O.E.C.D. Report No. 354
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Report on test in accordance with O.E.C.D. STANDARD-CODE for the Official Testing of Agricultural Tractors



TRACTOR DIESEL BNT - 90 F

Manufactured by: BRATSTVO - NOVI TRAVNIK
YUGOSLAVIA

Date of Tests: Juli - Decembar 1970.

INSTITUT "KIRILO SAVIĆ" - BEOGRAD
INSTITUT ZA MEHANIZACIJU POLJOPRIVREDE - ZEMUN

This Bulletin is based on engineering tests accordance with the O.E.C.D. STANDARD-CODE for Official Testing of Agricultural Tractors.

It does not contain an evaluation of the performance of the Tractor on practical work.

This Report has been approved by the O.E.C.D. Co-Ordinating Centre (C.N.E.E.M.A. France) as being in accordance with the O.E.C.D. STANDARD-CODE.

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Tractor manufacturer's name and address:	BRATSTVO - Novi Travnik, Yugoslavia
Submitted for test by:	Manufacturer
Selected by:	The representatives of the Institute for Agricultural Mechanization
Place of running in:	Institute for Agricultural Mechanization, Beograd - Zemun, Yugoslavia
Duration of running-in:	60 h

SPECIFICATION OF TRACTOR

TRACTOR	
Make:	BRATSTVO - Novi Travnik, Yugoslavia
Model:	90 F
Type:	Crawler
Serial N^{O}:	0025
ENGINE	
Make:	FAMOS - Sarajevo, Yugoslavia
Model:	F - 2
Type:	Water cooled 4-stroke Diesel engine with direct injection
Serial N^{O}:	47884
Cylinders	
Number:	6
Disposition:	Vertical in line
Bore/Stroke:	112/140 mm (4,41/5,51 in)
Capacity:	8280 cm^3 (505,29 in^3)
Compression ratio:	18,0 : 1
Arrangement of valves:	Overhead valves
Cylinder liners:	Replaceable, wet liners
Fuel and injection system	
Type of fuel feed:	Under pressure
Make, type and model of fuel filter(s):	Double filter "Tehnotrans" - Rogatica, Type PG 01.000
Capacity of fuel tank:	250 lit (55,0 UK gal)
Make, type and model of injection pump:	Friedman Maier
Serial N^{O} of injection pump	FM P 16 T 9 - 13.133 A II OVR

Manufacturer's production setting:	Quantity of injected fuel: 52 ± 1 mm^3 for each element at 800 rpm of injection pump Injection timing: 25 ± 2° before T.D.C.
Make, type and model of injectors:	Needle's type of injector's nozzles "Bosch"
Manufacturer's production setting:	Injection pressure: 190 ± 10 kg/cm^2 (2702 ± 142 lb/in^2)
Governor	
Make:	Friedman Maier
Type:	Mechanical, centrifugal, all-range
Range of speed:	400 - 1800 rev/min
Rated speed:	1700 rev/min
Air cleaner	
Main	
Make:	Donaldson
Type:	Dry
Oil capacity:	-
Pre-cleaner	
Make:	Donaldson
Type:	GAH 00 - 0471
Lubrication system	
Type:	Under pressure, with oil pump
Type and number of filters:	With element, fine filter IK 737 A /IK 730
Oil capacity:	18 lit (3,96 UK gal)
Changing period:	240 hours
Cooling system	
Type:	Water cooled, with compulsory circulation
Details of pump and fan:	8 - blade belt driven fan Ø 540 mm (Ø 21,26 in)
Coolant capacity:	30 lit (6,60 UK gal)
Means of temperature control:	Thermostat
Pressure details:	Open system
Starting system	
Make:	Iskra - Kranj

Type:	Electrical starter SM 1/N - 24/4/11 TI-D, alternatively SM 1- 24/4/11 TI-D
Aids for cold starting:	Automatical heater
Electrical system	
Voltage:	24 V
Generator:	Direct current generator
Make:	Iskra - Kranj, Yugoslavia
Type:	DGD - 24/300/1300 M/2 TI - D or DGD - 24/300/1300 I/2 TI- D
Battery	
Make:	Munja - Zagreb, Yugoslavia
Type:	12 - 84 N 6, with leaden plates
Capacity and rating:	2 batteries a 12 V, serial connected, capacity of one battery 84 Ah
TRANSMISSION	
Clutch	
Make:	Famos - Sarajevo, Yugoslavia, according to the construction of factory Bratstvo
Type and diameter of discs:	Dry, with 2 discs Ø 355 mm (Ø 13,98 in)
Method of operation:	Operated mechanically, by single foot pedal
Gearbox	
Make:	Bratstvo - Novi Travnik, Yugoslavia
Type:	Mechanical
Number of gears:	7 forward and 1 reverse
Rear axle and final drive	
Make:	Bratstvo - Novi Travnik, Yugoslavia
Type:	Epicyclic (planetary) gearing and one pair of spur gearing
Differential lock:	None
Details of transmission if other than above:	-
Oil capacity	
Gear box and middle part of rear axle:	10 lit (2,20 UK gal)
Final drive(s):	2 x 3,5 lit (2 x 0,77 UK gal)
Changing period:	960 hours

Gear No.	Number of engine revolutions for one revolution of driving sprocket	Nominal travelling speed for 1700 rev/min rated speed of engine km/h	(mile/h)
Forward			
1	53,89	4,18	(2,60)
2	48,20	4,67	(2,91)
3	42,33	5,32	(3,31)
4	36,91	6,10	(3,79)
5	32,05	7,03	(4,37)
6	27,94	8,06	(5,08)
7	19,93	11,30	(7,04)
Reverse			
1	63,25	3,56	(2,22)

POWER LIFT

Make:	Bratstvo - Novi Travnik and Prva Petoletka - Trstenik, Yugoslavia
Type:	Hydraulic, with 3-point and 2-point linkage system
Oil capacity:	25 lit (5,50 UK gal)
Category:	III
Description of controls:	Position control

DRAWBAR

Type:	Stiff
Height above ground:	405 mm, 435 mm, 505 mm and 535 mm (15,94 in), (17,13 in), (19,88 in) and (21,06 in)
Distance from rear axle:	Horizontal 641 mm (25,24 in)
Lateral adjustment:	In steps to the left and to the right for distance of 90 mm, 180 mm and 270 mm (3,54 in), (7,09 in) and (10,63 in)

HITCH

Two hitches welded on the front side of the frame on the mutual distance of 700 mm (27,56 in). Height above ground of hitches 395 mm (15,55 in).

STEERING

Make:	Bratstvo - Novi Travnik, Yugoslavia
Type:	Two pieces of one-stage epicyclic gearings and self-tightening band brakes on separate drums.

Method of operation:	By acting the levers (handles), the brake of epicyclic gearing will be detached, respectively running of tractor will be eliminated. By acting the foot pedal, the brake of the corresponding halfshaft will be put into the action.
BRAKES	
Make:	Bratstvo, Novi Travnik
Type:	Band type
Method of operation:	Mechanical
Type of parking brake:	Parking latch
TRACKS (CATERPILLARS)	
Type:	Open type, with seven joints
Number of track plates:	42
Width of track plates:	390 mm (15,35 in)
Grouser height:	45 mm (1,77 in)
Track pitch:	170 mm (6,69 in)
Size of pins:	Ø 22 mm x 425 mm (Ø 0,87 in x 16,73 in)
Track gauge:	1330 mm (52,36 in)
Length of track in ground contact:	1810 mm (71,26 in)
Nominal ground pressure:	0,470 kg/cm^2 (6,68 lb/in^2)
Driving sprocket:	
Pitch circle diameter:	710 mm (27,95 in)
Number of teeth:	13
Face width:	45 mm (1,77 in)
Suspension:	
Type:	Elastic type of supsnsion; each track has two balancing units with 4 rollers. The spiral balancing spring is situated horizontally.
Details of idler wheels:	With double rim; tightening by means of two spiral springs.
Details of top and bottom rollers:	Two top rollers on each track four bottom rollers on each balancing unit.

Lubrication:	Grease points on the bearings of balancing units, of top and bottom rollers and of idle wheels.
WEIGHTS	
Tractor (without driver but with tanks full)	6600 kg (14561 lb)
SEAT	
Make:	Vaso Miskin Crni – Sarajevo, Yugoslavia
Type of suspension:	Stiff
Type of damping:	Sponge and springs
Range of adjustments:	In 2 steps - horizontally 40 mm (1,57 in) - vertically 30 mm (1,18 in)
NUMBER OF GREASE POINTS (whole tractor)	32
OVERALL DIMENSIONS	
Overall length:	
- with linkage of hydraulic system	4750 mm (187,01 in)
- without linkage of hydraulic system	4250 mm (167,32 in)
Overall width:	1740 mm (68,50 in)
Overall height (measured on the driver's cab):	2620 mm (103,15 in)
Special remarks:	

LIGHTING

	Height above ground of centre		Diameter		Distance from outside edge of tractor to centre	
	cm	(in)	cm	(in)	cm	(in)
Headlights	236,5	(93,11)	13,0	(5,12)	37,5	(14,76)
Rear lights	230,0	(90,55)	13,0	(5,12)	47,0	(18,50)

Unrestricted beam angle of headlight in plan view: 35^{o}

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FUELS AND LUBRICANTS USED IN TESTS

LABORATORY AND TRACK TESTS

Fuel:

Type:	Commercial Diesel oil D_2
Specific gravity at 15 °C (59 °F):	0,829 gr/cm^3 (0,03 lb/in^3)
Cetane number:	57

Engine oil:

Type:	SAE 30 Super HD S 3
Viscosity:	According to SAE Standard

Transmission oil:

Type:	Hypenol SAE 90
Viscosity:	According to SAE Standard

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COMPULSORY TESTS

(1) ENGINE'S PERFORMANCE ON THE FLYWHEEL

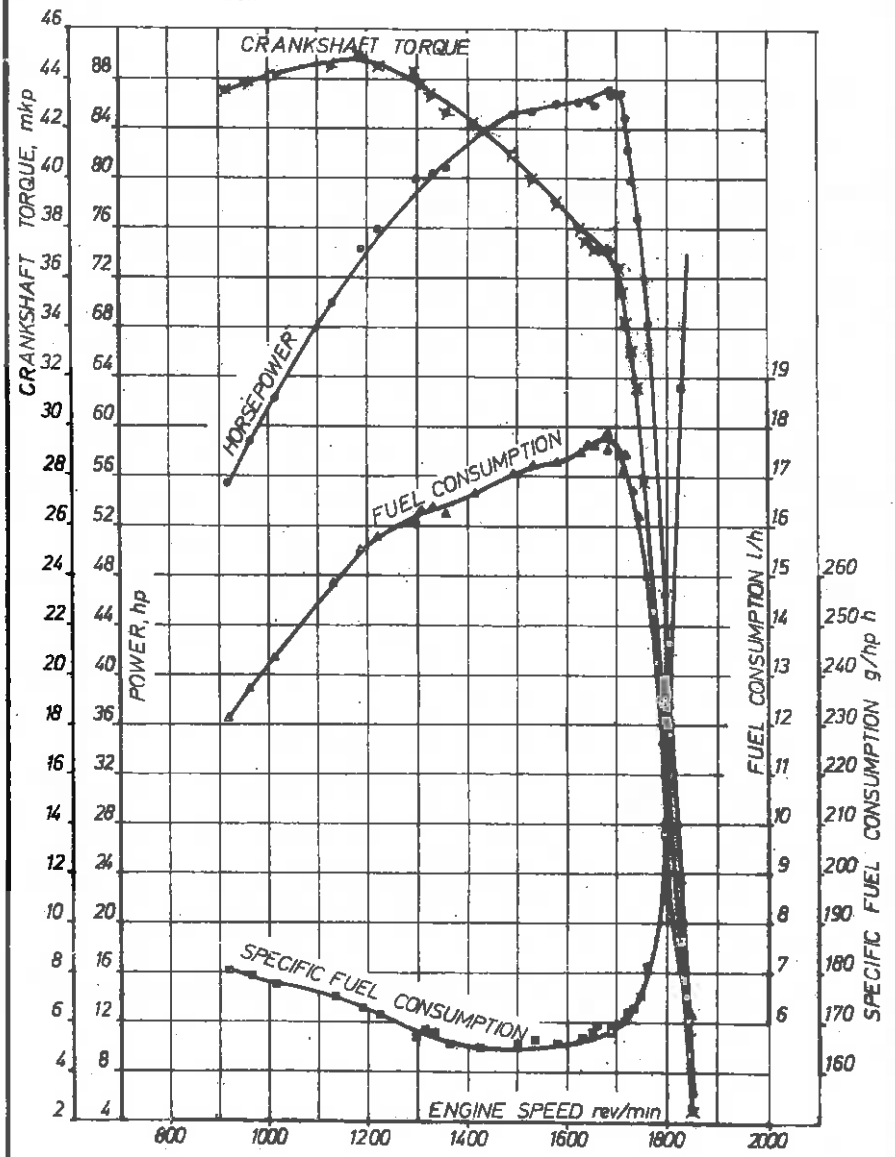
Date and location of tests: 16th July 1970
Institute for Agricultural Mechanization, Beograd-Zemun, Yugoslavia

Type of dynamometer: Hydraulic brake "Schenck" U 1 - 30

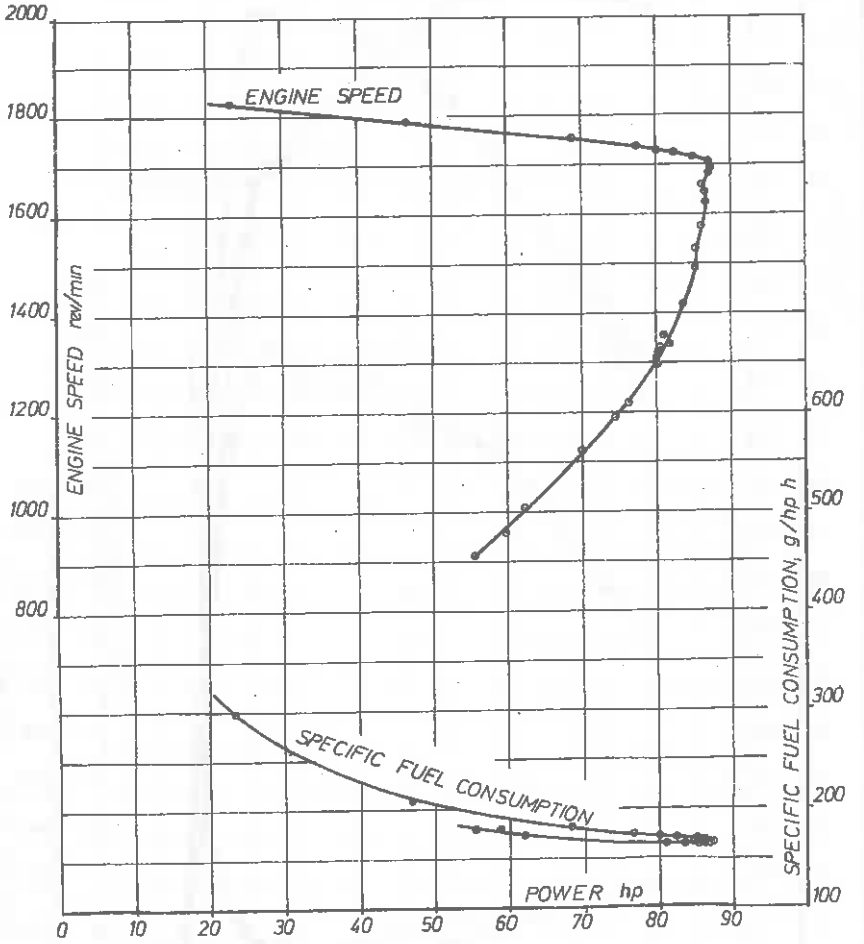
Horsepower metric hp (VK HP)	Engine speed rev/min.	Fuel consumption: Per hour l/h (UK gal/h)	Fuel consumption: Specific g/met hph (lb/hph)	Fuel consumption: Hp hour / unit of volume metric hph/lit (HPh /UK gall)
MAXIMUM POWER - 2 hour test				
87,50 (86,20)	1683	17,89 (3,94)	168,6 (0,372)	4,89 (21,90)
SPEED RECOMMENDED BY MANUFACTURER FOR DRAWBAR WORK				
87,50 (86,20)	1683	17,89 (3,94)	168,6 (0,372)	4,89 (21,90)
FUEL CONSUMPTION AT PART LOADS (i) 85 % of torque at maximum power				
77,00 (75,85)	1742	16,35 (3,60)	175,2 (0,387)	4,71 (21,12)
(ii) unloaded				
6,50 (6,40)	1848	6,23 (1,37)	790,0 (1,741)	1,04 (4,66)
(iii) 50 % of the load defined in (i)				
46,80 (46,10)	1795	11,78 (2,59)	208,0 (0,459)	3,97 (17,80)
(iv) maximum power				
87,50 (86,20)	1683	17,89 (3,94)	168,6 (0,372)	4,89 (21,90)
(v) 25 % of the load defined in (i)				
23,70 (23,35)	1825	8,56 (1,89)	298,0 (0,657)	2,77 (12,42)
(vi) 75 % of the load defined in (i)				
68,50 (67,45)	1756	15,05 (3,31)	181,5 (0,400)	4,55 (20,40)

No load, maximum engine speed:	1850 rev/min
Crankshaft torque on the engine's flywheel at maximum power:	37,20 kg (267,8 lbft)
Maximum crankshaft torque on the engine's flywheel:	45,00 kg (325,50 lbft) at 1184 rev/min engine speed
Mean atmospheric conditions:	
Temperature	26 °C (25 - 28 °C) 79 °F (77 - 82 °F)
Pressure	750,0 mm Hg (29,53 in Hg)
Relative humidity	42 %
Maximum temperature:	
Coolant	89 °C (192 °F)
Engine oil	85 °C (185 °F)
Fuel	23 °C (73 °F)

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(2) DRAWBAR PERFORMANCE

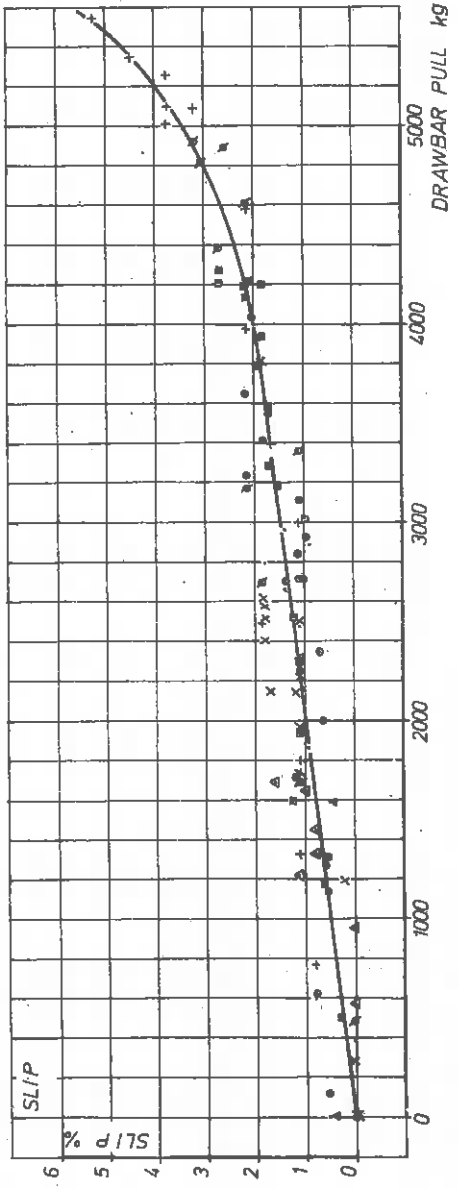
Date of tests: 30 and 31 July 1970
Type of track: Grassland
Height of drawbar above ground: 405 mm (15,94 in)

Gear	Speed km/h (mile/h)	Horsepower metric hp (U.K. HP)	Drawbar pull kg (lb)	Engine speed rev/min	Track-slip %	Specific work hph/lit (drawbar HPh/UK gal)	Specific fuel consumption g/hph (lb / /draw HPh)	Temperature Coolant °C (°F)	Fuel °C (°F)	Engine °C (°F)	Atmospheric conditions Temperature °C (°F)	Relative humidity	Pressure mm Hg (in Hg)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(i)	MAXIMUM	POWER	(tractor unballasted – the ballast is not foreseen by the construction)										
1.	3,95 (2,45)	67,00 (65,95)	4580 (10098)	1700	2,70	3,73 (16,72)	221 (0,487)	32 (90)	86 (187)	80 (176)	24 (75)	44,0	758,6 (29,87)
2.	4,20 (2,62)	65,60 (64,60)	4218 (9299)	1730	2,10	3,72 (16,70)	218 (0,481)	32 (90)	86 (187)	80 (176)	24 (75)	44,0	758,6 (29,87)
3.	4,57 (2,84)	64,30 (63,25)	3796 (8369)	1735	1,90	3,68 (16,50)	225 (0,496)	31 (88)	86 (187)	80 (176)	25 (77)	43,0	758,6 (29,87)
4.	5,39 (3,35)	62,10 (61,15)	3110 (6857)	1740	1,10	3,51 (15,75)	236 (0,521)	31 (88)	87 (189)	81 (178)	25 (77)	43,0	758,6 (29,87)
5.	6,60 (4,03)	59,70 (58,80)	2475 (5457)	1745	1,10	3,37 (15,12)	246 (0,543)	31 (88)	87 (189)	81 (178)	25 (77)	43,0	758,6 (29,87)
6.	7,21 (4,47)	57,50 (56,60)	2153 (4747)	1755	1,17	3,28 (14,70)	254 (0,560)	30 (86)	88 (190)	82 (180)	26 (79)	42,0	758,6 (29,87)
7.	9,78 (6,08)	52,60 (51,80)	1450 (3197)	1765	0,80	2,99 (13,42)	372 (0,821)	30 (86)	88 (190)	82 (180)	26 (79)	42,0	758,6 (29,87)
(ii)	TEN HOUR TEST at 75 % of pull at maximum power												
3.	5,40 (3,36)	55,00 (54, 20)	2750 (6063)		1,45	3,25 (14,58)	255 (0,563)	30 (86)	80 (176)	75 (167)	26 (79)	43,0	760,2 (29,93)

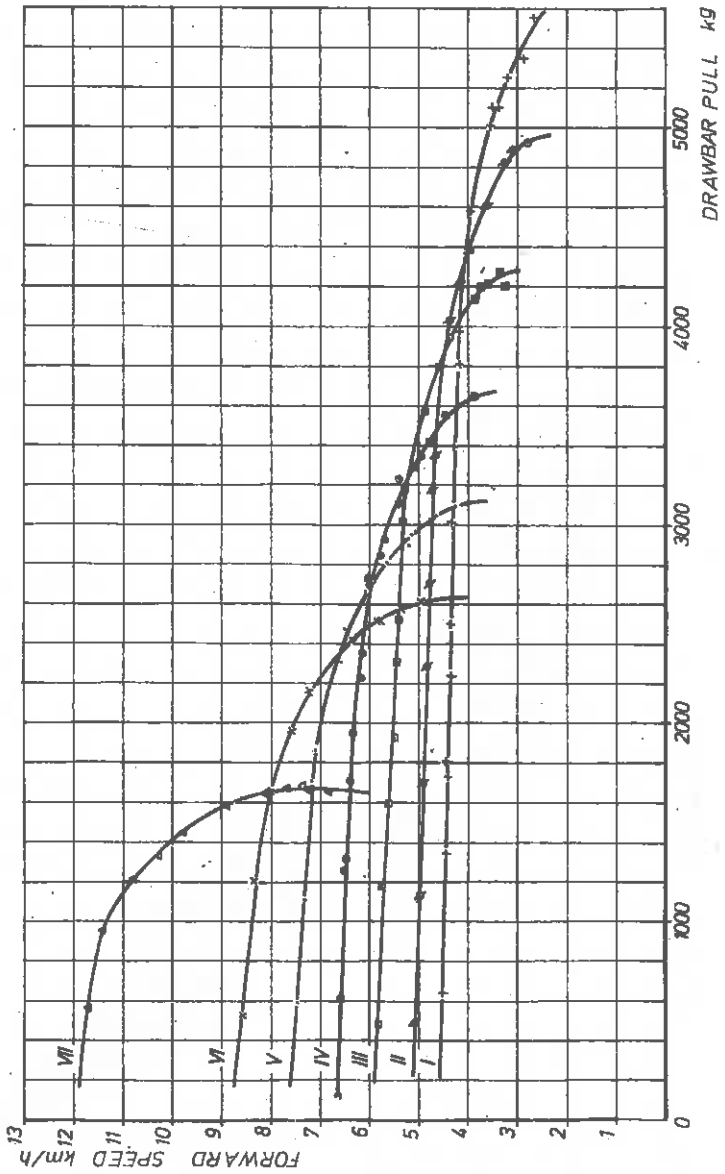
Total oil consumption during ten hours duration of test (ii): . . . . . 43,6 gr/h = (0,096 lb/h)
Maximum drawbar pull 5550 kg (12236 lb) at trackslip of 5,2 %)

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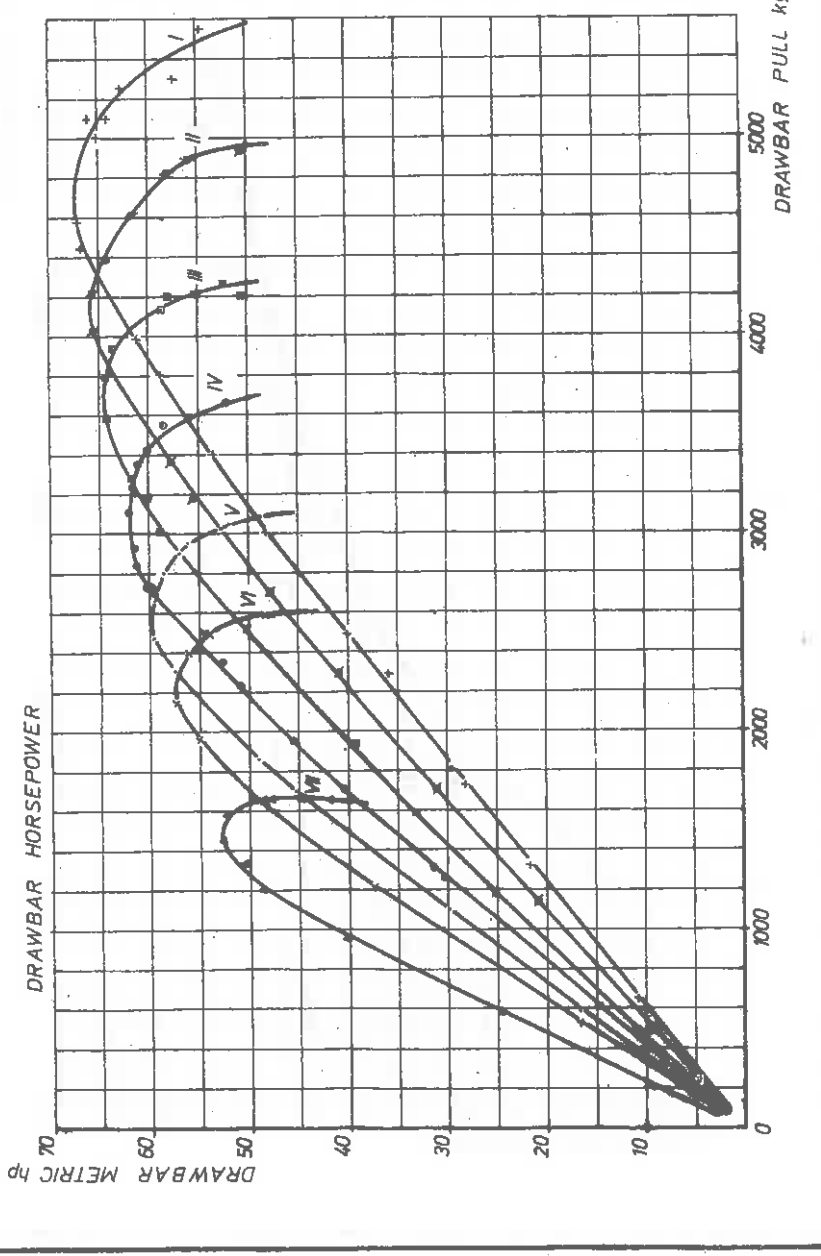
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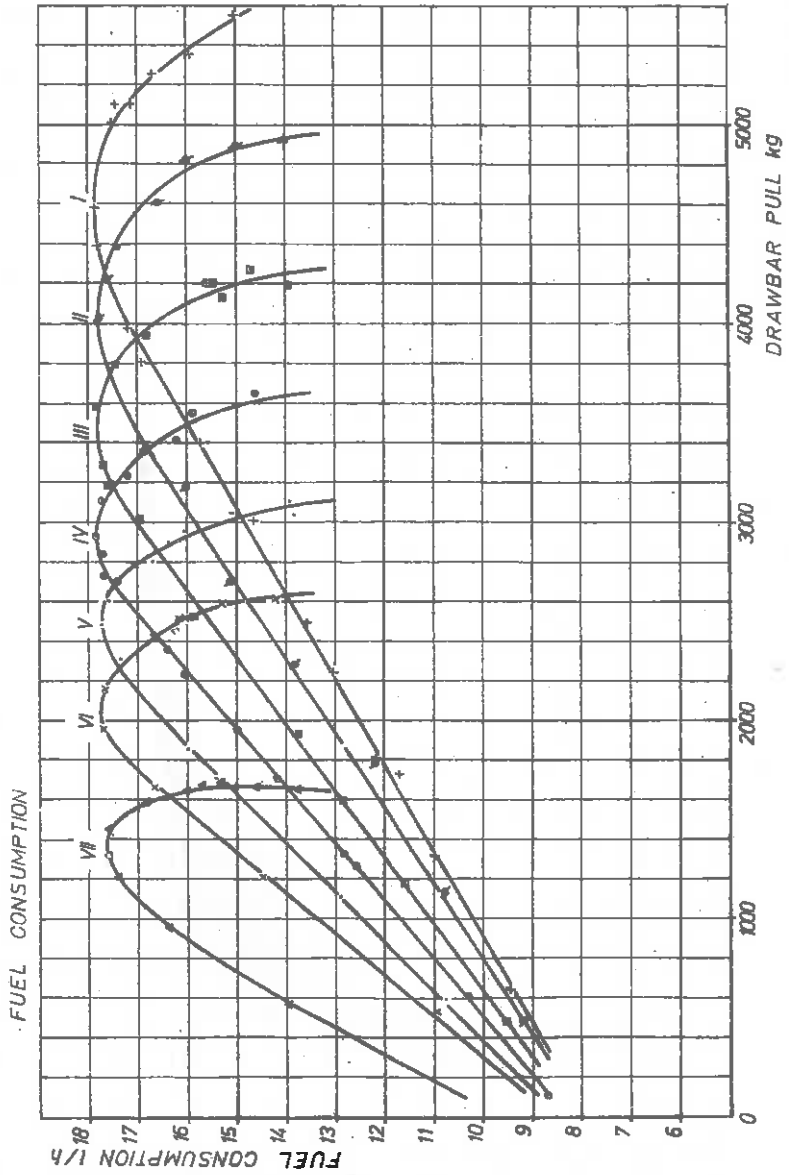
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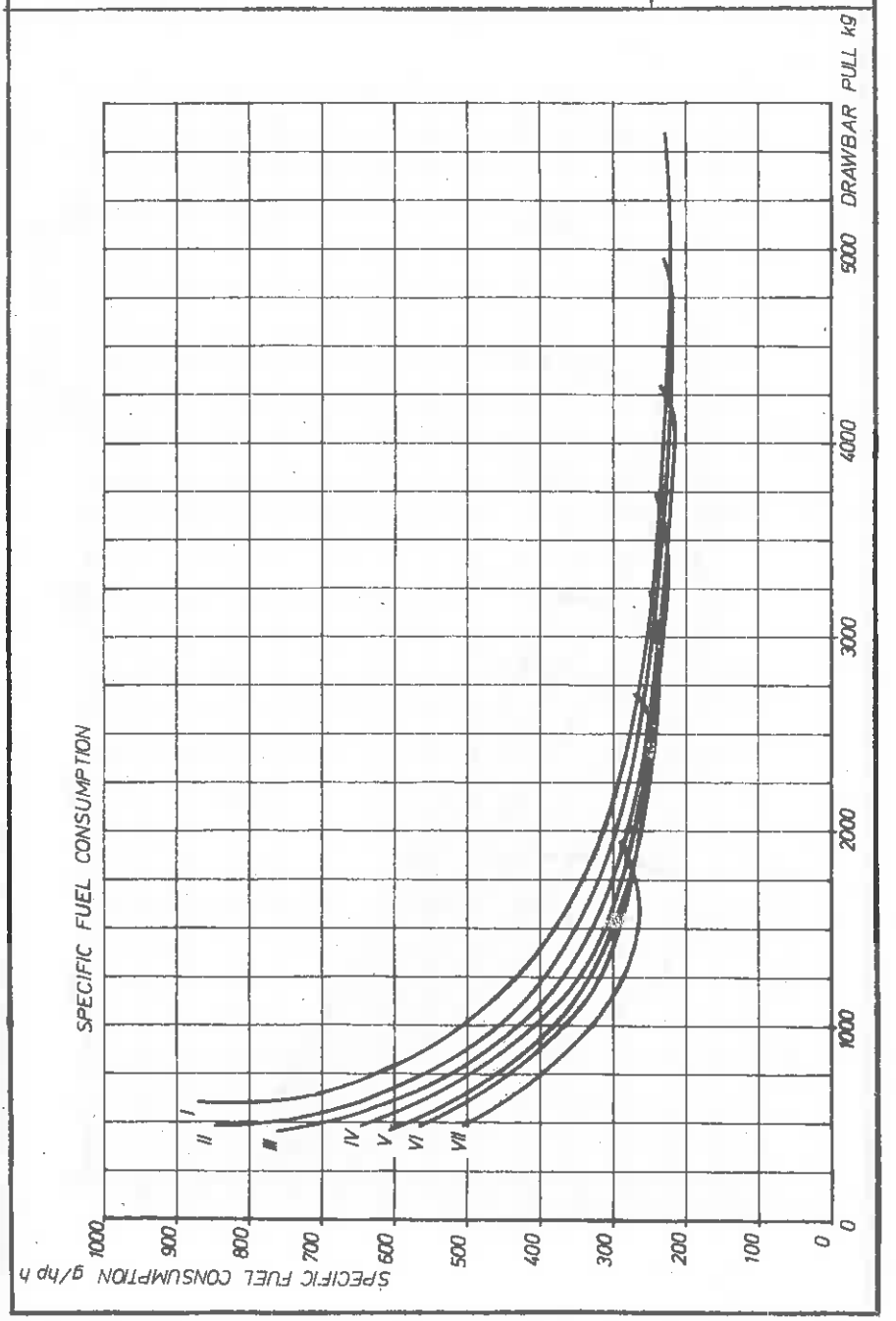
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(3) TURNING SPACE AND TURNING CIRCLE

Width of tracks 1330 mm (52,36 in)

	With brakes	
	Right hand	Left hand
Radius of turning circle	2050 mm (6,74 ft)	2050 mm (6,74 ft)
Radius of turning space	2780 mm (9,14 ft)	2780 mm (9,14 ft)

(4) LOCATION OF CENTRE OF GRAVITY

Height above ground:	714 mm (28,11 in)
Distance forward from the vertical plane containing the axis of the driving sprocket:	1232 mm (48,50 in)
Distance from the median plane:	10 mm (0,40 in) to the left

(5) NOISE MEASUREMENT AT THE DRIVER'S EAR LEVEL

Date of tests:	8.12.1970
Type of sound level meter and octave filter:	Precision Sound Level Meter Type 2203 + Octave Filter Set Type 1613, both of the firm Bruel & Kjaer
Type of track:	Grassland
Type of frequency analyser:	Octave filter according to I E C
Results of tests (tractor with the cab)	Gear: 6 - th Travelling speed: 7,6 km/h (4,72 mile/h) Sones : 101,4 Remark: In no gear was recorded the noise over 1 dB higher from the noise recorded in the 6-th gear.

(6) POWER LIFT AND HYDRAULIC PUMP PERFORMANCE

Date and location of tests:	10.8.1970, Institute for Agricultural Mechanization, Beograd - - Zemun, Yugoslavia

(Further data after "Results of T sts")

RESULTS OF TESTS

HEIGHT ABOVE GROUND IN DOWN POSITION		VERTICAL MOVEMENT		MAXIMUM FORCE EXERTED THROUGH FULL RANGE		PRESSURE		LIFTING FORCE WHEN FRONT OF TRACTOR LIFTS	
mm	(in)	mm	(in)	kg	(lb)	kg/cm^2	(lb/in^2)	kg	(lb)
i). TWO-POINT LINKAGE									
		Linkage giving maximum mechanical advantage							
170	(6,69)	770	(33,31)	2360	(5203)	140	(1991)	1940	(4277)
		Linkage giving minimum mechanical advantage							
95	(3,74)	830	(32,68)	2300	(5071)	141	(2005)	1940	(4277)
ii). THREE-POING LINKAGE									
		Linkage giving maximum mechanical advantage							
235	(9,25)	825	(32,48)	2200	(4850)	139	(1977)	1830	(4034)
		Linkage giving minimum mechanical advantage)							
130	(5,12)	893	(35,16)	2140	(4718)	140	(1991)	1830	(4034)

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Hydraulic fluid

Make and type:	Hydracil, respectively SAE
Viscosity:	Winter period: Hydraoil 50, respectively SAE 20 Super HD Summer period: Hydraoil 90, respectively SAE 30 Super HD
Viscosity index:	According to the Standard
Type of linkage lock for transport:	Chains

Pump characteristics

i) Opening pressure of the relief valve	144 kg/cm^2	(2048 lb/in^2)
Sustained pressure by the open relief valve	140 kg/cm^2	(1991 lb/in^2)
ii) Pump delivery rate at minimum pressure and rated engine speed	74,0 lit/min	(16,30 UK gal/min)
iii) Pump delivery rate	65,2 lit/min	(14,32 UK gal/min)
Delivery pressure	128 kg/cm^2	(1821 lb/in^2)
Power	18,6 metric hp	(18,3 HP)

Test Engineer: Dr. M. STEGENŠEK

Officer in charge: N. MILOVANOVIĆ

Director: V. VIDAKOVIĆ

Date: 30th December 1970