SOCIALISTIC REPUBLIC OF CROATIA
INSTITUTE FOR MECHANIZATION, TECHNOLOGY AND BUILDINGS IN AGRICULTURE
Z A G R E B

TEST BULLETIN: O. E. C. D. No. 884

Report on test in accordance with O. E. C D. Standard Code for the official testing of Agricultural Tractors

Date of Approval: 17th November 1983

AGRICULTURAL TRACTOR

ŠTORE 502 (2 WD)

Manufactured by: Slovenske železarne, Železarna Štore

TOZD Tovarna traktorjev, Štore, Yugoslavia

Date of tests: July 1982 – July 1983

This report has been approved by the O. E. C. D. Coordinating Centre (C. N. E. E. M. A., Antony, France) as being in accordance with the O. E. C. D. Standard Code for the Official Testing of Agricultural Tractor Performance.

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

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In this report all measurements are given in SI units.
The relation with former Technical System of Units is given by following relations:

Forces: 1 N = 0.102 kp or 1 kp = 9.81 N
Powers: 1 kW = 1.36 hp or 1 hp = 0.736 kW
Pressures: 100 kPa = 1.02 kp/cm² = 750.1 mm Hg or 1 kp/cm² = 98.1 kPa

Tractor manufacturer:	Slovenske železarne – Železarne Štore TOZD Tovarna traktorjev
Submitted for test by:	Manufacturer
Selected by:	Manufacturer in agreement with the Institute
Place of running-in:	Zagreb
Duration of running-in:	60 hours

SPECIFICATION OF TRACTOR

Tractor	
Make:	ŠTORE
Model:	502
Type:	Wheel tractor, unit construction, all wheel driven
Serial No.:	120270
Engine	
Make:	IMR – INDUSTRIJA MOTORA RAKOVICA
Model:	DM/33 T
Type:	4-stroke diesel engine, water cooled, direct ignition
Serial No.:	124334
Cylinders:	3 in line, bore 91.4 mm, stroke 127 mm, displacement 2500 cm3, compression ratio 17.4 : 1, dry cylinder liners, overhead valves
Fuel sistem:	Diaphragm fuel feed pump, double fuel filter with replaceable cartridge; rotary fuel injection pump C.A.V. DPA Y3230F020; serial No. ZY 136; manufacturer's production setting 50–52 mm^3/stroke at rated engine speed; injection timing 16^0 before TDC; C.A.V. IPM injection nozzles, injection pressure 19± 0.5 MPa; capacity of fuel tank 33 l
Governor:	C.A.V. mechanical centrifugal variable speed governor; governed range of engine speed 500 to 2400 rev/min; rated engine speed 2250 rev/min
Air cleaner:	Own make; oil bath filter with centrifugal prefilter, oil capacity 0.94 l
Exhaust silencer:	Own make; single chamber absorption silencer; 85 mm dia x 525 mm; 1200 mm long; on the left side of engine showing upward; 2240 mm above ground level

Lubrication system:	Forced feed from excentric rotor pump; oil filter with replaceable cartridge; recommended filter change period 400 hours; recommended oil quality acc. MIL-L-2104A Recommended oil viscosities: Below $0^{o}C$ SAE 10 $0^{o}C$ to $30^{o}C$ SAE 20 Above $25^{o}C$ SAE 30 Oil capacity: 5.5 l Recommended oil change period: 200 hours
Coling system:	Water cooling with impeller pump, pressurized system set to 500 kPa overpressure, with by-pass thermostat; fan with 6 blades 345 mm diameter; water capacity 8.8 l
Starting system:	Electrical Solenoid engaged starter motor ISKRA AZJ 0404 12 V 3 kW; flame plug in inlet manifold
Electrical equipment:	12 Volt 3-phase alternator ISKRA AAG 1302 14 V 28 A; 1 baterry 97 Ah at 20 hours rating; lead acid type
Transmission	
Clutch:	Make: FIAT – RUEN double effect type clutch, 254 mm dia, pedal operated
Gearbox:	Own make; speed change gear with 3 forward + 1 reverse speeds; group gear with 2 forward groups, sliding gear shifted; totally 6 forward + 2 reverse speeds
Rear axle and final drive:	Own make: bevel gear drive with crown wheel and pinion; bevel gear differential with lock, pedal operated, self disengaging; spur gear final drives
Transmission lubrication:	Gear box, rear axle and hydraulic system 19.2 l; final drives 2 x 2.8 l; recommended oil type acc. API service classification: service CC; viscosity SAE 30. Recommended oil change period 1600 hours

Total ratios and speeds:

Speed range	Gear	Number of engine revolutions for one revolution of driving wheel	Nominal traveling speed for rated speed of engine* 2250 rev/min (km/h)
Slow	1	191.387	2.62
	2	110.179	4.56
	3	69.982	7.18
	reverse	155.179	3.42
Fast	4	54.130	9.28
	5	31.349	16.02
	6	19.793	25.37
	reverse	43.889	11.44

*Calculated with a tyre dynamic radius index of 592 mm

Power take off

Main power take-off: Semi independent p.t.o., driven by the second disc of the dual disc clutch
Proportional to engine speed: standard p.t.o. speed 540 rev/min at 1908 rev/min of the engine, 638 rev/min at rated engine speed
Proportional to ground speed take-off: 19.332 revolutions of the p.t.o. to 1 revolution of rear wheels; 0.193 m distance covered to 1 revolution of p.t.o.
P.T.O. 34.9 mm dia with 6 splines in accordance with ISO 500 type 1; 254 mm rear of the rear axle centre line, 605 mm above ground in median plane of the tractor; direction of rotation: clockwise viewed from rear of the tractor; p.t.o. speeds can be set by aid of tractor meter

Power lift: Own make; hydraulic power lift in unit construction; gear type oil pump directly driven by engine feeds oil to the single ram cylinder; single control valve for lifting, lowering, floating position, draft and position-control; top-link control; maximum working pressure 17 MPa, overpressure relief valve setting: 14.7 ± 0.5 MPa; one external oil tapping

	Oil from gear box and rear axle housing 19.2 l; 10 l of oil may be taken off on exterior oil tapping; recommended oil type acc. API service classification: service CC; viscosity SAE 30; recommended oil change period 1600 hours
Implement linkage:	Three point linkage category I according to ISO 730/I Length of lift rods: 410–490 mm Length of lower links: 820 mm Length of top link: 570–820 mm Lifting range above ground: 255–935 mm
Holed bar:	Short bar; fitted on clevis of lower links; width 80 mm, thickness 32 mm, centre hole and 3 holes on each side 22 mm dia at 80 mm distance, height above ground 210 to 940 mm; distance of centre hole with lower links in horizontal position: from axle centre 824 mm from p.t.o. shaft end 584 mm
Swinging drawbar:	Optional; not fitted on tractor tested; reversible, height above ground adjustable 265–460 mm, hitch hole diametre 25 mm, distance of hitch hole centre adjustable by shifting of the bar; from p.t.o. shaft end: 360 or 440 mm; from rear axle centre: 615 or 695 mm; lateraly swingable: 195–220 mm to either side. Distance of pivot point to rear axle centre: 68 mm forward
Pull attachment:	Height above ground 350 or 420 mm; horizontal distance from rear axle: 334 mm: maximum admissible vertical load 1100 kg; position relative to p.t.o.: vertical: 260 mm or 190 mm below horizontal: 80 mm rear hitch hole diameter: 28 mm
Steering:	Own make; mechanical globoid worm type, operated by hand wheel
Brakes	
Service brake:	Band brakes, mechanically acting on drums on differential half shafts; pedal operated
Steering brake:	Divided pedal on service brake; for normal use locked together
Parking brake:	Operated by hand lever with ratchet; mechanically acting on service brakes

Braking of trailers: Optional pneumatic system for braking of trailers fitted; vertical, single cylinder piston or compressor Prva Petoletka, Trstenik, directly driven by engine without possibility of disengaging; working pressure 40 kPa; capacity of pneumatic reservoir 9 l; system activated via service brakes' pedals

Wheels

Steering and driving wheels: 2 pneumatics at front 5.50–16; 6 ply; maximum permissible weight on each tyre 4.25 kN at 250 kPa pressure; track width 1200–1700 mm, adjustable by extending telescopic half axles

Driving wheels: 2 pneumatics at reav 12.4/11–28; 6 ply; maximum permissible weight on each tyre 11.75 kN at 150 kPa pressure; track width 1305, 1405, 1505, 1605, 1705 mm, adjustable by wheels and offset lug type rims

Wheelbase: 1900 mm

Lighting

	Height from ground to centre mm	Dimensions mm	Distance from outside edge of tractor to centre* mm
Headlights	1010	ϕ 115	690
Side lights	1220	65 x 120	220
Rear lights	1330	120 x 95	290
Reflector	1370	ϕ 110	305

*At track width 1305 mm

Number of grease points: 9 (whole tractor)

Overall dimensions:

	Length m	Width m		Maximum height m
		max	min	
With ballast	3.35	2.04	1.64	2.35
Without ballast	3.10	2.04	1.64	2.35

Ground clearance: 425 mm (at differential); 370 mm (at pneumatic reservoir)

Overturning protection frame: Šolinc, Šentjur, overturning protection frame

Seat: Own make; upholstered seat with back rest. Mechanical suspension adjustable to driver's mass. Damping by hydraulic shock absorber; range of vertical adjustment 80 mm; range of horizontal adjustment 65 mm

CONDITIONS DURING TEST

Masses:

Tractor without driver but with tanks full

	Front kg	Rear kg	Total kg
Without ballast	610	1105	1715
With ballast	720	1305	2025

Ballast:

	No. of weights	Total mass kg	Water kg
Front	3	90	–
Rear	2 x 2	220	–

Track setting:

During test front 1240 mm
rear 1305 mm

FUELS AND LUBRICANTS USED IN TESTS

Laboratory and track tests:

Fuel: INA D-2

Density at 15°C	0.836 kg/dm³
Viscosity at 50°C	2.6 cSt
Cetane number	53
Conforms to standard	JUS.B.H2.411

Engine, transmission and hydraulic oil: INA Super 3 SAE 30

Viscosity at 50°C	8°E

COMPULSORY TESTS

(1) Main power take-off performance

Date and location of tests: 1982. 10. 25. Zagreb
Type of dynamometer: SCHENK hydraulic dynamometer Ul-40

Power	Speed		Fuel consumption		Specific energy
kW	Engine rev/min	p.t.o. rev/min	Hourly l/h	Specific kg/kWh	kWh/l
Maximum power – 2 hour test					
32.2	2283	646	10.6	0.275	3.04
The speed recommended by manufacturer for drawbar work					
32.2	2283	646	10.6	0.275	3.04
Part loads – at rated engine speed (i) 85 per cent of the torque obtained at maximum power					
27.6	2311	654	9.1	0.274	3.05
(ii) unloaded					
0	2364	669	3.2	–	–
(iii) half of the torque defined in (i)					
14.0	2360	668	5.8	0.347	2.41
(iv) the torque corresponding to maximum power					
32.2	2283	646	10.6	0.275	3.04
(v) one – quarter of the torque defined in (i)					
7.1	2360	668	4.4	0.525	1.59
(vi) three – quarters of the torque defined in (i)					
21.0	2346	664	7.4	0.295	2.83

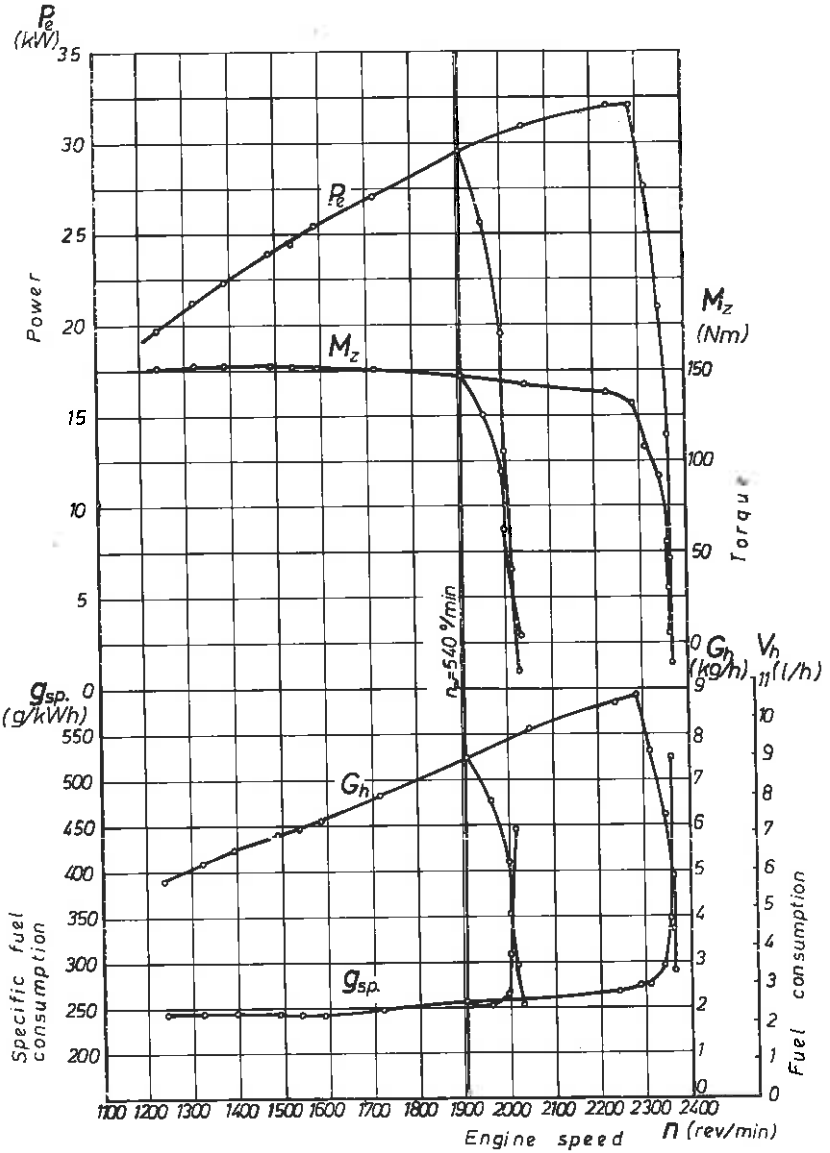
Power kW	Speed		Fuel consumption		Specific energy kWh/1
	Engine rev/min	p.t.o. rev/min	Hourly 1/h	Specific kg/kWh	
Part loads – standard speed of the p.t.o. (540 rev/min) (i) 85 per cent of the torque obtained at maximum power					
25.6	1957	554	7.8	0.254	3.29
(ii) unloaded					
0	2028	574	2.5	–	–
(iii) half the torque defined in (i)					
13.1	2000	566	4.8	0.309	2.71
(iv) the torque corresponding to maximum power available					
29.4	1908	540	9.0	0.256	3.27
(v) one – quarter of the torque defined in (i)					
6.6	2014	570	3.5	0.443	1.89
(vi) three – quarters of the torque defined in (i)					
19.6	1996	565	6.2	0.265	3.15

STANDARD SPECIFIC FUEL CONSUMPTION (kg/kWh)

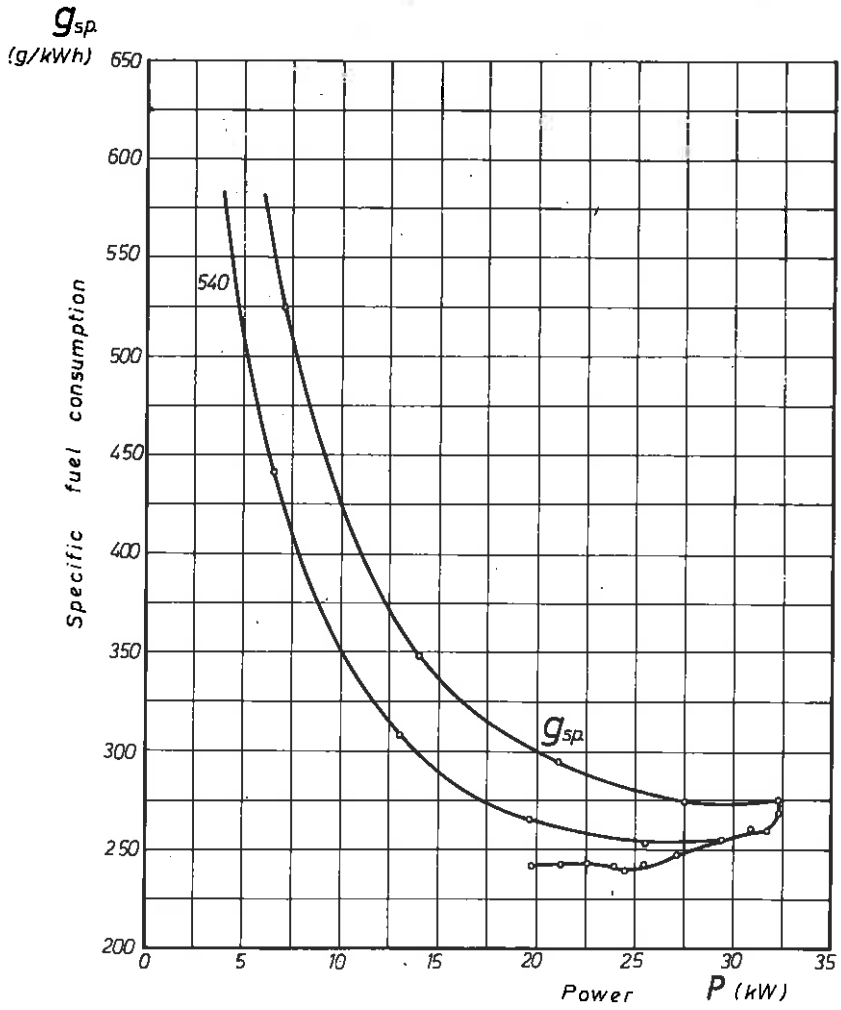
a (i) 0.274
a (iii) 0.347
b (i) 0.254
b (iii) 0.309

No load maximum engine speed:		2364 rev/min
Equivalent crankshaft torque at maximum power:		134.6 Nm
Maximum torque:		153.8 Nm at 1400 rev/min of the engine
Mean atmospheric conditions:	temperature	17 °C
	pressure	101.1 kPa
	relative humidity	58 per cent
Maximum temperatures:	coolant	84 °C
	engine oil	140 °C
	fuel	26 °C
	engine air intake	21 °C

Tractor „ŠTORE" 502



Tractor „ŠTORE" 502



(2) **DRAWBAR PERFORMANCE**

Date of tests: 1982. 12. 7–8.; 19 5. 13–14.

Type of track: tarmacadam

Height of drawbar above ground:
unballasted and ballasted: 385 mm
Tyre inflation pressure: front: 250 kPa
unballasted and ballasted: rear. 100 kPa

Gear	Speed	Power	Drawbar pull	Engine speed	Wheel-slip	Specific fuel consumption	Specific energy	Temperature			Atmospheric conditions		
								fuel	co-olant	oil	tempe-rature	relative humi-dity	pres-sure
	km/h	kW	N	rev/min	per cent	kg/kWh	kWh/l	°C	°C	°C	°C	per cent	kPa
	(i) MAXIMUM POWER (UNBALLASTED)												
1	2.22	7.43	12066	2234	15.2	0.567	1.47	5	83	80	6	82	101.5
2	3.94	13.4	12263	2270	14.8	0.423	1.98	5	83	92	6	82	101.5
3	6.55	21.6	11870	2288	11.0	0.370	2.26	6	83	98	7	80	101.5
4	8.45	27.2	11567	2265	10.4	0.330	2.53	6	83	96	8	76	101.5
5	15.52	27.5	6377	2254	4.0	0.323	2.59	7	83	98	8	76	101.5
	(ii) MAXIMUM POWER (BALLASTED)												
1	2.33	9.51	14715	2281	15.3	0.526	1.59	7	83	78	9	90	100.9
2	4.02	16.7	14911	2256	15.0	0.407	2.05	8	83	92	10	90	100.9
3	6.36	25.1	14225	2236	12.3	0.360	2.32	8	83	98	10	90	100.9
4	8.42	28.2	12066	2222	7.8	0.322	2.60	8	83	98	10	90	100.9
5	15.25	28.3	6671	2192	5.6	0.320	2.61	9	83	96	11	90	100.9
	(iii) FIVE HOUR TEST AT 75 PER CENT OF PULL AT MAXIMUM POWER												
3	6.87	20.4	10670	2283	9.6	0.383	2.18	49	83	96	26	65	101.3
	(iv) FIVE HOUR TEST AT PULL CORRESPONDING TO 15 PER CENT WHEELSLIP IN TEST (ii)												
2	4.14	17.1	14911	–	–	–	–	54	85	93	26	52	101.2

Oil consumption during ten hours' testing (iii) and (iv): 30 g/h

(3) TURNING SPACE AND TURNING CIRCLE

Details of wheel equipment:	Tractor without ballast
Tyres:	front: 5.50–16 PR-6
	rear: 12.4/11–28 PR-6
Track of wheels:	front: 1240 mm
	rear: 1305 mm

	With brakes		Without brakes	
	left-hand m	right-hand m	left-hand m	right-hand m
Radius of turning space	3.17	3.07	3.48	3.47
Radius of turning circle	3.09	2.99	3.40	3.39

(4) LOCATION OF CENTRE OF GRAVITY

Height above ground:	873 mm
Distance forward from the vertical plane containing the axis of the rear wheels:	640 mm
Distance from the medium plane:	to left 5.5 mm

(5) BRAKING

Date of tests: 1982. 12. 9.
Tractor masses during brake tests

	Front kg	Rear kg	Total kg
Ballasted	710	1400	2110
Unballasted	616	1188	1804

Type 0 (ordinary cold service braking device performance) test
Speed before application of brakes 26.7 km/h

Ballasted	Braking device control force N	100	260	350	560	Locked 800
	Mean deceleration m/s^2	1.3	1.7	2.0	2.9	3.6
Unballasted	Braking device control force N	180	350	520	650	Locked 770
	Mean deceleration m/s^2	1.0	1.6	2.2	3.1	3.4

Type I (fade) test

Braking device control force N	200	320	410	500	Locked 700
Mean deceleration m/s^2	1.7	2.2	2.8	3.0	4.2

Maximum deviation of tractor from its original course: 0 m
Abnormal vibrations: None
The brakes were heated by: The first method

Parking braking device test

	18 per cent slope		12 per cent slope with trailer of 1.7 tone	
	up	down	up	down
Braking device control force N	275	285	280	295

(6) MEASUREMENT OF EXTERNAL NOISE LEVEL

Date of tests: 1982. 12. 7.
Type of sound level meter: Bruel &Kjaer Type 2203
Type of track: Tarmacadam
Results of tests:
Gear: 6.

Travelling speed before acceleration: 20.7 km/h
Sound level: 91.0 dB(A)

(7) NOISE MEASUREMENTS – AT THE DRIVER'S EAR

Date of tests: 1982. 12. 7.
Type of sound level meter: Bruel &Kjaer Type 2203
Type of track: Tarmacadam
Cab fitted: No

Results of tests:

Gear	Drawbar pull at which the tractor develops the maximum sound level kN	Measured travelling speed km/h	Sound level dB(A)
3*	11.9	6.55	102.5
3*	light load	7.74	97.0
6	light load	27.7	97.2

*The 3rd gear corresponds to the nominal travelling speed nearest to 7.5 km/h

(8) POWER LIFT AND HYDRAULIC PUMP PERFORMANCE

Date and location of tests: 1983. 5. 19. Zagreb

Hydraulic fluid

Make and type: INA Super 3 – SAE 30
Viscosity: 8°E/50°C
Viscosity index: min 95
Type of linkage lock for transport: Hydraulic

Power lift

	Height of hitch point above ground in down position mm	Vertical movement mm	Maximum force exerted through full range kN	Corresponding pressure of hydraulic fluid MPa	Moment about real axle kNm	Maximum tilt angle of implement linkage over range of lift degrees
At hitch points	250	675	12.6	14.3	10.38	–
On the frame	275	730	9.34	14.3	13.39	6

Temperature of hydraulic fluid at start of tests 62°C

Hydraulic pump performance

Opening pressure of relief valve: 14.7 MPa
Sustained pressure with relief valve open: 14.3 MPa
Pump delivery rate at minimum pressure, the governor control level being set for maximum pover: 25.0 l/min
Hydraulic power at 90 per cent of relief valve setting: 4.4 kW
Corresponding: delivery rate: 20.3 l/min
pressure: 12.9 MPa
Temperature of hydraulic fuel: 68 °C

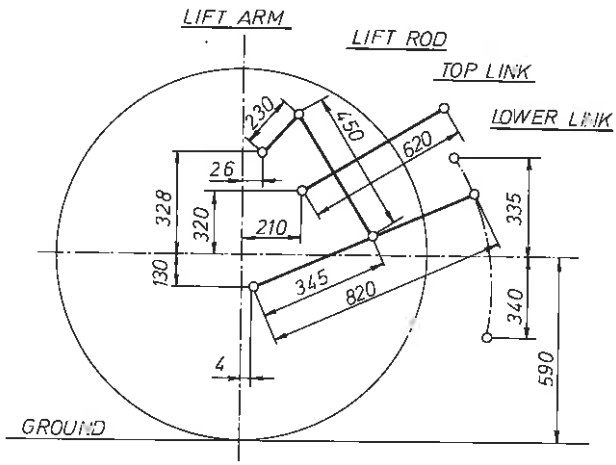
Linkage geometry

Projected length in side wiew:

Lower links:	820 mm
Lift arms:	230 mm
Lift rods:	410–490 mm
Top link:	570–820 mm
Distance of lift rod connection point from pivot point of lower link:	345 mm

The following dimensions are given relative to the rear wheel centre line, situated 590 mm above the ground level

Lower link pivot point	4 mm behind, 130 mm below
Top link pivot point	210 mm behind, 320 mm above
Lift arm pivot point	26 mm behind, 328 mm above
Maximum and minimum height of lower hitch points	335 mm above, 340 mm below
Height of lower link hitch points when locked in transport position	335 mm above



Date: 5th September 1983.
Head of Testing Division: Dr Ivan Piria
Director: Dr Ivan Todorić