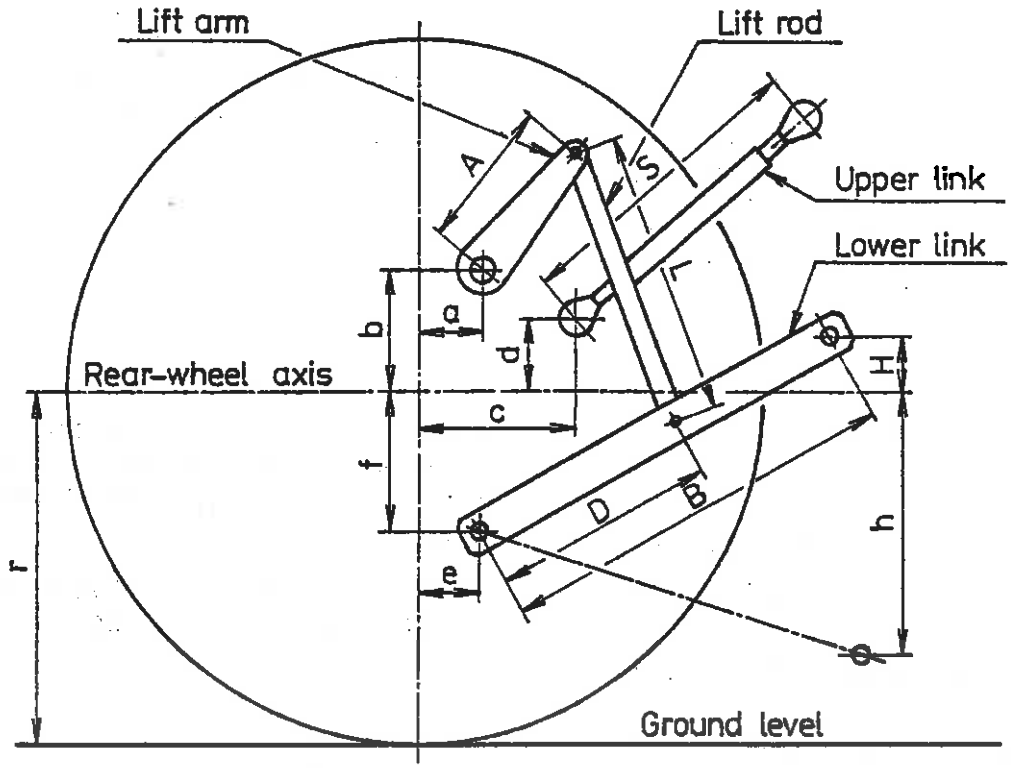
Direction of rotation with forward gear engaged (viewed facing driving end): Clockwise

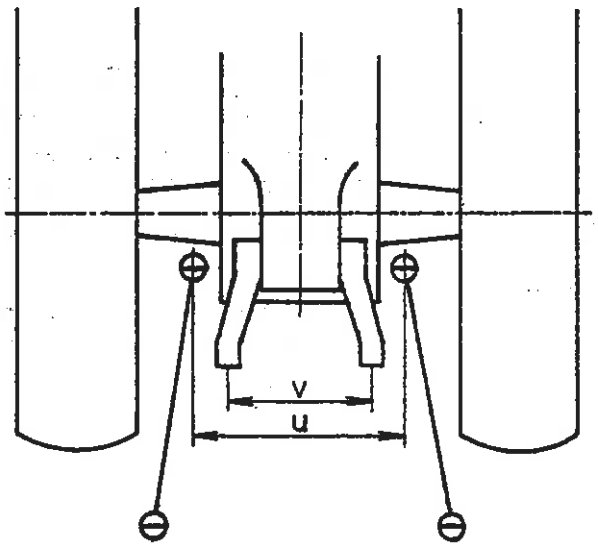
POWER LIFT

Make, model and type:	ZETOR, 7211 9485, hydraulic with mechanical position, draft or mixed control, top link sensing
Type of hydraulic system:	Open centre
Type and number of cylinders:	1 integral single-acting and 2 external single-acting
Type of linkage lock for transport:	Hydraulic
Relief valve pressure setting:	18.0+2.0 MPa
Opening pressure of cylinder safety valve:	21.0+2.0 MPa
Lift pump type:	Gear
Transmission between pump and engine:	Gear driven from engine
Type and number of filters:	1 magnetic, 1 screen and 1 filter with paper cartridge in delivery side of distributor
Site of oil reservoir:	Transmission housing
Type, number and location of tapping points:	2 pressure and 1 return, quick release at rear of tractor
Maximum volume of oil available to external cylinders:	10 dm^3

Three-point linkage

Category:	2, in conformity with ISO 730/1-1990
Category adapter:	None





Linkage geometry dimensions:

		Dimension or range mm	Settings used in test mm
Length of lift arms	(A)	320	320
Length of lower links	(B)	857	857
Distance of lift arm pivot point from :horizontally	(a)	30	30
rear-wheel axis :vertically	(b)	362	362
Horizontal distance between the 2 lower link points	(u)	636	636
Horizontal distance between the 2 lift arm end points	(v)	450	450
Length of upper link	(S)	590 to 770	658
Distance of upper link pivot point from :horizontally	(c)	288	288
rear-wheel axis :vertically	(d)	182, 229, 276, 323	276
Distance of lower link pivot point from :horizontally	(e)	83	83
rear-wheel axis :vertically	(f)	138	138
Distance of lower link pivot points to lift rod pivot points on lower links	(D)	401	401
Length of lift rods	(L)	436 to 572	565
Height of lower hitch points relative to the rear-wheel axis:			
- in low position	(h)	271 to 605	545
- in high position	(H)	99 to 370	195
Height above ground of lower hitch points when locked in transport position (*)		Any height withing lift range	

(*) Assuming the tyre dynamic radius index r=745 mm of ISO 4251/1-1988

SWINGING DRAWBAR

Type:	Clevis
Height above ground:	
Maximum:	644
Minimum:	474

Type of adjustment:	Inverting drawbar and clevis
Distance of hitch point from rear-wheel axis, horizontally:	653, 664 and 668 mm
Distance of hitch point from power take-off shaft end:	
Vertically:	108, 188, 198 and 278 mm
Horizontally:	390, 401 and 405 mm
Lateral adjustment:	
Right-hand:	80 and 160 mm
Left-hand:	80 and 160 mm
Distance of pivot point from rear-wheel axis, horizontally:	185 mm to front
Diameter drawbar pin hole:	32 mm
Maximum vertical permissible load:	6 kN

TRAILER HITCH

Type:	Automatic clevis
Hole diameter:	35 mm
Height above ground:	777, 827, 877, 927 and 977 mm
Distance of hitch point from rear-wheel axis, horizontally:	628 mm
Distance of hitch point from power take-off shaft end:	
Vertically:	25, 75, 125, 175 and 225 mm
Horizontally:	365 mm
Maximum vertical permissible load:	10 kN

HOLED DRAWBAR

Number of holes:	7
Distance between holes:	80 mm
Hole diameter:	32 mm
Thickness/width of the drawbar:	2x20 mm/90 mm
Height above ground:	
Maximum:	940 mm
Minimum:	200 mm
Horizontal distance to power take-off shaft end:	677 mm

FRONT TOWING HITCH

Height above ground:	701 mm
Diameter of pin hole:	31 mm

STEERING

Make, model and type:	DANFOSS, OSPC 100 ON, hydrostatic
Method of operation:	Independent hydraulic circuit for steering
Pump:	Gear, driven from engine
Ram:	Double-acting cylinder on the front axle, symmetrical design
Working pressure:	8.0 MPa

BRAKES

Service brake

Make, model and type:	ZETOR, 7245 2600, dry disc, multiplate, 2 discs each side
Method of operation:	Hydraulically by pedals, coupled or independent
Trailer braking take-off:	Air brake operated by tractor pedals

Parking brake

Type:	Common with service brake
Method of operation:	Mechanically by hand lever with ratchet

WHEELS

Number:	
Front:	2, steering
Rear:	2, driving
Wheelbase:	2256 mm

Track width adjustment:

	Minimum mm	Maximum mm	Adjustment method
Front	1420	1795	By extending of front axle
Rear	1420	1795	Reversing wheels and off-set lug rims

PROTECTIVE STRUCTURE

Make, model and type: ROSTROJ, BK 6245, cab with integrated safety frame

Manufacturer's name and address: ROSTROJ s.p., 683 01 Rousínov, Czech Republic

Protective device: Cab, not tiltable

O.E.C.D. approval number: CSD 1363/3

DRIVER'S SEAT

Make, model and type: MARS, Zetor 5911 - 5400, upholstered seat

Type of suspension: Parallelogram linkage adjustable for driver's weight

Type of damping: Hydraulic

Range of adjustment:

Longitudinal: 150 mm

Vertical: 60 mm

MISCELLANEOUS

Additional seat:

Location: Left-hand side of driver

Number of places: 1

LIGHTING

	Height above ground of centre mm	Size mm	Distance from outside edge of lights to median plane of tractor mm
Headlights	1080	120x120	188
Sidelights	1560	60x65	655
Rearlights	1535	105x70	750
Reflectors	985	ϕ78	760

II. TEST CONDITIONS

Overall dimensions

Length mm	Width		Height at top of	
	minimum mm	maximum mm	protective structure mm	exhaust silencer mm
3755	1875	2250	2665	2770

Ground clearence
(unballasted tractor): 383 mm

Clearance-limiting part: Swinging drawbar in lowest position

Tractor mass (with cab)

	Without driver kg	With driver kg
Front	1055	1065
Rear	2145	2210
Total	3200	3275

Tyre and track width specifications

	Front	Rear
Tyres:		
Make	BARUM	BARUM
Dimensions	7.50-20	16.9-34
Ply rating	6	8
Type	diagonal	diagonal
Maximum load (tyre manufacturer's)	8.75 kN	23.80 kN
Maximum load (tractor manufacturer's)	8.75 kN	18.00 kN
Inflation pressure (tyre manufac.)	280 kPa	170 kPa
Dynamic radius index	430 mm	745 mm
Chosen track width:	1420 mm	1420 mm

Oils and lubrication

Capacity and change interval:

	Capacity dm^3	Oil change h	Filter change h
Engine	12.0	200	200
Gear box	25.0	1200	600
Rear axle	Common with gear box		
Final drive (rear)	2x1.9	1200	-
Hydraulic system	Common with gear box		
Steering	4.6	1200	1200

Specifications:

	Recommended	Used during test
Engine oil: Type Viscosity Classification	 SAE 20W/40 14.0 cSt at 100 °C API SE/CD+	 As recommended
Transmission oils: Type Viscosity Classification	 SAE 80W 7.5 cSt at 100 °C API GL-4	 As recommended
Steering oil: Type Viscosity Classification	 OH-HM 32 28.8 cSt at 40 °C ISO 6743 HM 32	 As recommended

Hydraulic fluid: Same as transmission

Grease:

Number of lubrication points: 21

Fuel

Type: Diesel fuel, in conformity with national standard ČSN 65 6506

Density at 15 °C: 0.836 g/cm^3 for P.T.O. tests
0.843 g/cm^3 for drawbar tests

III. TEST RESULTS

COMPULSORY TESTS RESULTS

1. MAIN POWER TAKE-OFF

Date and location of tests: 10th June 1993, SZZPLS Praha

Type of dynamometer: FROUDE AG 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						
54.8	2200	1073	14.33	17.14	261	3.20
1.2 POWER AT RATED ENGINE SPEED						
54.8	2200	1073	14.33	17.14	261	3.20
1.3 STANDARD POWER TAKE-OFF SPEED 1000 rev/min						
53.5	2050	1000	13.31	15.92	249	3.36
1.4 PART LOADS 1.4.1 the torque corresponding to maximum power at rated engine speed						
54.8	2200	1073	14.33	17.14	261	3.20
1.4.2 85 % of torque obtained in 1.4.1						
48.0	2267	1106	12.81	15.32	267	3.13
1.4.3 75 % of torque defined in 1.4.2						
36.7	2310	1127	9.98	11.94	272	3.07
1.4.4 50 % of torque defined in 1.4.2						
24.9	2351	1147	7.93	9.49	318	2.62
1.4.5 25 % of torque defined in 1.4.2						
12.7	2394	1168	5.77	6.90	454	1.84
1.4.6 unloaded						
-	2415	1178	3.85	4.61	-	-

Power	Speed		Fuel consumption			Specific energy
	Engine	P.T.O.	Hourly		Specific	
kW	rev/min		kg/h	l/h	g/kWh	kWh/l
1.5 PART LOADS AT STANDARD POWER TAKE-OFF SPEED 1000 rev/min						
1.5.1 the torque corresponding to maximum power						
53.5	2050	1000	13.31	15.92	249	3.36
1.5.2 85 % of torque obtained in 1.5.1						
46.3	2085	1017	11.48	13.73	248	3.37
1.5.3 75 % of torque defined in 1.5.2						
35.4	2128	1038	9.14	10.93	258	3.24
1.5.4 50 % of torque defined in 1.5.2						
24.1	2177	1062	7.21	8.62	299	2.80
1.5.5 25 % of torque defined in 1.5.2						
12.4	2228	1087	5.19	6.21	419	2.00
1.5.6 unloaded						
-	2253	1099	3.33	3.98	-	-

No load maximum engine speed: 2415 rev/min

Torque (equivalent crankshaft) at maximum power: 237.9 Nm

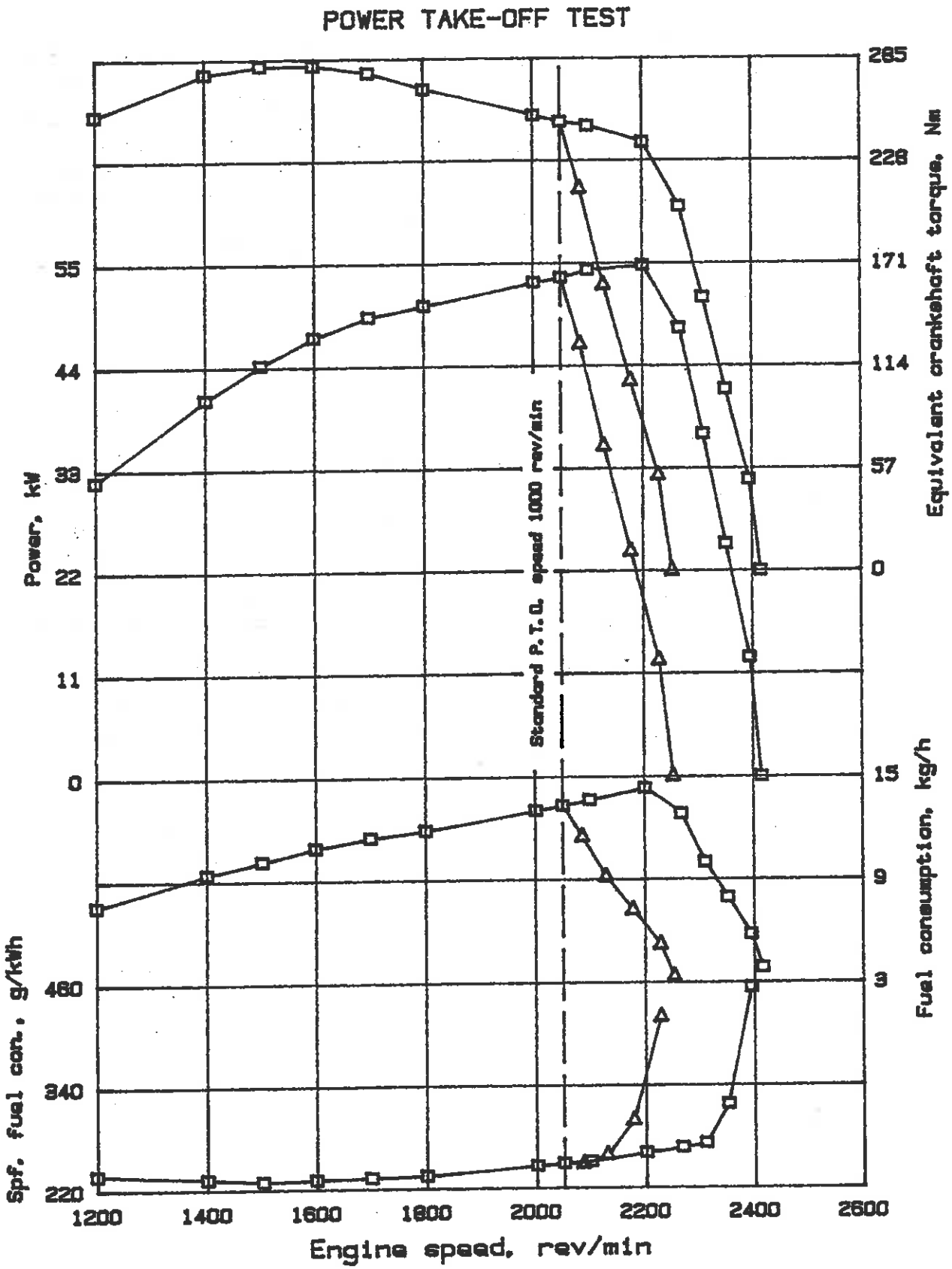
Maximum torque (equivalent crankshaft): 281.3 Nm
(engine speed: 1599 rev/min)

Mean atmospheric conditions:

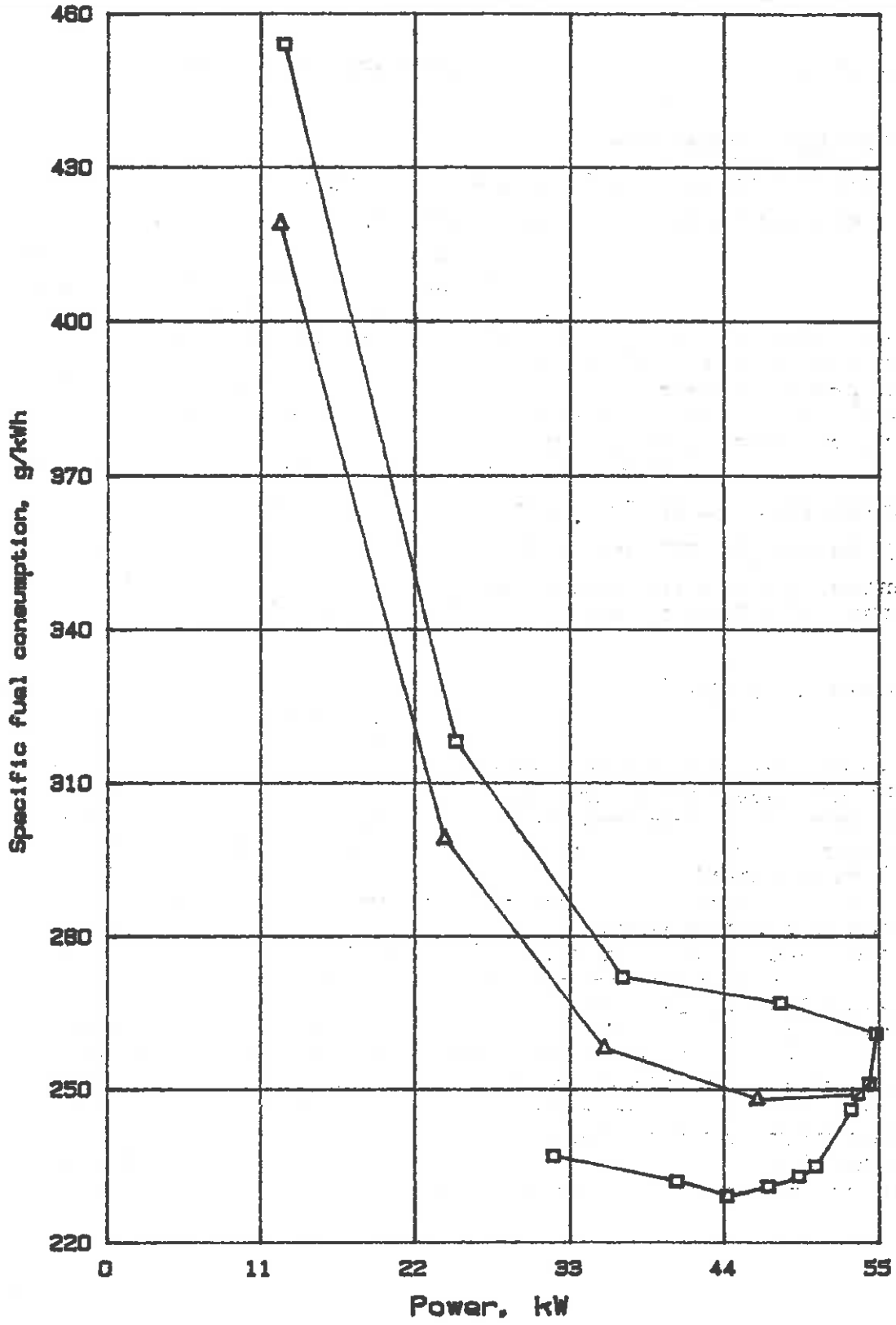
Temperature: 34 °C
Pressure: 96.9 kPa
Relative humidity: 53 %

Maximum temperatures:

Coolant: 83 °C
Engine oil: 107 °C
Fuel: 52 °C
Engine air intake: 30 °C


POWER TAKE-OFF TEST
Power, kW
55
44
33
22
11
0
Spf. fuel con., g/kWh
460
340
220
Standard P.T.O. speed 1000 rev/min
Equivalent crankshaft torque, Nm
285
228
171
114
57
0
Fuel consumption, kg/h
15
9
3
1200
1400
1600
1800
2000
2200
2400
2600
Engine speed, rev/min

POWER TAKE-OFF TEST



2. HYDRAULIC POWER AND LIFTING FORCE

Date of test: 13th and 16th June 1993

2.1 HYDRAULIC POWER TEST

Sustained pressure with relief valve open: 19.5 MPa

Pump delivery rate at minimum pressure: 40.0 l/min

	Flow rate l/min	Pressure MPa	Power kW
At 90 % of the actual relief valve pressure setting	36.1	17.6	10.6
At maximum hydraulic power	36.1	17.6	10.6

Tapping point used for test: External tapping

Temperature of hydraulic fluid: 65 °C

Opening and closing pressures of the unloading valve: Not applicable

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	690 mm	850 mm
Maximum corrected force exerted through full range	36.1 kN	24.6 kN
Corresponding pressure of hydraulic fluid	17.6 MPa	17.6 MPa
Moment about rear-wheel axis	33.9 kNm	38.1 kNm
Maximum tilt angle of mast from vertical	-	11 degrees

Lifting heights relative to the horizontal plane including the lower link pivot points												
mm	-487	-407	-400	-300	-200	-100	0	+100	+200	+283	+300	+363
Lifting forces at the hitch points, corrected to 17.6 MPa												
kN	-	47.0	46.0	44.5	43.0	41.3	39.4	38.3	36.9	36.1	-	-
Lifting forces at the test frame, corrected to 17.6 MPa												
kN	41.2	-	39.1	37.0	35.1	32.7	31.1	29.1	27.1	-	25.3	24.6

3. DRAWBAR POWER AND FUEL CONSUMPTION (UNBALLASTED TRACTOR)

Date of test: 10th November 1993

Type of track: Bituminous-concrete surface

Height of drawbar above ground	Tyre inflation pressure	
	Front	Rear
474 mm	230 kPa	130 kPa

Gear and group	Power	Drawbar pull	Speed	Engine speed	Slip of wheels	Specific fuel consumption
	kW	kN	km/h	rev/min	%	g/kWh
3.1 MAXIMUM POWER IN TESTED GEARS						
5 T	34.1	19.2	6.39	2298	15.0	339
2 RM	39.7	19.1	7.48	2275	14.9	335
1 R	40.2	19.2	7.54	2267	15.0	337
2 R	46.4	16.9	9.89	2204	11.8	319
3 RM	47.0	15.8	10.72	2204	10.3	313
3 R	47.7	11.9	14.44	2192	7.1	308
4 RM	47.5	10.8	15.82	2197	6.3	315
4 R	47.1	8.0	21.18	2190	4.5	315
5 RM	46.4	7.5	22.26	2200	3.7	319
3.2 FUEL CONSUMPTION						
3.2.1 in selected gear, at maximum power at rated speed						
3 R	47.7	11.9	14.44	2192	7.1	308
3.2.1.1 75 % of pull at maximum power at rated speed						
3 R	38.2	8.9	15.44	2294	4.9	318
3.2.1.2 50 % of pull at maximum power at rated speed						
3 R	26.6	6.0	15.94	2330	3.2	354
3.2.1.3 next higher gear at reduced engine speed; same pull						
4 RM	38.1	8.9	15.40	2080	4.9	293
3.2.1.4 next higher gear at reduced engine speed; same pull						
4 RM	26.7	6.1	15.78	2126	3.2	324
3.2.2 in selected gear nearest to 7.5 km/h at rated speed						
	Out of measure					
3.2.2.1 75 % of pull at maximum power at rated speed						
	Out of measure					
3.2.2.2 50 % of pull at maximum power at rated speed						
	Out of measure					
3.2.2.3 next higher gear at reduced engine speed; same pull						
	Out of measure					
3.2.2.4 next higher gear at reduced engine speed; same pull						
	Out of measure					

Specific energy	Temperature			Atmospheric conditions		
	Fuel	Coolant	Engine oil	Temperature	Relative humidity	Pressure
kWh/l	°C	°C	°C	°C	%	kPa
2.49	17	77	85	6	98	96.7
2.52	18	77	85	6	98	96.7
2.50	19	77	86	6	98	96.7
2.65	21	77	88	6	98	96.7
2.69	21	76	89	6	98	96.7
2.74	19	77	90	7	97	96.7
2.68	20	77	87	8	89	96.7
2.67	24	77	89	8	89	96.7
2.64	24	77	91	8	82	96.6
2.74	19	77	90	7	97	96.7
2.65	21	77	86	8	82	96.6
2.38	20	76	88	8	82	96.6
and travelling speed as in 3.2.1.1						
2.88	21	77	88	7	85	96.6
and travelling speed as in 3.2.1.2						
2.60	20	76	88	7	87	96.6
and travelling speed as in 3.2.2.1						
and travelling speed as in 3.2.2.2						

OPTIONAL TEST RESULTS

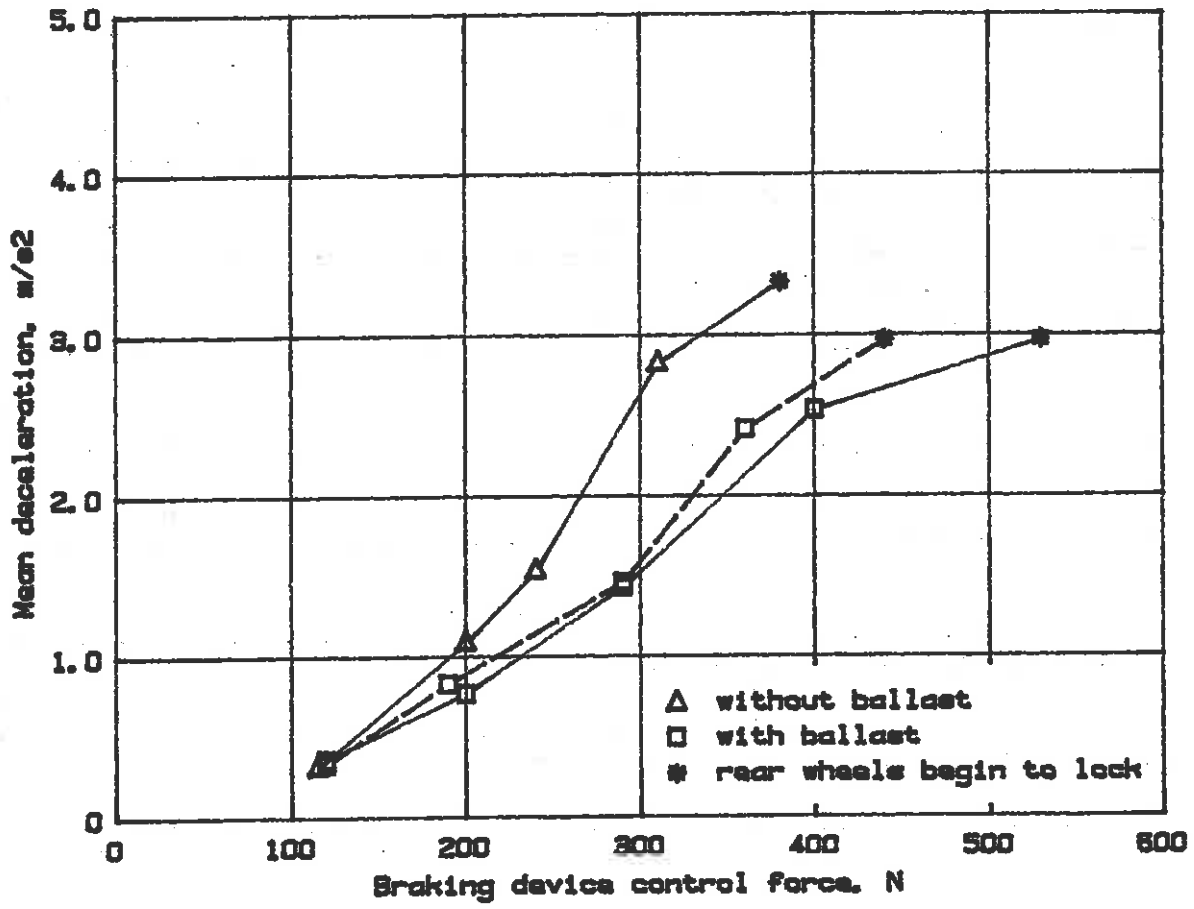
4. BRAKING

Date of test: 25th January 1994

	Tractor mass (with driver)			Speed before application of brakes
	Front kg	Rear kg	Total kg	km/h
Ballasted	1750	3600	5350	32.0
Unballasted	1055	2145	3200	32.4

4.1 COLD SERVICE BRAKING DEVICE TEST (————————)

4.2 FADE TEST (- - - - - -)



Maximum deviation of tractor from its original course:	Not significant
Abnormal vibration:	None
Brake heating method:	Driven with brakes applied for 1 km at 80 % of maximum speed with a pedal force corresponding to a deceleration of 1 m/s^2

4.3 PARKING BRAKING DEVICE TEST

	Ballasted tractor on 18 % - slope	
	Uphill	Downhill
Braking device control force	242 N	235 N

5. MEASUREMENT OF EXTERNAL NOISE LEVEL

Date of test:	16th December 1993
Make and model of sound level meter:	BRÜEL & KJAER, 2231
Type of track:	Bituminous-concrete surface
Gear number:	5 R
Travelling speed before acceleration:	24.3 km/h
Sound level:	84.0 dB(A)

6. REPAIRS

None

7. REMARKS

None

Test carried out by: Dipl. Ing. Peter Pernis

Head of the Tractor Department	Director
Dipl. Ing. Peter Pernis	Dipl. Ing. Vladimír Hanzlík