O. E. C. D. Report No. 330

Report on test in accordance with

O. E. C. D. Test Code for Agricultural Tractors

SATOH TRACTOR S-650G

Manufactured by: Satoh Agricultural Machine Mfg. Co., Ltd., Shimane Japan



Test No. : 45001/O.E.C.D.

Date of test: March–April 1970

This report has been approved by the O.E.C.D. Coordinating Centre (C.N.E.E.M.A., France) as being in accordance with the O.E.C.D. Tractor Test Code
Date of Approval: 29th May, 1970 Serial NO. : 330

INSTITUTE OF AGRICULTURAL MACHINERY

OMIYA SAITAMA JAPAN

TABLE OF CONTENTS

	page	fig.
Specification of tractor	3	
Fuels and lubricants used in tests	7	
Compulsory tests	8	
Power take-off	8	1
Drawbar	10	2, 3 and 4
Turning space and turning circle	11	
Location of centre of gravity	11	
Braking	11	
Noise measurement	12	
Power lift and hydraulic pump performance	13	
Repairs and adjustments, remarks	14	
Performance curves	15~18	

Tractor manufacturer:	Satoh Agricultural Machine Mfg. Co., Ltd. Shimane, Japan
Submitted for test by:	The manufacturer
Selected by:	The manufacturer with the agreement of the I. A. M.
Place of running-in:	Satoh Limited
Duration of running-in:	68 hours

SPECIFICATION OF TRACTOR

Tractor

Make:	Satoh Agricultural Machine Mfg. Co., Ltd.
Model:	Satoh tractor S-650G
Type:	Gasoline tractor, four wheel
Serial No.:	000823

Engine

Make:	Toyo Kogyo Co., Ltd.
Model:	PB
Type:	Water cooled 4 stroke gasoline engine
Serial No.:	010620
Cylinders:	4 cylinders, vertical in line, 68 mm bore x 68 mm stroke, capacity 987 cm^3, compression ratio 8.6 : 1, overhead valves, replaceable wet cylinder liners
Fuel system:	Mechanical diaphragm type fuel feed pump, TOKYO ROKI replaceable cartridge-type paper filter, fuel tank capacity 36 1, HANSHIN TRANSFORMER HP5-10E_4 coil, MITSUBISHI ELECTRIC TVD-4MR distributor, NIHON CARBURETOR 210028-061 carburetor, main jet dia 0.77 mm, slow jet dia 0.44 mm, power jet dia 0.45 mm, ignition timing 13° before TDC, NIHON TOKUSHU TOGYO B6E spark plugs
Governor:	KOSHIDA SHOKO centrifugal variable speed governor, governed range of engine speed 700 - 3150 rev/min, rated engine speed 2800 rev/min
Air cleaner:	TOKYO ROKI oil bath type, oil capacity 0.25 1, pre-cleaner none
Lubrication system:	Forced feed from gear-type pump with metal strainer in sump, replaceable cartridge-type paper element full flow filter, oil capacity 3 1, recommended oil change period 100 hours, cartridge change period 100 hours

Cooling system:	Water cooled, impeller assisted with 320 mm dia 4-blade belt driven fan, thermostat for temperature control, cooling water capacity 7 1, pressurized at 0.7 kg/cm^2
Starting system:	Electrical, 12V NIPPON DENSO 28000-289-0, solenoid engaged starter motor, choke valve cold starting aid
Electrical system:	Voltage 12, MITSUBISHI ELECTRIC AC2020V generator, YUASA BATTERY N40L battery, capacity 40Ah

Transmission

Clutch:	DAIKIN single dry clutch, 184.2 mm dia plate, operated by single foot pedal
Gearbox:	Own make, mechanical type with sliding gear and constant-mesh, 2-stage group gear giving 6 forward speeds and 2 reverse
Rear axle and final drive:	Own make, crown wheel and bevel pinion with spur gear final drives, pedal operated mechanical differential lock
Oil capacity:	Gearbox and final drives 17 1, recommended oil change period 600 hours

Gear ratios and speeds

Gear No.	Number of engine revolutions for one revolution of driving wheel	Nominal travelling speed for rated speed of engine km/h
Forward		
1	422.2	1.30
2	294.7	1.86
3	220.3	2.49
4	153.7	3.57
5	77.9	7.05
6	40.7	13.50
Reverse		
1	223.9	2.45
2	116.8	4.70

Power take-off	Main: at rear of tractor, 1 3/8 in (34.9 mm) dia 6-spline acc. to SAE standard, height above ground 526 mm, proportional engine speed giving 540 and 1092 rev/min at 2800 rev/min rated engine speed, 1000 rev/min at 2564 rev/min engine speed, direction of rotation clockwise viewed from driving end Optional, (not fitted on tractor tested: figures acc. to manufacturer's specification) p.t.o. in the middle of tractor: 1 3/8 in (34.9 mm) dia 6-spline acc. to SAE standard, height above ground 352 mm, proportional engine speed giving 560 and 1073 rev/min at 2800 rev/min rated engine speed, engine speed 2700 rev/min at standard p.t.o. speed 540 rev/min, direction of rotation anti-clockwise viewed from driving end
Belt pully	Optional, (not fitted on tractor tested: figures acc. to manufacturer's specification) At rear of tractor, main p.t.o. driven, 203 mm dia x 104 mm face width, 540 and 1092 rev/min, 344.7 and 696.3 m/min at 2800 rev/min rated engine speed, direction of rotation clockwise viewed from driving end
Power lift	Own make, hydraulic, gear type pump directly from engine, supplies oil to a single acting ram and external hydraulic valve (optional), maximum oil pressure 115±5 kg/cm^2, oil capacity 3.5 l, Category 1 implement linkage (see page 14), control for position
Drawbar	
Linkage drawbar	Optional, drawbar fixed on lower links with central hole and 3 holes 80 mm apart either side of centre line, vertical adjustment from 225 mm to 866 mm changed by adjustable stay links, distance behind rear axle with lower links horizontal 775 mm, position relative to p.t.o. 518 mm to rear
Swinging drawbar	Optional, (not fitted on tractor tested: figures acc. to manufacturer's specification) Clevis type, radius of swing 5 positions, lateral adjustment 420 mm, vertical height to centre of clevis 370 mm, drawbar hole 23 mm dia, distance behind rear axle 514 mm, position relative to p.t.o. 257 mm to rear
Hitch	Clevis type, at rear of tractor, height above ground 350 mm, distance from rear axle 513 mm, position relative to p.t.o. 256 mm
Steering	Worm sector type with single drag link

Brakes

Mechanically acting as internal shoe type, acting on brake drums on differential half shafts, operated by foot pedals, operated independently or together by pedals, fixed by ratchet both pedals of the foot brake for parking

Wheels

Steering wheels: Two at front, Goodyear Super Rib 5.00-15 tyres, 4 ply rating, maximum permissible weight on each tyre 350 kg at 2.6 kg/cm^2 pressure, track widths 1040-1341 mm by 4 steps changed by extending front axle and reversing

Driving wheels: Two at rear, Goodyear Sure Grip 11.2/10-24 tyres, 4 ply rating, maximum permissible weight on each tyre 787 kg at 1.13 kg/cm^2 pressure, track widths 1017-1313 mm by 7 steps changed by reversing wheel and offset lugs on rims

Wheel base: 1535 mm

Tractor and ballast weights

(Without driver but with tanks full)

	Front kg	Rear kg	Total kg
Without ballast	324	637	961
With ballast	446	1002	1448

Ballast

	No. of weights	Total weight kg	Water kg
Front	4	130	-
Rear	6	204	153

Seat

TOYO SEAT, seat with rubber damper, pan seat with cution, range of adjustment 45 mm fore and aft

Number of grease points

Whole tractor: 16

Overall dimensions

	Length m	Width m	Height m
With ballast	2670	1540	1360
Without ballast	2670	1400	1360

Remarks: Length with three point linkage
Width at 1115 mm track of rear wheel
Height to top of steering wheel

Lighting

	Height above ground of centre cm	Size cm	Distance from outside edge of tractor to centre cm
Headlights	87	11 dia	41

FUELS AND LUBRICANTS USED IN TESTS

Laboratory tests

Fuel: Gasoline, specific gravity 0.750 at 15°C, Octane No. 94

Engine oil: Shell motor oil X-100

Transmission oil: Shell Dentax 90

Track tests

Fuel: Gasoline, specific gravity 0.750 at 15°C, Octane No. 94

Engine oil: Shell motor oil X-100

Transmission oil: Shell Dentax 90

COMPULSORY TESTS

(1) MAIN POWER TAKE-OFF PERFORMANCE

Date and location of tests : 11th April, 1970; I.A.M., Omiya, JAPAN

Type of dynamometer : DC Electrical, MEIDENSHA EB-DH

Horsepower (metric) hp	Speed		Fuel consumption		
	Engine rev/min	p.t.o. rev/min	l/h	g/metric hph	metric hph/l
MAXIMUM POWER - 2 hours test					
21.3	2830	546	7.41	262	2.87
STANDARD p.t.o. SPEED (540 rev/min)					
21.2	2800	540	7.44	261	2.85
PART LOADS					
(i) 19.1	2975	574	7.04	275	2.71
(ii) 0	3172	612	2.85	-	-
(iii) 9.9	3095	597	4.74	356	2.09
(iv) 21.3	2830	546	7.41	262	2.87
(v) 5.1	3126	603	3.86	565	1.32
(vi) 14.7	3069	592	5.68	287	2.59

No load maximum engine speed: 3172 rev/min

Equivalent crankshaft torque at maximum power: 5.40 kgm

Maximum torque: 5.60 kgm at 2177 rev/min of the engine

Means atmospheric conditions:
temperature: 18°C
pressure: 762 mmHg
relative humidity 69 %

Maximum temperature:
coolant: 79°C
engine oil: 111°C
fuel: 20°C

(*) The recommended speed for drawbar work was not expressly specify by the manufacturer.

The following results were obtained with the p. t. o. in high ratio:

Date and location of tests: 25th April 1970; I. A. M., Omiya, JAPAN

Horsepower (metric) hp	Speed		Fuel consumption		
	Engine rev/min	p. t. o. rev/min	1/h	g/metric hph	metric hph/1
MAXIMUM POWER - 2 hours test					
22. 3	2820	1100	7. 30	244	3. 05
STANDARD p. t. o. SPEED (1000 rev/min)					
20. 8	2564	1000	6. 63	237	3. 14

Means atmospheric conditions:
temperature: 17°C
pressure: 767 mmHg
relative humidity: 55 %

Maximum temperature:
coolant: 81°C
engine oil: 110°C
fuel: 22°C

(2) DRAWBAR PERFORMANCE

Date of tests: 15th to 21st April, 1970
Type of track: Concrete
Height of drawbar above ground: 330 mm

Gear No.	Speed km/h	Horse-power (metric) hp	Draw-pull kg	Engine speed rev/min	Slip of wheels %	Fuel Consumption		Temperature			Atmospheric conditions		
						Metric draw-bar hph/l	g/metric drawbar hph	Fuel °C	Coolant °C	Egnine oil °C	Temper-ature °C	Relative humidity %	Pressure mmHg
	(i) MAXIMUM POWER (ballasted)												
1	1.23	4.1	900	3090	14.1	0.96	763	36	75	90	15	55	773
2	1.75	5.9	900	3084	13.3	1.22	601	36	76	96	16	58	773
3	2.31	7.7	900	3050	15.3	1.58	464	36	74	95	17	54	773
4	3.30	*11.0	900	3053	15.1	1.87	392	36	74	98	18	56	773
5	6.21	16.9	720	2773	10.2	2.14	342	34	75	98	19	52	773
6	13.00	16.8	350	2836	4.0	2.08	352	36	74	98	19	52	773
	(ii) FIVE HOUR TEST at 75% of pull at maximum power												
5	7.02	14.0	540	3012	6.7	2.33	315	37	74	96	15	53	766
	(iii)+ FIVE HOUR TEST at pull corresponding to 15% wheelslip in test (i)												
4	3.44	-	900	-	-	-	-	40	71	97	16	49	758
	(iv) MAXIMUM POWER (unballasted)												
1	1.24	3.8	830	3093	12.9	-	-	34	69	92	17	54	761
2	1.76	5.4	830	3110	14.2	-	-	40	67	88	18	55	761
3	2.31	7.1	830	3099	15.3	-	-	42	72	92	18	60	761
4	3.32	*10.2	830	3087	14.9	-	-	44	72	94	19	67	761
5	6.2	17.0	740	2877	14.2	-	-	36	76	99	21	60	761
6	12.85	17.1	360	2877	6.3	-	-	39	76	100	22	62	761

Total oil consumption during ten hours duration of tests (ii) and (iii): 4.0 g/h

* Maximum power available at 15% wheelslip.

\+ Test (iii) was carried out with additional ballast and the results for power, slip and fuel consumption have no practical significance.

(3) TURNING SPACE AND TURNING CIRCLE

Details of wheel equipment: As in specification, without ballast

Track of wheels: front 1040 mm rear 1115 mm

Results	With brakes		Without brakes	
	right-hand m	left-hand m	right-hand m	left-hand m
Radius of turning space	2.54	2.50	2.73	2.69
Radius of turning circle	2.43	2.39	2.62	2.58

(4) LOCATION OF CENTRE OF GRAVITY

mm

Height above ground	655
Distance forward from the vertical plane containing the axis of the rear wheels	486
Distance from the median plane	0

(5) BRAKING

Date of tests: 23rd April, 1970

Type of track: Concrete

Type of decelerometer: YOSHIDA SEIKI Co., Ltd., Type 106-2C

Weight of ballasted tractor: 1448 kg

COLD BRAKES

	Ballasted	Without ballast
Travelling speed of the tractor km/h	15.0	15.0
(i) Deceleration m/s^2	6.6	6.0
(ii) Stopping distance m	1.8	1.9
(iii) Force exerted on the brake pedal kg	30.0	23.0
(iv) Force exerted on the brake pedal to achieve a deceleration of 2.5 m/s^2 kg	10.5	10.5

BRAKE FADE CHARACTERISTICS (hot tests)

		Ballasted	Without ballast
Deceleration hot/deceleration cold x 100	%	100	100
Stopping distance cold/stropping distance hot x 100	%	100	100
Force on pedal, cold/force on pedal, hot x 100	%	100	100

PARKING BRAKE

Efficiency of parking latch: Satisfactory facing up and down slope

(6) MEASUREMENT OF AMBIENT NOISE

Date of tests: 27th April, 1970

Type of sound level meter: RION type NA-07A

Type of track: Concrete

Results of tests:

Gear	6th
Travelling speed	15.0 km/h
Sound level	80 dB(A)

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

Date of tests: 27th April, 1970

Type of sound level meter: RION type NA-07A

Type of track: Concrete

Type of frequency analyser: RION type SA-55

Results of tests

Gear	Travelling speed km/h	Sones
5th	6.17	114

(8) POWER LIFT AND HYDRAULIC PUMP PERFORMANCE

Date and location of tests: 13th April, 1970; I. A. M., Omiya, JAPAN

Hydraulic fluid

make and type: IDEMITSU Hydraulic Fluid Daphne 52

viscosity: 7.58 cSt (98.9°C)

viscosity index: 103

	Height above ground in down position		Vertical movement	Maximum force exerted through full range	Pressure	Lifting force when front of tractor lifts
	hitch point mm	frame mm	mm	kg	kg/cm^2	kg
Linkage giving maximum mechanical advantage						
At hitch points	425	-	441	535	116	625
On the frame	-	436	776	312	116	353
Linkage giving minimum mechanical advantage						
At hitch points	222	-	482	485	116	625
On the frame	-	232	572	433	116	353

Type of linkage lock for transport: Hydraulic

Opening pressure of the cylinder over pressure relief valve (manufacturer's figures): 270 – 290 kg/cm^2

Pump characteristics

i - opening pressure of the relief valve (manufacturer's figures): 115±5 kg/cm^2

- sustained pressure by the open relief valve: 115 kg/cm^2

ii - pump delivery rate at minimum pressure and rated engine speed: 18.2 l/min

iii - pump delivery rate: 16.3 l/min
delivery pressure: 100 kg/cm^2
power: 3.6 metric hp

REPAIRS AND ADJUSTMENTS DURING TESTS

During the preliminary adjustments fuel pump was replaced.

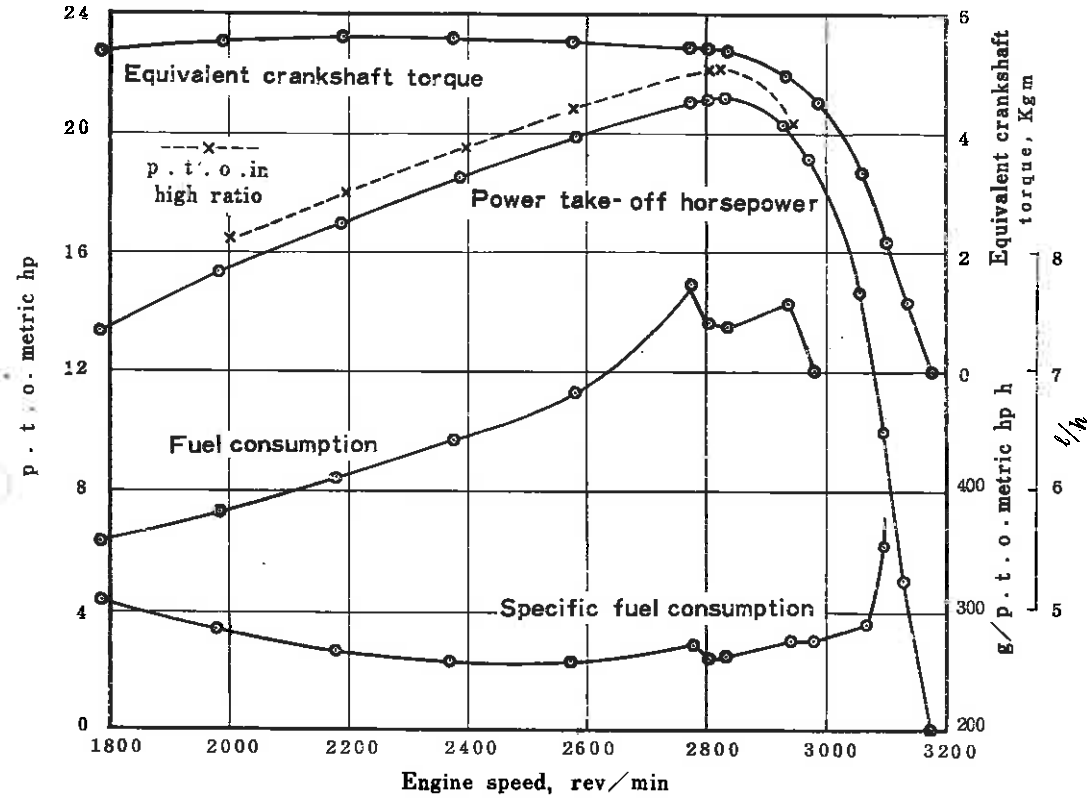
REMARKS

After checking up the three point linkage, the length of upper link pin was found not in conformity with Category I.
The manufacturer states that the pin is to be produced in accordance with Category I from June 1970.

Officer in charge : S. ARAI

Head of Testing Division : K. OGAWA

Date : 12th May, 1970



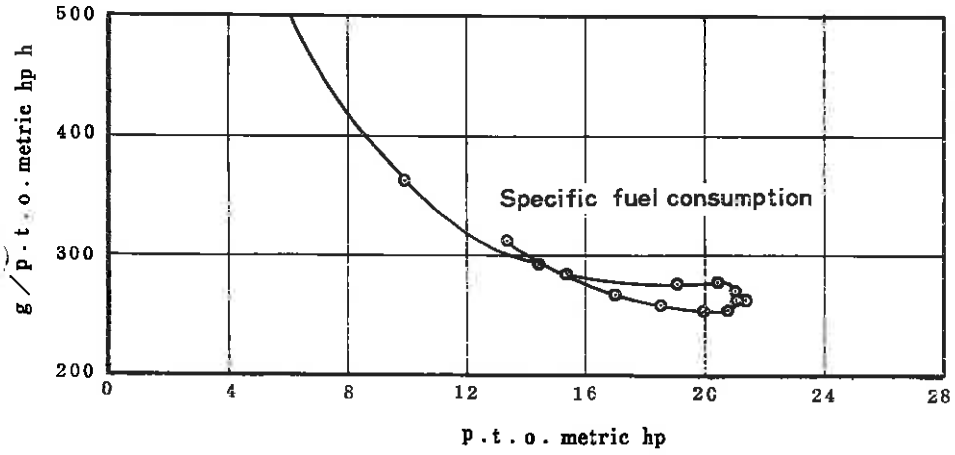


Fig . 1 . Power take-off test

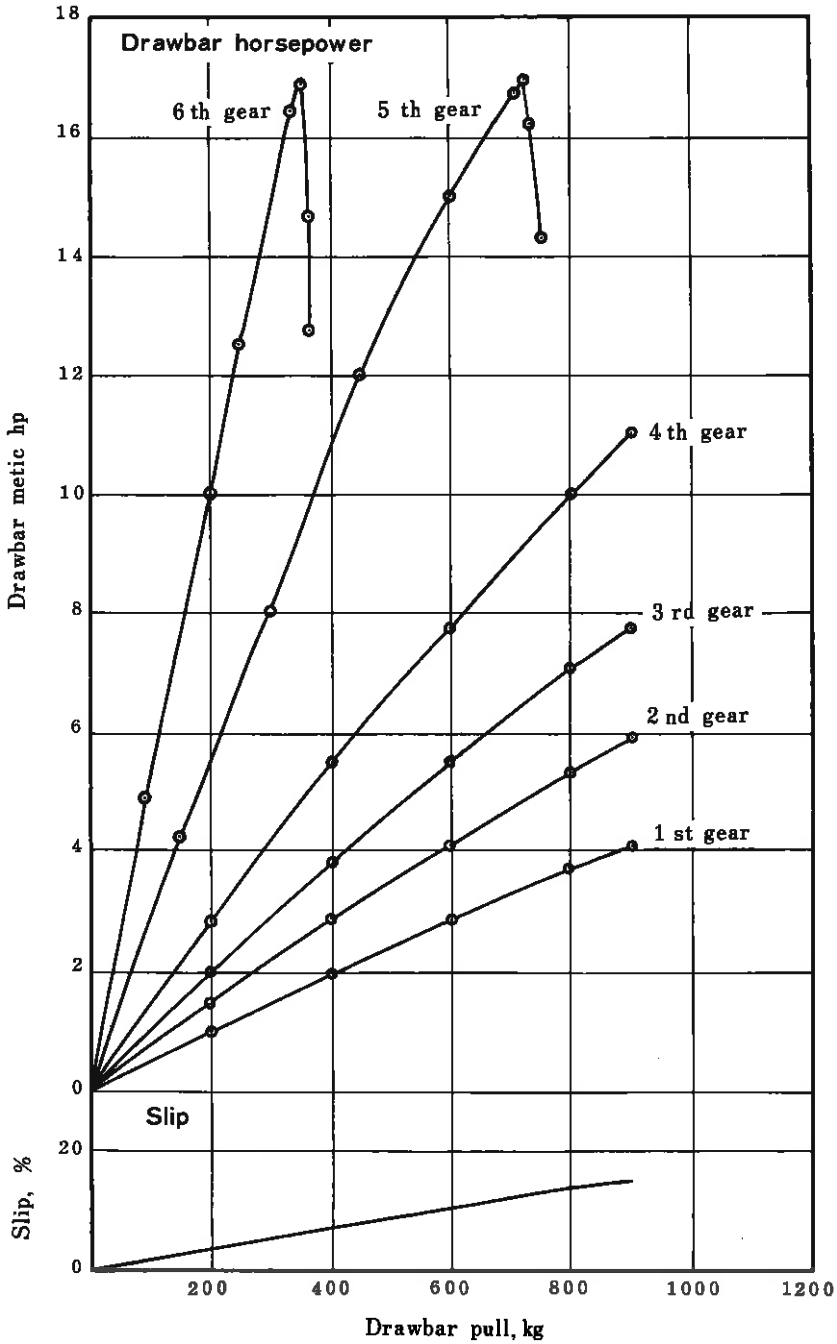


Fig · 2 . Drawbar-test on concrete, with ballast

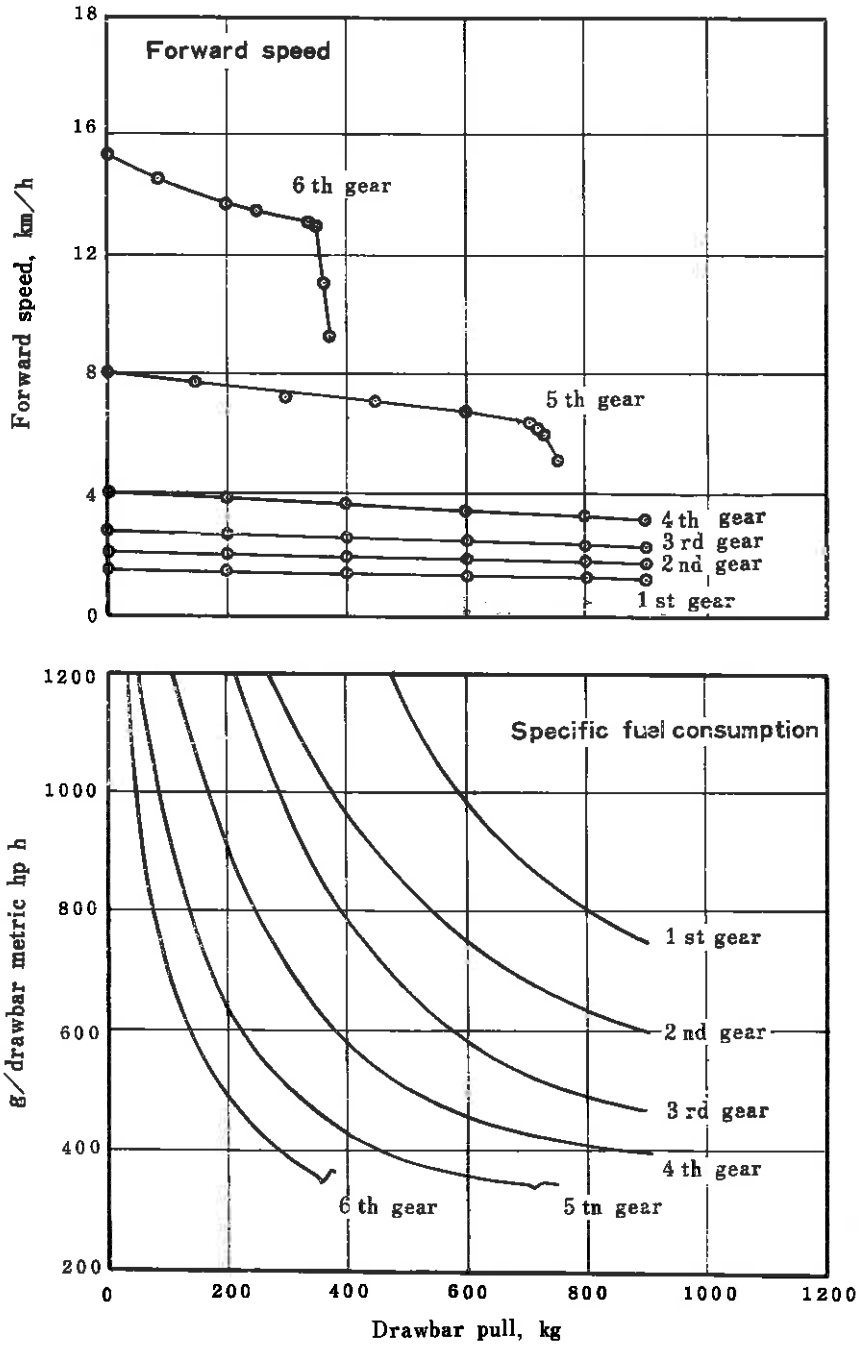


Fig. 3 . Drawbar test on concrete, with ballast

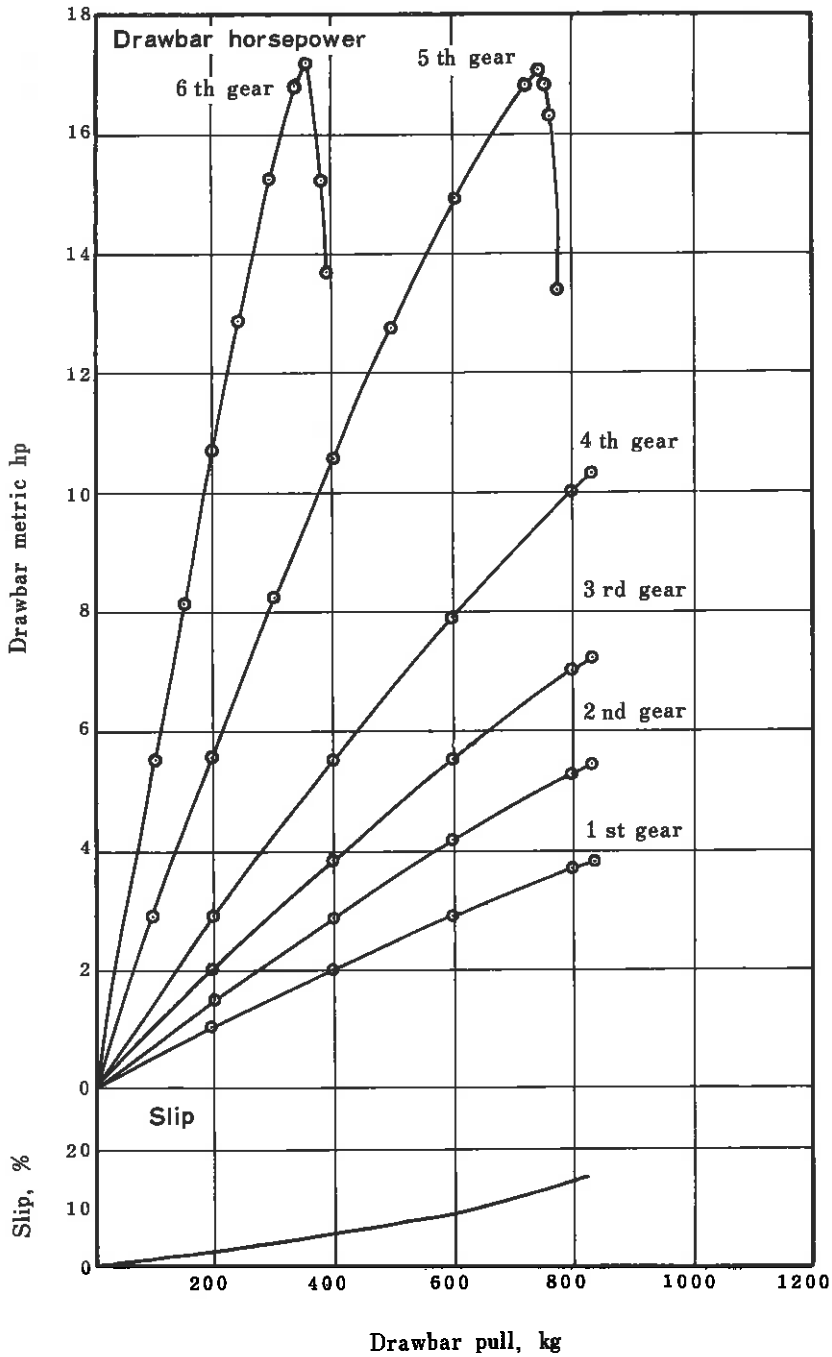


Fig. 4 . Drawbar test on concrete, without ballast