Institut za mehanizaciju poljoprivrede - Zemun

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Report on Test in Accordance with O.E.C.D. STANDARD CODE for the Official Testing of Agricultural Tractors



Agricultural tractor BNT – 105

Manufactured by: MMK „BRATSTVO"
Pucarevo – Yugoslavia

Date of test: February – June 1980

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

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

This Report has been aporoved by the O.E.C.D. Co–ordinating Cent (C.E.M.A.G.R.E.F., France) as being in accordance with the O.E.C.D. STANDARD – CODE.

Date of Approval: November 3rd, 1981

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Tractor manufacturer:	MMK "BRATSTVO" RO TT i PM 72280 Pucarevo, Borisa Kidriča 1 Yugoslavia
Submited for test by:	The manufacturer
Selected by:	Representatives of IMP
Place of running-in:	Laboratory of the manufacturer
Duration of running-in:	cca 60 hours

SPECIFICATION OF TRACTOR

TRACTOR

Make:	MMK "BRATSTVO" RO TT i PM
Model:	BNT - 105
Type:	Crawler, with frame and elastic type of suspension
Serial N°:	0015

ENGINE

Make:	FAMOS - Sarajevo, Yugoslavia
Model:	F 406 A
Type:	Four stroke, water cooled diesel, direct injection with combustion chamber in the piston head
Serial N°:	88798
Cylinders:	6, vertical, in-line, bore 112 mm, stroke 140 mm, displacement 8276 cm^3 compression ratio 17,5 : 1, overhead valves, replaceable wet cylinder liners

Fuel system:	RBR piston type feed pump with hand primer, driven by the injection pump shaft over an excenter; double filter TPR model 4517.o619.o with replaceable paper elements on the pressure side of feed pump; fuel tank capacity 25o l; RBR piston (in-line) type injection pump, model P16T13 - 9.121A IIOVR; serial N° R 78 316, manufacturer's production setting 69±1 mm^3 at 8oo rev/min injection pump speed (16oo rev/min engine speed), injection timing 2o±1° before T.D.C.; needle type injector nozzles model HRR (F&M) H1S4 o1/5o+D1 1 MK 92/2 o5; BOSCH KDAL 5oS4 + D11 5oS226, injection pressure 185±1o bar
Governor:	BOSCH, mechanical, centrifugal, all range, model EP/RSV 25o 85o BOB I R1o5, incorporated in fuel injection pump, governed range of engine speed 65o to 189o rev/min, rated engine speed 17oo rev/min
Air cleaner:	TPR, GHG 1o-oo36, dry, with replaceable paper element; TPR, PBH oo-o256, centrifugal pre-cleaner
Lubrication system:	Forced feed from gear pump with strainer in sump; two full flow filters with replaceable elements; oil capacity 18 l, recommended oil quality acc. MIL-L-21o4C, recommended oil viscosities: winter SAE 2o summer SAE 3o oil and filter change interval 18o h (first oil and filter change after 4o-5o working hours of the engine)

Cooling system:	Water cooling with impeller pump; pressurized system set to o,5 bar overpressure; cast aluminium fan with 8 blades, belt driven, 54o mm diameter; coolant capacity 4o l; temperature control by thermostat
Starting system:	Electrical, solenoid-engaged starter motor - OSN 1/N-24/4/11-1-TID, 24 V, 4 kW; no aids for cold starting
Exhaust:	Vertical, above bannet, on the left hand side of the engine, mouth cca 21oo mm above ground; silencer dimensions: diameter 16o mm, length 2oo mm
Electrical system:	24 Volt, negative earth; ISKRA generator DGD-24/3oo/13oo M/2-TID or DGD-24/3oo/13oo 1/2-TID, o,3 kW; two 12 V lead-acid batteries, serial connected, each with 11o Ah capacity at 2o-hour rating

TRANSMISSION

Clutch:	FAMOS Sarajevo; dry, single plate friction clutch, mod.AS.25.1, disc dia 38o mm, hydraulically pedal operated
Gearbox:	Own make; mechanical with sliding gears, 7 forward and 1 reverse gear; a reduction gear with gear ratio 1,583 : 1 available as optional equipment; Note: For the part of drawbar test the tractor was fitted with the reduction gear
Rear axle and final drive:	Own make; Bevel gear drive with crown wheel and pinion; epicyclic (planetary) gearing; final drive with one pair of spur gearing

Connecting shaft: A connecting shaft with one universal and one elastic joint between clutch and gearbox

Oil capacities: Gearbox and rear axle 1o,o l
final drive 2 x 3,5 l

Oil changing period: 96o hours for all gears

Recommended oil qualities: For all gears hypoid oil SAE 9o acc.to MIL-L-21o5 B

Total ratios and speeds

Gear	Total ratio engine: driving sprocket without reduction gear -	with reduction gear -	Nominal travelling speed at rated engine speed without reduction gear km/h	with reduction gear km/h
Forward speeds				
1	53,89	85,31	4,22	2,67
2	48,2o	76,3o	4,72	2,98
3	42,33	67,o1	5,37	3,39
4	36,91	58,43	6,16	3,89
5	32,o5	5o,74	7,1o	4,49
6	27,94	44,23	8,14	5,14
7	19,93	31,55	11,42	7,21
Reverse				
1	63,25	1oo,12	3,6o	2,27

Calculated with the driving sprocket pitch circle diameter 71o mm

Power take-off: Not fitted on the tested tractor

Power lift: Own make in cooperation with PPT;

Hydraulic system:	Gear pump PPT with 42 cm^3/rev delivery, driven from the front end of engine's crankshaft; control valve for lifting and sinking, position control and floating control; opening pressure of relief valve 115 bar, sustained pressure by the opened relief valve 115-120 bar; double acting external ram PPT with 63/36 mm bore, 235 mm stroke; hydraulic oil tank in common with oil tank for steering and brake controls, oil capacity 75 l; recommended oil: hydraulic oil SAE 50 comercially available (acc.to MIL-L-2105) oil changing interval 800-1000 hours; strainer in hydraulic pump suction line, every 500 hours maintained by waching optionally one or two paars of external tappings for front mounted implements
Implement linkage:	Own make; Three point linkage category IV, with possible connection of linkage to the tractor in three and two points (lower links with common pivot point); disposition of linkage acc.to ISO lift rods adjustable from 700 to 805 mm; lifting range above ground - with separate lower links pivot points: short lift rods from 145 to 1060 mm long lift rods from 40 to 990 mm - with common lower links pivot point: short lift rods from 120 to 1040 mm long lift rods from 10 to 955 mm (height of driving sprocket axle above ground 475 mm)
Pull atachment	
Stiff drawbar:	A drawbar attached to the holed bar; height above ground 405;435;505;535 mm, height adjusment by turning holed bar and drawbar; (height of driving sprocket axle 475 mm)

	horizontal distance from driving sprocket axle: 641 mm behind; lateral adjusment in seven steps: in the tractor`s median plane and 9o,18o and 27o mm to either side; drawbar`s hole diameter 41 mm
Hitch:	Two hitches welded on the front side of the tractor`s frame on the mutual distance of 7oo mm; height above ground 395 mm
Steering:	Own make in cooperation with "M.PUPIN" - Beograd Two one-stage epicyclic gearings and self-tightening band brakes on separate drums, hydraulically operated, as part of transmission, located in the driving axle housing
Method of operation:	From the control unit with the two levers (handles), located in front of driver`s seat, the hydraulic oil is distributed to rams (totally four rams); when levers are in the neutral position two rams braking band brakes of epicyclis gearings are engaged and two other rams, braking service brakes, disehgaged; By actuating left-hand or right-hand lever the oil pressure in the corresponding ram will be gradually decreased and the band brake loosen and respective tractor drive will be eliminated. When the epicyclic gearing brake is loosen the oil under pressure actuate the ram on the corresponding halfshaft brake causing gradually increased braking of the corresponding track The oil under pressure is supplied from the power lift pump

Brakes	
Service brake:	Own make; hydraulically operated; two band brakes with drums on both halfshafts; operated by actuating both steering control levers together
Parking brake:	Own make; mechanically operated; service band brake, but actuated by a hand lever
Steering brake:	Descripted under Steering
Tracks:	Open type, with seven joints; each track with 45 plates; plate`s width 390 mm, grouser height 45 mm, pitch 170 mm, pins Ø22x425 mm; track gauge 1330 mm; length of track in ground contact 2065 mm; mean ground pressure 4,04 N/cm^2
Driving sprocket:	Pitch circle dia 710 mm, 13 teeth, face width 45 mm
Suspension:	Elastic type of suspension; each track has two balancing units, each unit with two twin rollers (4 rollers per unit); the spiral balancing spring is situated horizontally
Idler wheels:	With double rim; tightening by means of two spiral springs per wheel
Top rollers:	Two twin rollers on each track
Lubrication:	Grease points on the bearings of balancing units, of top and bottom rollers and of idle wheels
Cab:	Make "MEHANIKA" - Orašje; metalic cab rigidlly tightened to the tractor`s frame.

Seat: Make "POLIESTER" - Priboj;
two seats symetrically situated in the cab;
upholstered with back rest;
stiff suspension, spronge and springs damping;
range of adjusments:
in two steps
- horizontally 4o mm
- vertically 3o mm

Number of grease points: 32 with grease (whole tractor)

Weights: 7o55 kg, without driver but with tanks full (the manufacturer does not recommend to use tractor without front ballast)

Overall dimensions:

Total length: 495o mm with linkage
445o mm without linkage

Total width: 174o mm
Total height: 262o mm, to the top of driver`s cab
Ground clearance: 345 mm, in tractor`s median plane, under the driving axle housing

Lighting equipment: Electrical, 24 Volt, negative earth

	Dimensions mm	Height above ground to centre mm	Distance from outside edge of tractor to centre mm
Head lights	Ø 13o	152o	55o
Rear light	Ø 13o	23oo	52o

Unrestricted beam angle of head light in plan view: 32 ± 3^{o}

FUELS AND LUBRICANTS USED IN TEST

Fuel:	INA Diesel-fuel D_2 in all tests	
	specific gravity at 15°C	o,824 kg/h
	cetane number	56
	viscosity at 15°C	4,9 mm^2/S
Engine oil:	INA SUPER HD S3 SAE 3o	
Transmission oil: (Gearbox, driving axle and final drive)	HENA HIPENOL SAE 9o	
Hydraulic oil: (Power lift, steering and brakes)	HENA HIDRAOL SAE 5o	

COMPULSORY TESTS

(1) ENGINE'S PERFORMANCE ON THE FLYWHEEL

Date and location of test: 26. February 198o
Institute for Agricultural Mechanization - Zemun

Type of dynamometer: Hydraulic brake SCHENCK U1-3o

Power kW (kp)	Engine speed rev/min	Fuel consumption hourly l/h	Fuel consumption hourly kg/h	Fuel consumption specific g/kWh (g/hph)	Specific energy kWh/l (hph/l)
MAXIMUM POWER					
At 2-hour test					
78,2 (1o6,3)	17oo	22,5o	18,56	237 (175)	3,48 (4,72)
At speed recommended by the manufacturer for drawbar work					
78,2 (1o6,3)	17oo	22,5o	18,56	237 (175)	3,48 (4,72)
PART LOADS					
Governor hand lever in the position giving maximum power at full load					
(i) 85 % of torque at maximum power					
68,8 (93,5)	1761	19,66	16,22	236 (173)	3,5o (4,76)
(ii) unloaded					
5,3 (7,2)	188o	6,61	5,45	-	-
(iii) 5o % of the load defined in (i)					
35,8 (48,6)	183o	12,4o	1o,23	286 (21o)	2,89 (3,92)
(iv) maximum power					
78,2 (1o6,3)	17oo	22,5o	18,56	237 (175)	3,48 (4,72)
(v) 25 % of the load defined in (i)					
18,1 (24,6)	1856	8,79	7,25	4o1 (295)	2,o6 (2,8o)
(vi) 75 % of the load defined in (i)					
53,9 (73,2)	1799	16,1o	13,28	246 (181)	3,35 (4,55)

STANDARD SPECIFIC FUEL CONSUMPTION: 236 (173); 286 (21o)

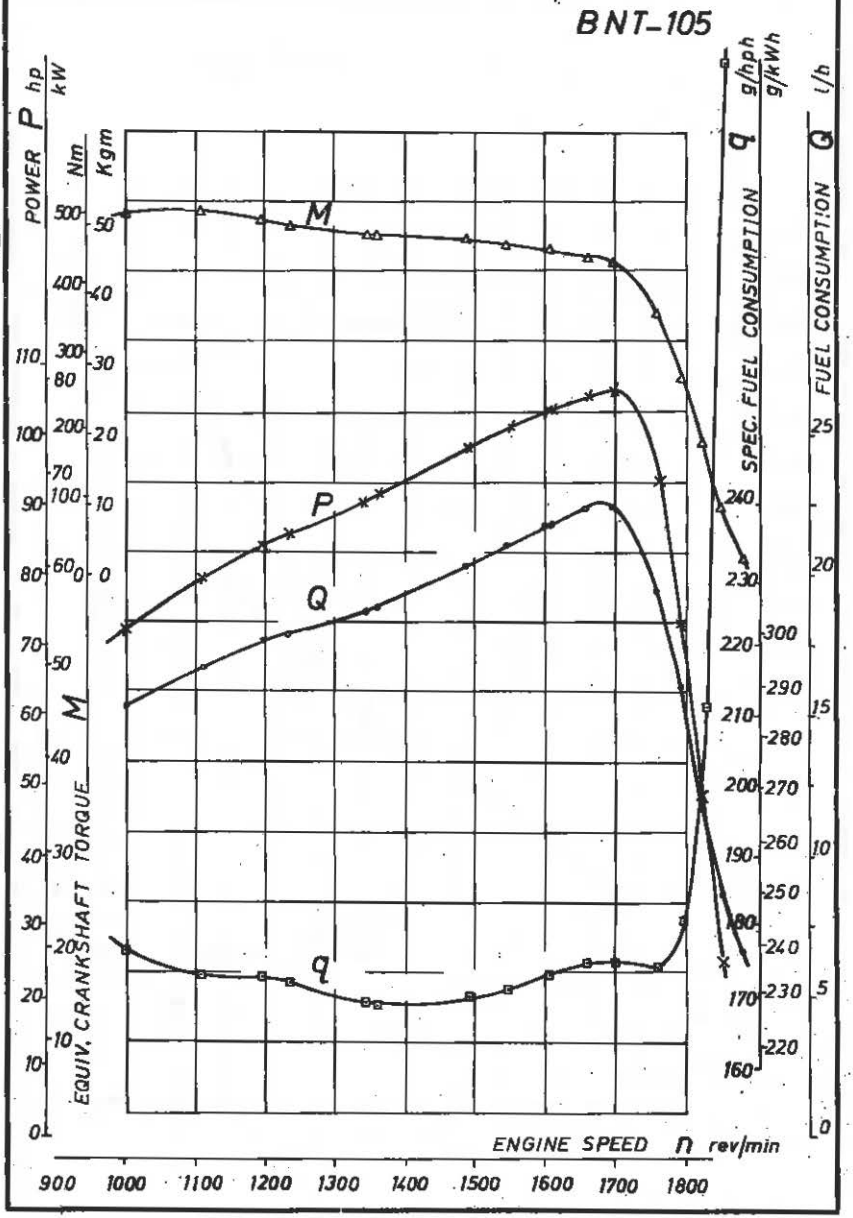
No load, maximum engine speed:	1884 rev/min
Cranfshaft torque at maximum power:	43,93 daNm (44,78 kpm)
Maximum cranksfaht torque:	5o,48 daNm (51,46 kpm) at 1112 engine rev/min

Mean atmospheric conditions

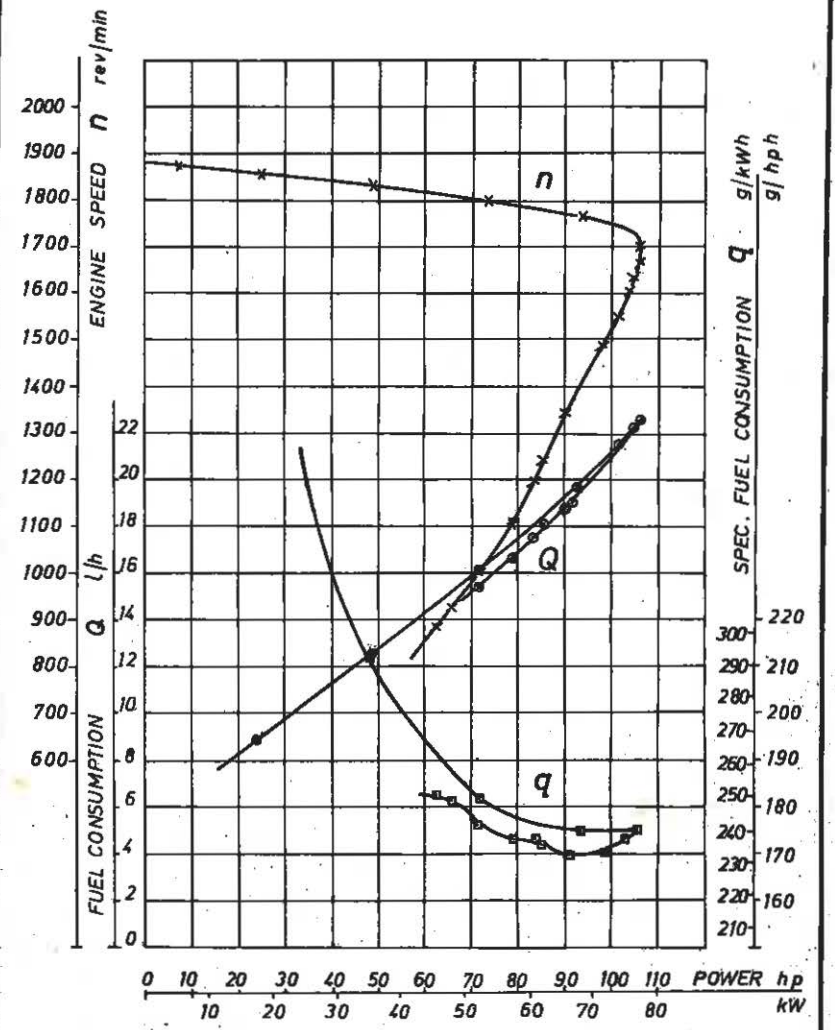
temperature:	16 °C
pressure:	1oo9 mbar
humidity:	59 %

Maximum temperatures

coolant:	89 °C
engine oil:	97 °C
fuel:	19 °C
air intake:	18 °C


BNT-105
POWER P hp kW
Nm Kgm
EQUIV. CRANKSHAFT TORQUE M
SPEC. FUEL CONSUMPTION q g/hph g/kWh
FUEL CONSUMPTION Q l/h
M
P
Q
q
ENGINE SPEED n rev/min
900 1000 1100 1200 1300 1400 1500 1600 1700 1800

BNT – 105


ENGINE SPEED n rev/min
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
FUEL CONSUMPTION Q l/h
22
20
18
16
14
12
10
8
6
4
2
0
n
Q
q
SPEC. FUEL CONSUMPTION q g/kWh g/hph
300
290
280
270
260
250
240
230
220
210
220
210
200
190
180
170
160
0 10 20 30 40 50 60 70 80 90 100 110 POWER hp
10 20 30 40 50 60 70 80 kW

(2) DRAWBAR PERFORMANCE

2.1. Tractor without reduction gear

Date of test: 9. and 1o. June 198o. Height of drawbar: 42o mm

Type of track: Grassland (measured on the grassland, without load)

Gear	Driving speed	Power	Drawbar pull	Engine speed	Track slip	Specific energy	Specific fuel consumption	Temperature			Atmospheric conditions		
								Fuel	Coolant	Engine oil	Temperature	Humidity	Pressure
	km/h	kW (hp)	daN (kp)	rev/min	%	kWh/h (hph/l)	g/kWh (g/hph)	°C	°C	°C	°C	%	mbar
1	2	3	4	5	6	7	8	9	1o	11	12	13	14
			(i) MAXIMUM POWER										
1.	4,o1	58,9 (8o,1)	529o (539o)	17oo	4,6	2,62 (3,55)	314 (231)	22	9o	96	21	64	1oo8
2.	4,54	58,8 (79,9)	466o (475o)	17oo	3,4	2,61 (3,54)	315 (232)	22	9o	96	21	64	1oo8
3.	5,21	58,5 (79,5)	4o4o (412o)	17oo	2,6	2,6o (3,54)	317 (233)	22	88	96	21	64	1oo8
4.	6,o6	58,4 (79,3)	347o (3535)	17oo	2,o	2,59 (3,53)	318 (234)	22	88	96	21	64	1oo8
5.	7,oo	57,5 (78,2)	296o (3o15)	17oo	1,5	2,56 (3,47)	322 (237)	22	88	95	22	61	1oo8
6.	8,o5	55,9 (76,o)	25oo (255o)	17oo	1,4	2,48 (3,37)	331 (244)	23	88	95	22	61	1oo8
7.	11,3o	51,3 (69,7)	1635 (1665)	17oo	o,8	2,28 (3,1o)	362 (267)	23	88	95	22	61	1oo8
			(ii) TEN HOUR TEST at 75 % of drawbar pull at maximum power in 3rd gear										
3.	5,45	46,o (62,6)	3o4o (31oo)	1765	1,8	2,51 (3,41)	328	25	85	92	23	57	1oo4

Total oil consumption during ten hours duration of test (ii) was 47,3 g/h

2.2 Tractor with reduction gear (optional equipment)

Date of test: 24. April 198o Height of drawbar: 42o mm

Type of track: Grassland (measured on the grassland, without load)

Gear	Driving speed	Power	Drawbar pull	Engine speed	Track slip	Specific energy	Specific fuel consumption	Temperature			Atmospheric conditions		
								Fuel	Coolant	Engine oil	Temperature	Humidity	Pressure
	km/h	kW (hp)	daN (kp)	rev/min	%	kWh/h (hph/l)	g/kWh (g/hph)	°C	°C	°C	°C	%	mbar
1	2	3	4	5	6	7	8	9	1o	11	12	13	14
		(i) MAXIMUM POWER											
1.	2,31	44,1 (59,9)	687o (7ooo)	1744	15,o	2,34 (3,18)	349 (257)	19	85	9o	18	59	1olo
2.	2,59	49,4 (67,2)	687o (7ooo)	1728	15,o	2,42 (3,23)	34o (25o)	19	86	92	18	59	1olo
3.	2,93	54,7 (74,3)	672o (685o)	17oo	14,2	2,42 (3,23)	34o (25o)	19	88	95	19	54	1olo
4.	3,64	58,4 (79,4)	578o (589o)	17oo	6,o	2,59 (3,53)	318 (234)	19	88	95	19	54	1olo
5.	4,27	59,3 (8o,7)	5oo5 (51oo)	17oo	4,2	2,63 (3,57)	313 (23o)	19	88	95	19	54	1olo
6.	5,o2	58,4 (79,4)	419o (427o)	17oo	3,1	2,59 (3,52)	318 (234)	19	87	95	19	54	1olo
7.	7,o6	57,4 (78,1)	293o (299o)	17oo	1,6	2,54 (3,46)	324 (238)	19	87	94	19	54	1olo

(3) TURNING SPACE AND TURNING CIRCLE

Track gange 133o mm

	With brakes	
	Right hand	Left hand
Radius of turning space	2,76 m	2,76 m
Radius of turning circle	2,o4 m	2,o4 m

(4) LOCATION OF CENTRE OF GRAVITY

Height above ground	73o mm
Distance forward from the axis of driving sprockets:	134o mm
Distance from tractor`s median plane	18 mm to the left

(5) NOISE AT THE DRIVER'S EAR LEVEL

Date of test: 17. June 1980
Type of track: Grassland
Type of sound lever meter: Bruel &. Kjaer type 2209

Results of test

Tractor with cab and without reduction gear

Gear	Drawbar pull at which the tractor develops the maximum sound level		Travelling speed nominal	Travelling speed effective	Sound level
	daN	(kp)	km/h	km/h	dB(A)
1.	4855	(4950)	4,22	4,2	91,8
2.	4519	(4600)	4,72	4,7	92,0
3.	3925	(4000)	5,37	5,4	91,3
4.	3335	(3400)	6,16	6,2	90,2
5.+)	2745	(2800)	7,10	7,2	91,8
6.	2355	(2400)	8,14	8,2	93,8
7.	Light load		11,42	11,7	96,7

+) The 5th gear corresponds to the travelling speed nearest to 7,5 km/h

(6) POWER LIFT AND HYDRAULIC PUMP PERFORMANCE

Date of test 28. May 198o

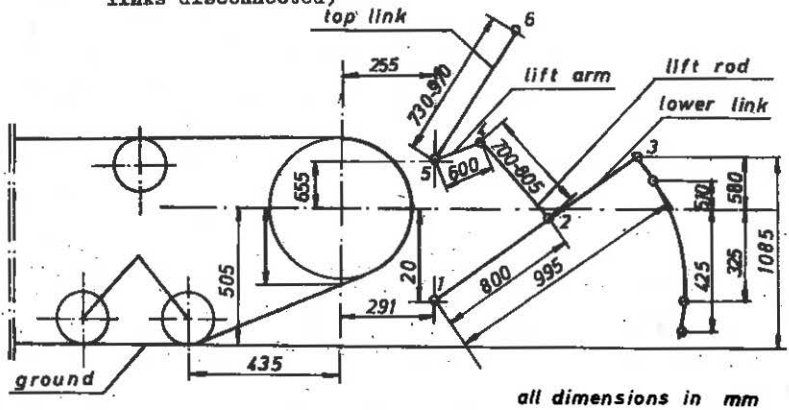
HYDRAULIC PUMP

(1) Opening pressure of relief valve	115 bar
Sustained pressure by open relief valve	118 bar
(2) Pump delivery rate at minimum pressure at rated engine speed	72,o l/min
(3) Pump delivery rate at maximum hydraulic power	65,o l/min
corresponding delivery pressure	112 bar
hydraulic power	12,1 kW (16,5 hp)

POWER LIFT

Dimensions of linkage geometry
for the table on page 21

Note:
Projected length in side view of lower links and lift rods and maximum and minimum height of lower link hitch points are given for the "three point linkage" (lower links disconnected)



LIFTING FORCES

Lifting heights relative to horizontal lower links
The tractor set on the hard surface with supports under the driving axle

At hitch points

(i) with disconnected lower links

				maximum mechanical advantage		
mm	-280	-200	-100	0	+100	+200
daN	2710	2695	2675	2665	2650	2640
(kp)	(2765)	(2745)	(2725)	(2715)	(2705)	(2690)

				minimum mechanical advantage		
mm	-380	-300	-200	-100	0	+100
daN	2725	2685	2665	2660	2635	2620
(kp)	(2780)	(2735)	(2715)	(2710)	(2690)	(2670)

Max.force exerted throughout the whole range 2515 daN (2565 kp)

Front of tractor does not lift

(ii) with connected lower links

				maximum mechanical advantage		
mm	-270	-200	-100	0	+100	+200
daN	2760	2545	2695	2665	2640	2605
(kp)	(2810)	(2795)	(2745)	(2715)	(2690)	(2655)

				minimum mechanical advantage		
mm	-370	-300	-200	-100	0	+100
daN	2780	2745	2705	2665	2635	2600
(kp)	(2835)	(2800)	(2755)	(2715)	(2685)	(2650)

Max.force exerted throughout the whole range 2395 daN (2440 kp)

Front of tractor does not lift

+2oo	+3oo	+4oo	+5oo	+575
264o (269o)	263o (268o)	261o (266o)	2575 (2625)	2515 (2565)

+1oo	+2oo	+3oo	+4oo	+5oo
263o (267o)	261o (266o)	2585 (2635)	2535 (2585)	248o (253o)

All values of forces are given for pressure at maximum hydraulic power (112 bar), calculated from measurements at maximum oil pressure (118 bar)

+2oo	+3oo	+4oo	+5oo	+585
26o5 (2655)	2565 (2615)	2525 (2575)	247o (252o)	2395 (244o)

+1oo	+2oo	+3oo	+4oo	+5oo	+515
26oo (265o)	2565 (2615)	251o (256o)	2445 (2495)	236o (24o5)	2345 (239o)

LINKAGE GEOMETRY

	Lower links connected		Lower links disconnected	
	max.mech. advantage	min.mech. advantage	max.mech. advantage	min.mech. advantage
Projected length in side view:				
Lower links	990		995	
Lift arms	600			
Lift rods	698	802	700	805
Top link	(730-970)			
Distance of lift rod connection point from pivot point of lower links	800			
The following dimensions are given relative to driving sprocket axle 505 mm above ground				
Lower link pivot point	291 mm behing, 20 mm below			
Top link pivot point	255 mm behind, 655 mm above			
Lift arm pivot point	255 mm behind, 655 mm above			
Maximum and minimum height of lower link hitch points +)	below - above	below - above	below - above	below - above
	340 mm 570 mm	450 mm 480 mm	325 mm 580 mm	425 mm 510 mm
Height of lower link hitch points above ground when locked in highest transport position	1025	985	1085	1015

+) Stroke limiting valves are located on the lifting cylinder. They are forced to begin opening at approx. 25 mm before upper or lower dead point, respectively