O. E. C. D. Report No. : 476

Report on test in accordance with

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

# MITSUBISHI FARM TRACTOR D 2000

*Manufactured by :* Mitsubishi Heavy Industries Ltd.
Sagamihara Machinery Works,
Kanagawa, Japan



*Test No. : 49008/O.E.C.D.*
*Date of test : September - October 1974*

*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 : 16th September, 1975 Serial No. : 476*

INSTITUTE OF AGRICULTURAL MACHINERY

OMIYA SAITAMA JAPAN

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| | |
|---|---|
| Tractor manufacturer: | Mitsubishi Heavy Industries Ltd.<br>Sagamihara Machinery Works<br>Kanagawa, Japan |
| Submitted for test by: | The manufacturer |
| Selected by: | The manufacturer with the agreement of the I. A. M. |
| Place of running-in: | Mitsubshi Limited |
| Duration of running-in: | 60 hours |

## SPECIFICATION OF TRACTOR

Tractor

| | |
|---|---|
| Make: | Mitsubishi Heavy Industries Ltd. |
| Model: | Mitsubishi farm tractor D 2000 |
| Type: | Four wheel, rear wheel driven |
| Serial No.: | M62-70935 |

Engine

| | |
|---|---|
| Make: | Mitsubishi Heavy Industries Ltd. |
| Model: | MITSUBISHI 2DR5 |
| Type: | Water cooled, 4 stroke, indirect injection diesel |
| Serial No.: | 11030 |
| Cylinders: | 2 cylinders, vertical in line, 92mm bore x 98 mm stroke, capacity 1302 $cm^3$, compression ratio 20 : 1, overhead valves, monoblock construction |
| Fuel system: | Gravity feed, TOKYO ROKI replaceable paper filter, fuel tank capacity 20 l, NIPPON DENSO PES2A injection pump, serial No. 4M0019, manufacturer's production setting for injection pump; 0.035 $cm^3$/stroke at 2400 rev/min engine speed, NIPPON DENSO ND-DN4SD 24 injector nozzles, injection pressure 125 $kg/cm^2$ |
| Governor: | NIPPON DENSO centrifugal variable speed governor, governed range of engine speed 900- 2640 rev/min, rated engine speed 2400 rev/min |
| Air cleaner: | TOKYO ROKI dry type with replaceable paper element, 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 5 l, recommended oil change period 100 hours, cartridge change period 100 hours, recommended oil viscosity HD SAE 10W/30 |
| Cooling system: | Water cooled, impeller assisted with 325 mm dia 6-blade belt driven fan, cooling water capacity 5.0 l, pressurized at 0.7 $kg/cm^2$ |
| Starting system: | Electrical, 12V MITSUBISHI ELECTRIC MOO5T20071 solenoid engaged starter motor, electrical glow plug and excess fuel injection for cold starting |
| Electrical system: | Voltage; 12, negative earth<br>Generator; MITSUBISHI ELECTRIC AH 2015S |

Battery ; JAPAN STORAGE BATTERY N70, capacity 70Ah at 20 hour rating

Transmission

Clutch : DAIKIN single dry clutch, 210 mm dia plate, operated by single foot pedal

Gearbox : Own make, mechanical type with sliding gear, 3-stage group gear giving 9 forward speeds and 3 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 12 l, final reduction units 0.8 l each, recommended oil change period 600 hours recommended oil viscosity ;
winter SAE 80
summer SAE 90

Gear ratios and speeds

| Gear | Number of engine revolution for one revolution of driving wheel | *Nominal travelling speed for 2400 rev/min rated speed of engine, km/h |
|---|---|---|
| Forward 1 | 562. 89 | 0. 83 |
| 2 | 393. 55 | 1. 19 |
| 3 | 280. 49 | 1. 67 |
| 4 | 193. 89 | 2. 42 |
| 5 | 135. 56 | 3. 46 |
| 6 | 96. 62 | 4. 86 |
| 7 | 73. 01 | 6. 43 |
| 8 | 51. 05 | 9. 19 |
| 9 | 36. 38 | 12. 90 |
| Reverse 1 | 350. 61 | 1. 34 |
| 2 | 120. 77 | 3. 89 |
| 3 | 45. 48 | 10. 32 |

* Calculated with a tyre rolling radius of 519 mm

Power take-off

At rear of tractor, 35 mm dia, 6-spline acc. to JIS standard (see page 14), height above ground 564 mm in tractor's median plane, proportional engine speed giving 530, 750, 1017 and 1265 rev/min rated engine speed, 540 rev/min at 2446 rev/min engine speed, direction of rotation clockwise viewed from driving end

Belt pully

Opitonal, not fitted on tractor tested

Power lift

Own make, hydraulic, gear type pump directly from engine, supplies oil to a single acting ram and 3 external tappings, maximum oil pressure 130 ± 5 kg/cm², JIS 0 implement linkage with nudging system, oil capacity and oil changing period in common with transmission box (see page 2)

Drawbar

Linkage drawbar, optional, not fitted on tractor tested

Hitch

Optional, clevis type, at rear of tractor, height above ground 443 mm, distance from rear axle 389 and 444 mm, position relative to p. t. o. 166 and 221 mm to rear

Steering

Ball and nut 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, OHTSU FO-1 4.00-15 tyres, 4 ply rating, maximum permissible weight on each tyre 290 kg at 3.25 kg/cm² pressure , track width 960 mm

Driving wheels: Two at rear, OHTSU AT-5 9.5/9-24 tyres, 4 ply rating, maximum permissible weight on each tyre 675 kg at 1.2 kg/cm² pressure, track width 965-1115 by 2 steps changed by reversing wheel

Wheel base: 1450 mm

Lighting

| | Height above ground of centre cm | Size cm | Distance from outside edge of tractor to centre cm |
|---|---|---|---|
| Headlights | 101 | 11 dia | 49 |
| Reflectors | 124 | 5 dia | 19 |

Number of grease points: (whole tractor) 9

## CONDITIONS DURING TEST

### Weights

Tractor (Without driver but with tanks full)

| | Front kg | Rear kg | Total kg |
|---|---|---|---|
| Without ballast | 360 | 559 | 919 |
| With ballast | 488 | 681 | 1169 |

Ballast

| | No. of weights | Total weight kg | water kg |
|---|---|---|---|
| Front wheels | 4 | 50 | — |
| Rear wheels | 6 | 140 | — |
| Additional | 3 | 60 | Front flame weights |

Track setting — Front wheels track width 960 mm
Rear wheels track width 1115 mm

Overall dimensions

| | Length m | Width m | | Heights m | |
|---|---|---|---|---|---|
| | | Max. | Min. | With exhaust | Without exhaust |
| With ballast | 2.92 | 1.41 | 1.26 | 1.96 | — |
| Without ballast | 2.77 | 1.39 | 1.24 | 1.96 | — |

Remarks: Length with three point linkage

Seat — TAIYO SEISAKUSHO, seat with rubber damper, pan seat with cushion, range of adjustment 60 mm fore and aft

## FUELS AND LUBRICANTS USED IN TESTS

Fuel: Diesel oil, specific gravity 0.8306 at 15°C, viscosity at 30°C 3.382 cSt, Cetane No. 57, to No. 2 JIS

Engine oil: MITSUBISHI 30 DIAMOND HD, viscosity at 37.8 °C 112 cSt

Transmission oil: 80 FUSO EP, viscosity at 37.8°C 102 cSt

## COMPULSORY TESTS

### (1) MAIN POWER TAKE-OFF PERFORMANCE

Date and location of tests: 27th September, 1974 I. A. M., Omiya, JAPAN

Type of dynamometer: DC Electrical, MEIDENSHA EB-DH

| Horsepower (metric) | Speed | | Fuel consumption | | |
|---|---|---|---|---|---|
| | Engine rev/min | p. t. o. rev/min | l/h | g/metric hph | metric hph/l |
| MAXIMUM POWER - 2 hours test | | | | | |
| 19.4 | 2400 | 529 | 5.07 | 215 | 3.82 |
| STANDARD p. t. o. SPEED (540 rev/min) | | | | | |
| 19.0 | 2446 | 540 | 5.03 | 218 | 3.78 |
| PART LOADS | | | | | |
| (Ⅰ)17.2 | 2509 | 553 | 4.65 | 223 | 3.70 |
| (Ⅱ) 0 | 2622 | 578 | 1.72 | — | — |
| (Ⅲ) 8.8 | 2568 | 566 | 3.12 | 292 | 2.82 |
| (Ⅳ)19.4 | 2400 | 529 | 5.07 | 215 | 3.82 |
| (Ⅴ) 4.5 | 2595 | 572 | 2.39 | 437 | 1.88 |
| (Ⅵ)13.1 | 2545 | 561 | 3.88 | 244 | 3.38 |

| | | |
|---|---|---|
| No load meximum engine speed : | 2622 rev/min | |
| Equivalent crankshaft torque at maximum power : | 5.78 kgm | |
| Maximum torque : | 6.22 kgm at 2200 rev/min of engine | |
| Means atmospheric conditions : | temperature ; | 23 °C |
| | pressure ; | 767 mmHg |
| | relative humidity ; | 77% |
| | coolant ; | 80 °C |
| | engine oil ; | 90 °C |
| | fuel ; | 24 °C |

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

## (2) DRAWBAR PERFORMANCE

Date of tests: 30th September to 14th October, 1974
Type of track: Concrete
Height of drawbar above ground: 420 mm

| Gear No. | Speed km/h | Horse-power (metric) hp | Drawbar pull kg | Engine speed rev/min | Slip of wheels % | Fuel Consumption | | Temperature | | | Atmospheric Conditions | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Metric drawbar hph/l | g/metric drawbar hph | Fuel °C | Coolant °C | Engine °C | Temperature °C | Relative humidity % | Pressure mmHg |
| (Ⅰ) MAXIMUM POWER (ballasted) | | | | | | | | | | | | | |
| 1 | 0.76 | 1.40 | 500 | 2599 | 15.5 | 0.66 | 1229 | 36 | 78 | 82 | 25 | 44 | 761 |
| 2 | 1.08 | 2.00 | 500 | 2596 | 15.4 | 0.91 | 897 | 36 | 80 | 80 | 26 | 45 | 761 |
| 3 | 1.48 | 2.73 | 500 | 2584 | 15.1 | 1.07 | 776 | 36 | 78 | 84 | 27 | 41 | 761 |
| 4 | 2.12 | 3.93 | 500 | 2571 | 15.7 | 1.31 | 621 | 38 | 79 | 85 | 27 | 39 | 761 |
| 5 | 3.06 | 5.67 | 500 | 2565 | 15.0 | 1.72 | 474 | 38 | 79 | 85 | 27 | 41 | 761 |
| 6 | 4.28 | 7.93 | 500 | 2554 | 15.0 | 2.23 | 364 | 39 | 80 | 83 | 27 | 47 | 761 |
| 7 | 5.65 | 10.47 | 500 | 2523 | 14.4 | 2.55 | 318 | 41 | 81 | 87 | 27 | 47 | 761 |
| 8 | 7.74 | *14.62 | 510 | 2454 | 15.4 | 2.59 | 300 | 42 | 81 | 85 | 28 | 48 | 761 |
| 9 | 11.09 | 16.02 | 390 | 2400 | 11.0 | 3.02 | 268 | 42 | 82 | 84 | 28 | 57 | 761 |
| (Ⅱ) FIVE HOUR TEST at 75% of pull at maximum power | | | | | | | | | | | | | |
| 7 | 5.58 | 10.85 | 525 | 2527 | 14.4 | 2.58 | 315 | 39 | 80 | 85 | 24 | 69 | 759 |
| (Ⅲ)+ FIVE HOUR TEST at pull corresponding to 15% wheelslip in test (Ⅰ) | | | | | | | | | | | | | |
| 8 | 8.24 | — | 510 | — | — | — | — | 35 | 80 | 85 | 20 | 66 | 768 |
| (Ⅳ) MAXIMUM POWER (unballasted) | | | | | | | | | | | | | |
| 1 | 0.72 | 1.68 | 630 | 2588 | 15.0 | 0.75 | 1096 | 31 | 65 | 78 | 19 | 65 | 764 |
| 2 | 1.04 | 2.44 | 630 | 2584 | 15.0 | 1.02 | 804 | 33 | 66 | 76 | 20 | 66 | 764 |
| 3 | 1.44 | 3.36 | 630 | 2580 | 15.0 | 1.29 | 632 | 33 | 66 | 78 | 20 | 66 | 764 |
| 4 | 2.09 | 4.87 | 630 | 2572 | 15.5 | 1.68 | 486 | 33 | 69 | 79 | 20 | 66 | 764 |
| 5 | 2.99 | 6.97 | 630 | 2552 | 15.3 | 2.08 | 393 | 33 | 67 | 80 | 20 | 66 | 764 |
| 6 | 4.14 | 9.66 | 630 | 2534 | 15.4 | 2.45 | 358 | 34 | 78 | 81 | 21 | 67 | 764 |
| 7 | 5.44 | *12.68 | 630 | 2514 | 15.6 | 2.76 | 295 | 37 | 80 | 85 | 21 | 67 | 764 |
| 8 | 7.42 | 15.66 | 570 | 2380 | 14.5 | 2.95 | 275 | 40 | 80 | 85 | 22 | 68 | 764 |
| 9 | 11.27 | 16.69 | 400 | 2388 | 7.9 | 3.09 | 274 | 41 | 81 | 86 | 26 | 64 | 764 |

Total oil consumption during ten hours duration of tests (Ⅱ) and (Ⅲ): 18g/h

* Maximum power available at 15% wheelslip.

\+ Test (Ⅲ) was carried out with additional ballasted 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
front 960 mm, rear 965 mm

| Results | With brakes | | Without brakes | |
|---|---|---|---|---|
| | right-hand<br>m | left-hand<br>m | right-hand<br>m | left-hand<br>m |
| Radius of turning space | 2.23 | 2.26 | 2.45 | 2.48 |
| Radius of turning circle | 2.15 | 2.18 | 2.37 | 2.40 |

## (4) LOCATION OF CENTRE OF GRAVITY

mm

| | |
|---|---|
| Height above ground | 692 |
| Distance forward from the vertical plane containing the axis of the rear wheels | 535 |
| Distance from the median plane | 0 |

## (5) BRAKING

Date of tests: 15th October, 1974

Type of track: Concrete

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

Weight of ballasted tractor: 1200 kg

**COLD BRAKES**

| | Ballasted | Without ballast |
|---|---|---|
| Travelling speed of the tractor km/h | 14.0 | 14.0 |
| (1) Deceleration $m/s^2$ | 4.2 | 4.3 |
| (2) Stopping distance m | 2.1 | 1.8 |
| (3) Force exerted on the brake pedal kg | 30.0 | 30.0 |
| (4) Force exerted on the brake pedal to achive a deceleration of 2.5 $m/s^2$ kg | 14.0 | 12.0 |

**BRAKE FADE CHARACTERISTICS** (hot tests)

| | | Ballasted |
|---|---|---|
| Deceleration hot/deceleration cold x 1000 | % | 88 |
| Stopping distance cold/stopping distance hot x 100 | % | 95 |
| Force on pedal cold/force on pedal hot x 100 | % | 100 |

**PARKING BRAKE**

Efficiency of parking latch: Satisfactory facing up and down slope

## (6) MEASUREMENT OF AMBIENT NOISE

Date of tests: 14th October, 1974

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

Type of track: Concrete

Results of tests: Gear 9th

Trevelling speed before acceleration 10.2 km/h

Sound level 80 dB(A)

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

Date of tests: 14th October, 1974

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

Type of track: Concrete

Results of tests

| Gear | Travelling speed km/h | dB(A) |
|---|---|---|
| 7th | 5.54 | 91 |
| 8th | 8.28 | 93 |
| 9th | 11.08 | 93 |

## (8) POWER LIFT AND HYDRAULIC PUMP PERFORMANCE

Date and location of tests: 2nd October, 1974; I. A. M., Omiya, JAPAN

Hydraulic fluid

make and type: 80 FUSO EP

viscosity: 112 cSt (37.8°C)

viscosity index 102

Type of linkage lock for transport: Hydraulic

Pump characteristics

| | | |
|---|---|---|
| i) | Opening pressure of the relief valve (manufacturer's figures) : | 115 kg/cm$^2$ |
| | Sustained pressure of the open relief valve : | 128 kg/cm$^2$ |
| ii) | Pump delivery rate at minimum pressure and rated engine speed : | 13.3 l/min |
| iii) | Pump delivery rate : | 13.0 l/min |
| | Delivery pressure : | 115 kg/cm$^2$ |
| | Power : | 3.32 metric hp |

Linkage geometry

| | Maximum mechanical advantage | Minimum mechanical advantage |
|---|---|---|
| Projected length in side view | | |
| lower links, mm | 810 | 810 |
| lift arm, mm | 300 | 300 |
| lift rods, mm | 415 | 585 |
| top link, mm | — | — |
| Distance of lift rod cannection point from pivot point of lower link, mm | 660 | 570 |
| The following dimension are giving relative to the rear wheel centre line, situated 506 mm above the ground level | | |
| Lower link pivot point | 21 mm behind, 66 mm below | 21 mm behind, 66 mm below |
| Top link pivot point | 197 mm behind, — | 197 mm behind, — |
| Lift arm pivot point | 37 mm behind, 362 mm above | 37 mm behind, 362 mm above |
| Maximum and minimum height of lower link hitch points | 399 mm above, 60 mm above | 145 mm above, 463 mm below |
| Height of lower link hitch points when locked in transport position | 399 mm above, — | — — |

Lifting heights in relation to a horizontal line through the lower link pivoting point, cm

| | | −39.8 | −35 | −30 | −25 | −20 | −15 | −10 | −5 | 0 | +5 | +10 | +11.8 | +15 | +20 | +20.9 | +25 | +30 | +35 | +40 | +45 | +45.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lifting force at the hitch point<br>kg<br>(Values for the pressure at maximum hydraulic horsepower, calculated from measurements made at maximum pressure) | max. mech. advantage | — | — | — | — | — | — | — | — | — | — | — | 1410 | 1105 | 910 | — | 815 | 785 | 720 | 690 | 650 | 620 |
| | min. mech. advantage | 545 | 490 | 520 | 515 | 525 | 540 | 545 | 540 | 530 | 510 | 485 | — | 475 | 460 | 435 | — | — | — | — | — | — |
| | Maximum force exerted throughout whole range 620 kg<br>Force at which front of tractor is calculated to lift with maximum allowable front ballast 855 kg | | | | | | | | | | | | | | | | | | | | | |
| | Pressure 125 kg/cm² | | | | | | | | | | | | | | | | | | | | | |

| | | |
|---|---|---|
| REPAIRS AND ADJUSTMENTS DURING TESTS: | | None |
| REMARKS | : | After checking up the power take-off spline dimensions, the length of effective spline was found not in conformity with JIS standard. |
| Officer in charge | : | S. ARAI |
| Head of Testing Division | : | M. ARIYOSHI |
| Date | : | 19th February, 1975 |

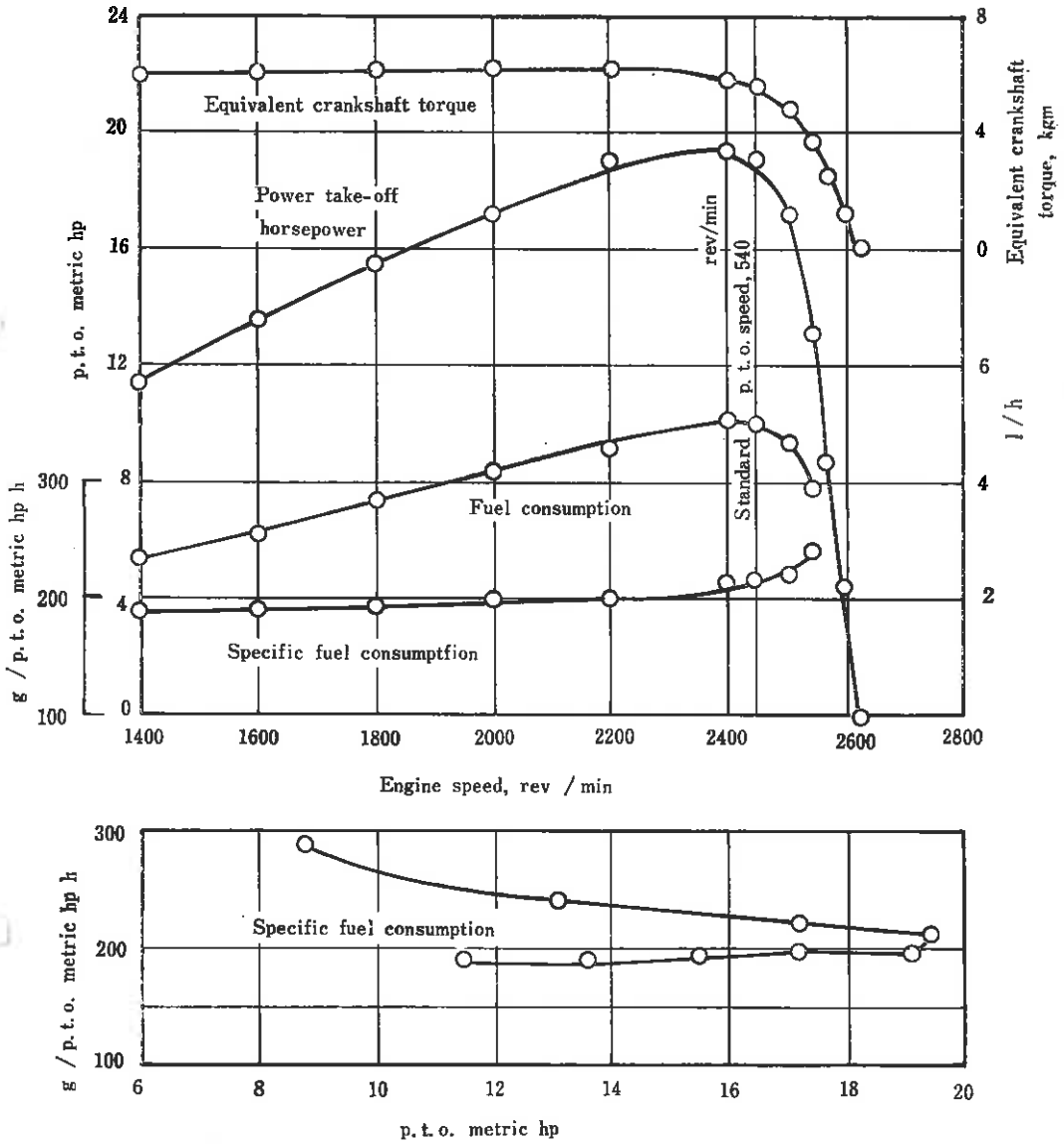



Fig. 1 Power take-off test

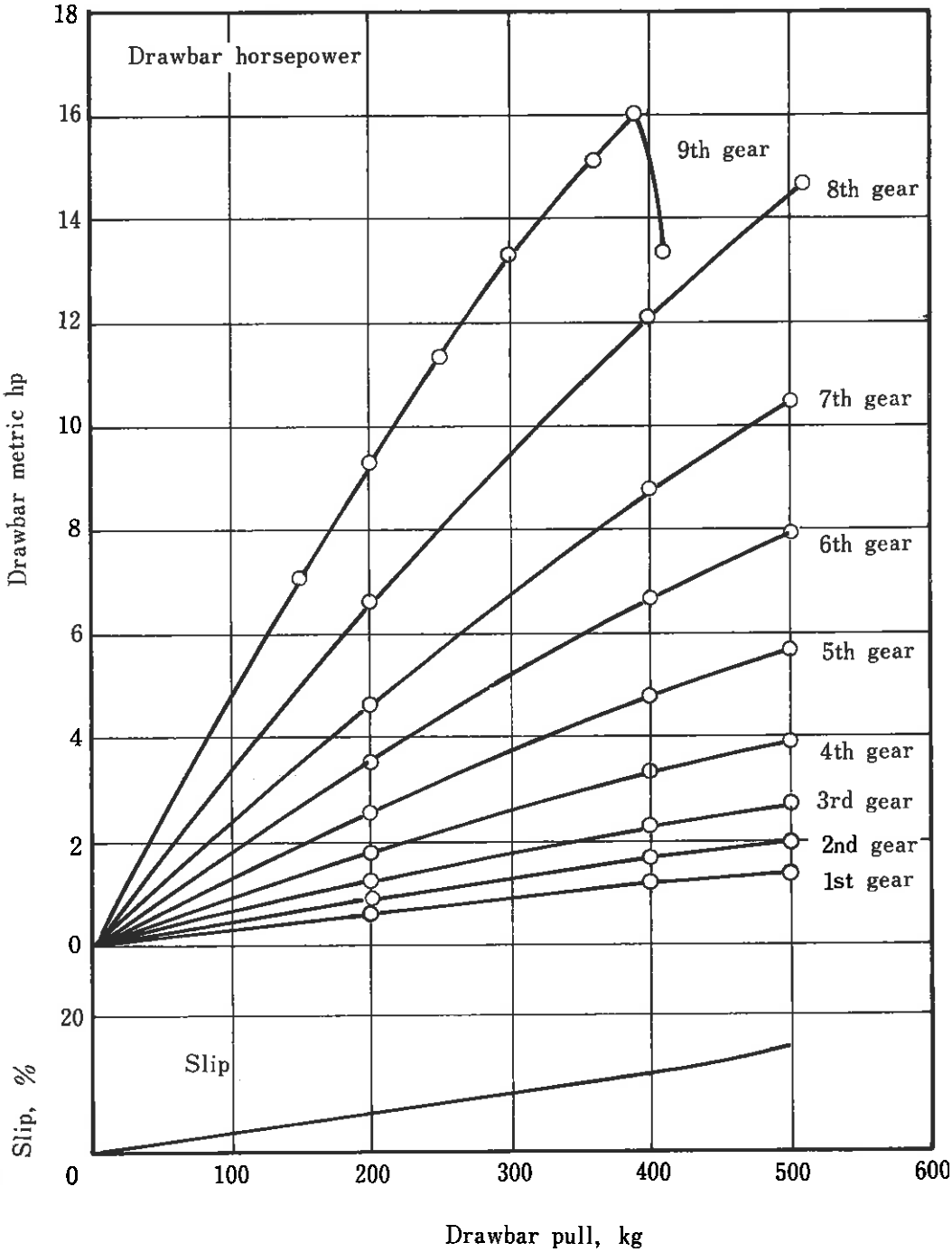



Fig. 2 Drawbar-test on concrete, with ballast

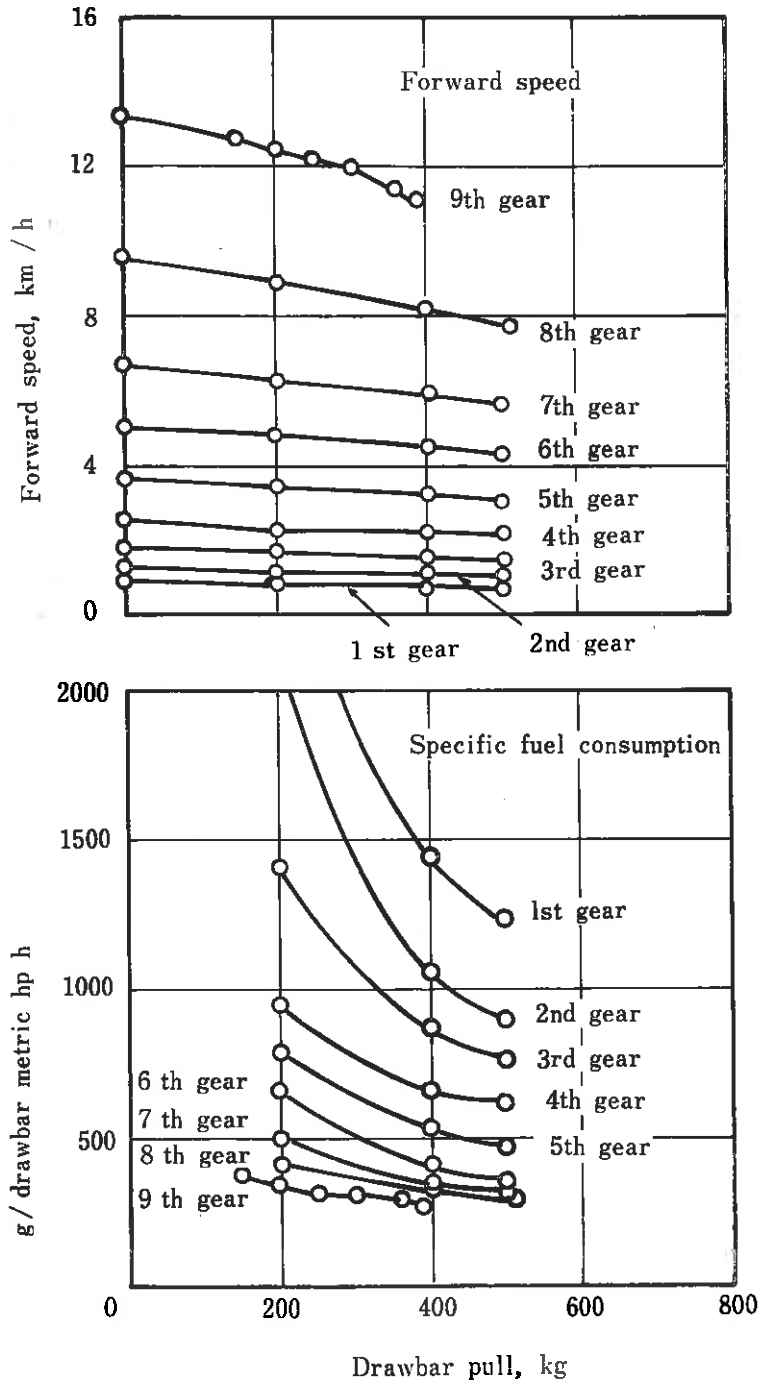



Fig. 3 Drawbar-test on concrete, with ballast

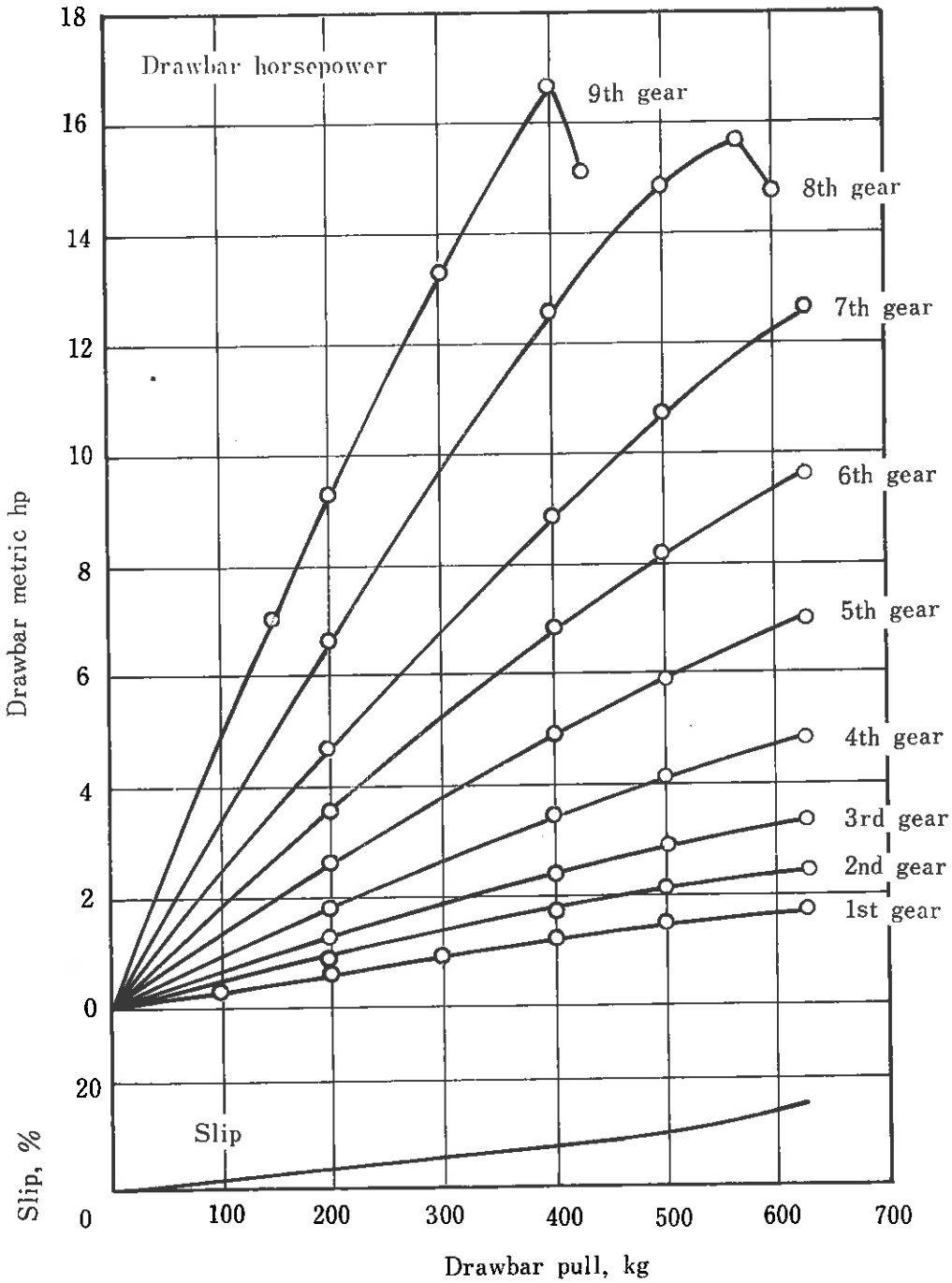



Fig. 4 Drawbar-test on concrete, without ballast