499

COMITATO DI COORDINAMENTO PER L'OMOLOGAZIONE
DELLE MACCHINE AGRICOLE IN ITALIA

No. 355/O.E.C.D.

REPORT ON TEST IN ACCORDANCE WITH O. E. C. D.
TEST CODE FOR AGRICULTURAL TRACTORS

CAST 440 L

Manufactured by: CAST S.p.A.
Calderara di Reno - BOLOGNA (ITALY)



Date of tests: November 1970 - February 1971

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: 26 may 1971

CENTRO DI OMOLOGAZIONE DELL'ISTITUTO DI MECCANICA AGRARIA
UNIVERSITA' DEGLI STUDI DI BOLOGNA - ITALIA

COMITATO DI COORDINAMENTO PER L'OMOLOGAZIONE
DELLE MACCHINE AGRICOLE IN ITALIA

No. 355/O.E.C.D.

REPORT ON TEST IN ACCORDANCE WITH O. E. C. D.
TEST CODE FOR AGRICULTURAL TRACTORS

CAST 440 L

Manufactured by: CAST S.p.A.
Calderara di Reno - BOLOGNA (ITALY)



Date of tests: November 1970 - February 1971

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: 26 may 1971

CENTRO DI OMOLOGAZIONE DELL'ISTITUTO DI MECCANICA AGRARIA
UNIVERSITA' DEGLI STUDI DI BOLOGNA - ITALIA

This bulletin is based on engineering tests in accordance with the OECD Serial 1970 Tractor Test Code. It does not contain an evalutation of the performance of the tractor on practical farm work.

Symbols used for the following units of measure

Mass:	g = gram; kg = kilogram
Force or weight:	gr = gram; kgr = kilogram
Power:	metric h.p. = metric horse power
Pressure:	bar; kgr/cm^2

Equivalences with the symbols used in another Centres

kgr = kp = kg' = kgf

metric h.p. = CV = PS = ch

TABLE OF CONTENTS

I - Specification of tractor . . . . . Page 5

II - Compulsory test . . . . . » 10

1 - Main power take-off performance . . . » 10

2 - Drawbar performance . . . . . » 13

3-4 - Turning space and turning circle . . . . » 16

5 - Location of center of gravity . . . . » 16

6 - Braking . . . . . » 16

7-8 - Measure of noise . . . . . » 17

9 - Power lift and external tapping point . . » 17

— **Tractor manufacturer:** CAST S.p.A. - Calderara di Reno (Bologna) - Italy.

— **Submitted for test by:** the manufacturer.

— **Selected by:** manufacturer with the agreement of « Istituto di Meccanica Agraria - University of Bologna ».

— **Place of running in:** CAST workshop - Calderara di Reno.

— **Duration of running in:** 25 hrs for the tractor transmission; 30 hrs for the engine.

This is of series tractor conforming to manufacturer's descriptive sheet.

I - SPECIFICATION OF TRACTOR

— Make: CAST.

— Model: 440 L.

— Type: monoblock frame, four wheels drive steering and with spring suspensions. Reversible driving position with repeated controls.

— Serial n° 010603.

ENGINE

— Make: RUGGERINI - Rubiera (Reggio Emilia) - Italy.

— Model: P 101/2.

— Type: direct injection diesel at four stroke.

— Serial n° 00256.

Cylinders: two cylinders, vertical; bore: 100 mm; stroke 95 mm; total capacity: 1492 cm^3; compression ratio: 17,2; overhead valves; dry cylinders.

Fuel system: forced with diaphragm pump FISPA model 4015.09; FIAAM FNA 32/01 filter; capacity of fuel tank 18 liters.
BOSCH injection pump, model PFR 2k70; manufacturer's production setting for injection pump: 38÷42 mm^3 for stroke at fuel temperature 15°C; BOSCH injection nozzles model DLLA 180 SV 9549/2; injection pressure 204÷214 bar (200÷210 kgr/cm^2).

Governor: make Ruggerini; mechanical type with centrifugal weights governed range of speed 650-3150 rev/min with rated speed of 3000 rev/min.

Air cleaner: make C.M.T. model FAVO 4 oil bath type; oil capacity 0.5 liters; flow 3100 l/min.

Lubrication system: forced feed from lobes pump type Root make Ruggerini; sieve filter in section and paper model FIAAM FT 4664 at delivery; oil capacity 6 liters; recommended oil change period 150 hrs.

Cooling system: air forced with flywheel - axial impeller, diameter 186 mm, with 9 blades; flow 780 m^3/h at 3000 rev/min.

STARTING SYSTEM

Electric BOSCH model JD (R), 12 V; 1.8 metric h.p. motor.

ELECTRICAL SYSTEM

Voltage: 12 V; BOSCH model EH 14V 11A 19 dynamo.

Battery: 12 V; FIAMM model 6MC4R, capacity 60 Ah.

TRANSMISSION

Clutch: make Pitteri-Violini model PV 19.13.02, single dry plate type; diameter 218 mm; pedal operated with repetition on two directions steering.

Gearbox: own make; mechanical with reversing gear; 6 forward speeds and 6 reverse.

Front and rear axles: own make, model 440.L; suspensions at articulated parallelogram and spring shock absorber; outside differential shafts with two constant speed universal joints each; differential into the frame with mechanical blocking at hydraulic control; front and rear axle with ratio 1:5.625; front and rear gears spur final with ratio 1:4.2.

Oil capacities: gearbox and front differential 7 liters; gears final 2.4 liters; rear differential 4 liters; recommended oil change period 1000 working hrs.

Gear	Number of engine revolutions for one revolution of driving wheels	Theoretical travelling speed for 3000 rev/min rated speed of engine km/h
1st	237.886	1.81
2nd	133.371	3.24
3rd	78.004	5.54
4th	55.117	7.84
5th	30.902	13.98
6th	18.073	23.90

N° 6 reverse speeds with the same ratios.

POWER TAKE-OFF

Main:

— Location: at the rear of tractor, central position.

— Dimensions: 34.8 x 28.9 x 8.6 mm (1.3/8 inc) (DIN 9611-ASAE S 203.6), 6 splines.

— Height above ground: 550 mm.

— Speed proportional at engine speed:
750 rev/min at 3000 rev/min rated engine speed
2160 engine rev/min at 540 rev/min p.t.o. speed
Direction of rotation: clockwise viewed from tractor rear.

— Speed proportional to travelling speed:
one p.t.o. revolution for 0.20 m
12 p.t.o. revolutions for one revolution of driving wheels
Direction of rotation: clockwise in forward speeds; anti-clockwise in reverse speeds.

Accessory:

— Location: at the rear of the tractor, central position, utilizable when tractor has not power lift.

— Dimensions: 21 x 25 x 5 mm (21 UNI 221), 6 splines.

— Height above ground: 630 mm.

— Speed proportional at engine speed:
3000 rev/min at 3000 rev/min rated engine speed
540 engine rev/min at 540 rev/min p.t.o. speed
Direction of rotation: anti-clockwise viewed from tractor rear.

— Speeds proportional to travelling speed:
one p.t.o. revolution for 0.05 m
20 p.t.o. revolutions for one revolution for driving wheels
Direction of rotation: anti-clockwise in forward speeds; clockwise in reverse speeds.

BELT PULLEY

None fitted.

POWER LIFT

— Own make; hydraulic system: gear pump driven by engine supplies oil at 82 bar (80 kgr/cm²) to ram cylinder; oil capacity 7 liters.
Vertical displacement of the hitch point 482 mm, starting from 114 mm above ground level.

DRAWBAR

— Rectangular section connected in three points linkage.

— Height above ground: continous adjustement from 144 mm to 626 mm above ground level.

— Maximum distance from rear axle 877 mm; lateral adjustement 180 mm.

— Pivot connection position to rear wheels center: horizontal distance 172 mm, vertical distance 24 mm.

HITCH

— Height above ground of the center of the clevis: 420 mm.

— Distance from rear axle: 390 mm.

— Position referred to the principal take-off: horizontal distance 70 mm, vertical distance 130 mm.

STEERING

— Own make; mechanical type working on the center steers the tractor's four wheels. Particular device reverses simultaneously the direction of rotation of the steering wheels and the seat position. Another clevice disconnects the steering from rear wheels.

BRAKES

— Own make; mechanical expanding shoe brakes mounted on four wheels; operated by a single pedal, repeated on two directions steering, for normal braking action and by a hand lever with ratchet for parking (on rear wheels).

DRIVE WHEELS

— Two at front and two at rear; tyres « Goodyear » 7.50-16, 4 ply-rating; maximum permissible weight on each tyre 595 kgr at 1.53 bar (1.5 kgr/cm²) internal air pressure.

— Track width 990 mm.

— Wheelbase 1050 mm.

TRACTOR WEIGHTS

(with fuel full tank, oil, no driver)

— On front wheels 712 kgr
— On rear wheels 348 kgr
— Total 1060 kgr

For this tractor no ballast fitted.

SEAT

— Own make, rotating type, elastic suspension; range of adjustement: 20 mm on horizontal.

NUMBER OF GREASE POINTS: 2

OVERALL DIMENSIONS

— Width 1.23 m.

— Height 1.11 m.

— Lenght 2.53 m.

LIGHTING

	Height above ground of center cm	Diameter cm	Distance of centre from outside edge of tractor cm
Headlights	88	10	23
Side lights	88	10	23
Rear lights	88	5.5 x 3	14
Reflectors	93	5 x 4.5	14.5

FUEL AND LUBRICANTS USED IN TEST

Fuel: agricultural diesel oil; viscosity 2.14 cst at 50°C; density 0.825 kg/l at 15°C; cetane number 56.

Engine and transmission oil: ESSOLUBE HDX - viscosity SAE 40 - viscosity index 96.

Hydraulic fluid: ESSOLUBE XDX - viscosity SAE 10 - viscosity index 105.

II - COMPULSORY TEST

1) MAIN POWER TAKE-OFF PERFORMANCE

— Date and location of tests: 18th november 1970 - Experimental Centre of Cadriano of the Istituto di Meccanica Agraria - University of Bologna.

— Type of dynamometer: electrical, type IMA Bo 65.

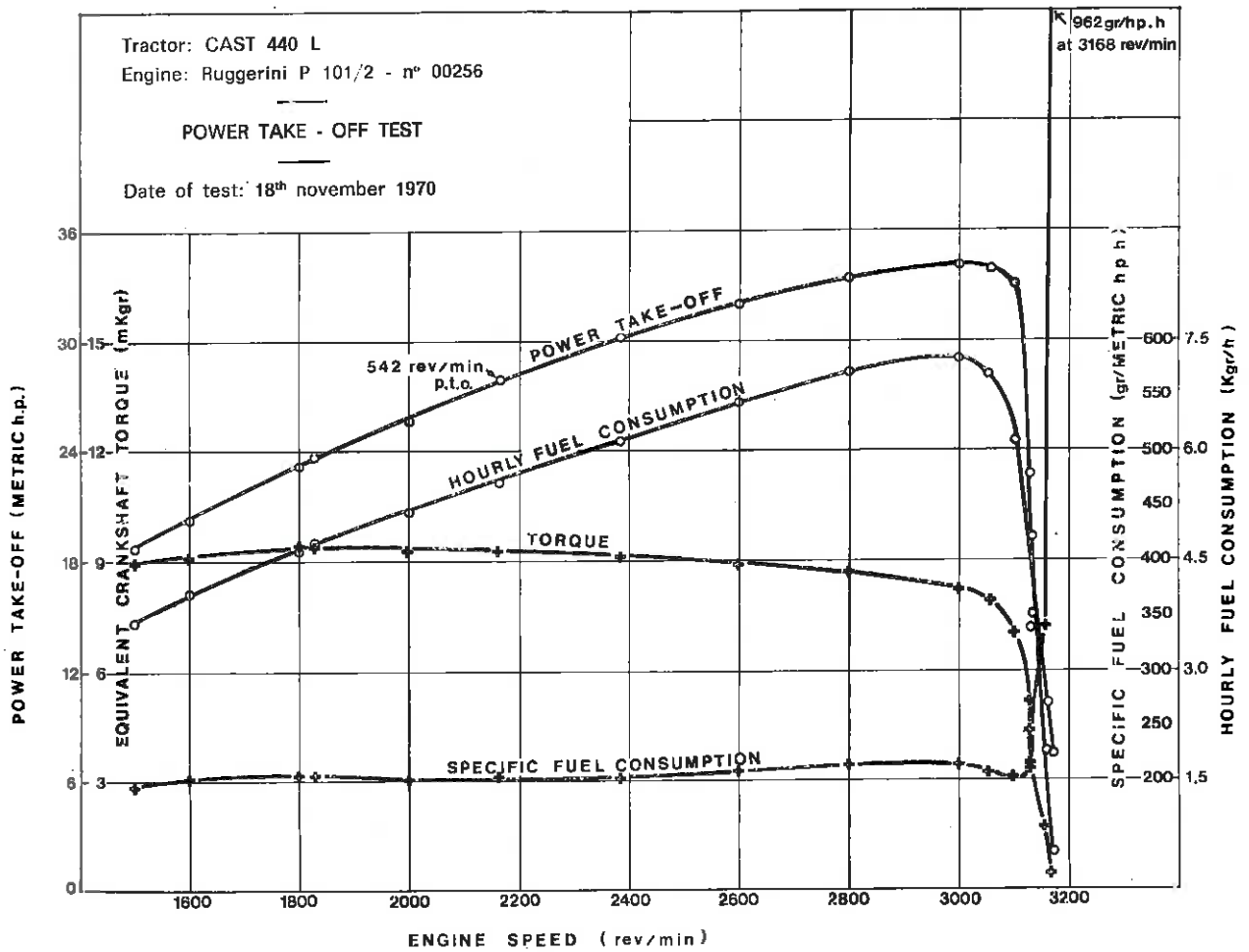
Horse power metric h.p.	Speed		Fuel consumption		
	engine rev/min	p.t.o. rev/min	hourly l/h	specific gr/metric h.p.h	h.p.h for unit of volume metric h.p.h/l
At maximum power - 2 hours test					
34.15	3000	750	8.822	213	3.87
At standard p.t.o. speed (540 ±10 rev/min)					
27.86	2168	542	6.764	200	4.13
At the speed recommended by the manufacturer for drawbar work					
34.15	3000	750	8.822	213	3.87
At part loads					
I 30.03	3104	776	7.418	204	4.04
II 2.06	3168	792	2.400	962	0.86
III 15.09	3128	782	4.364	239	3.45
IV 34.15	3000	750	8.822	213	3.87
V 7.66	3160	790	3.127	337	2.45
VI 22.68	3128	782	5.818	212	3.89

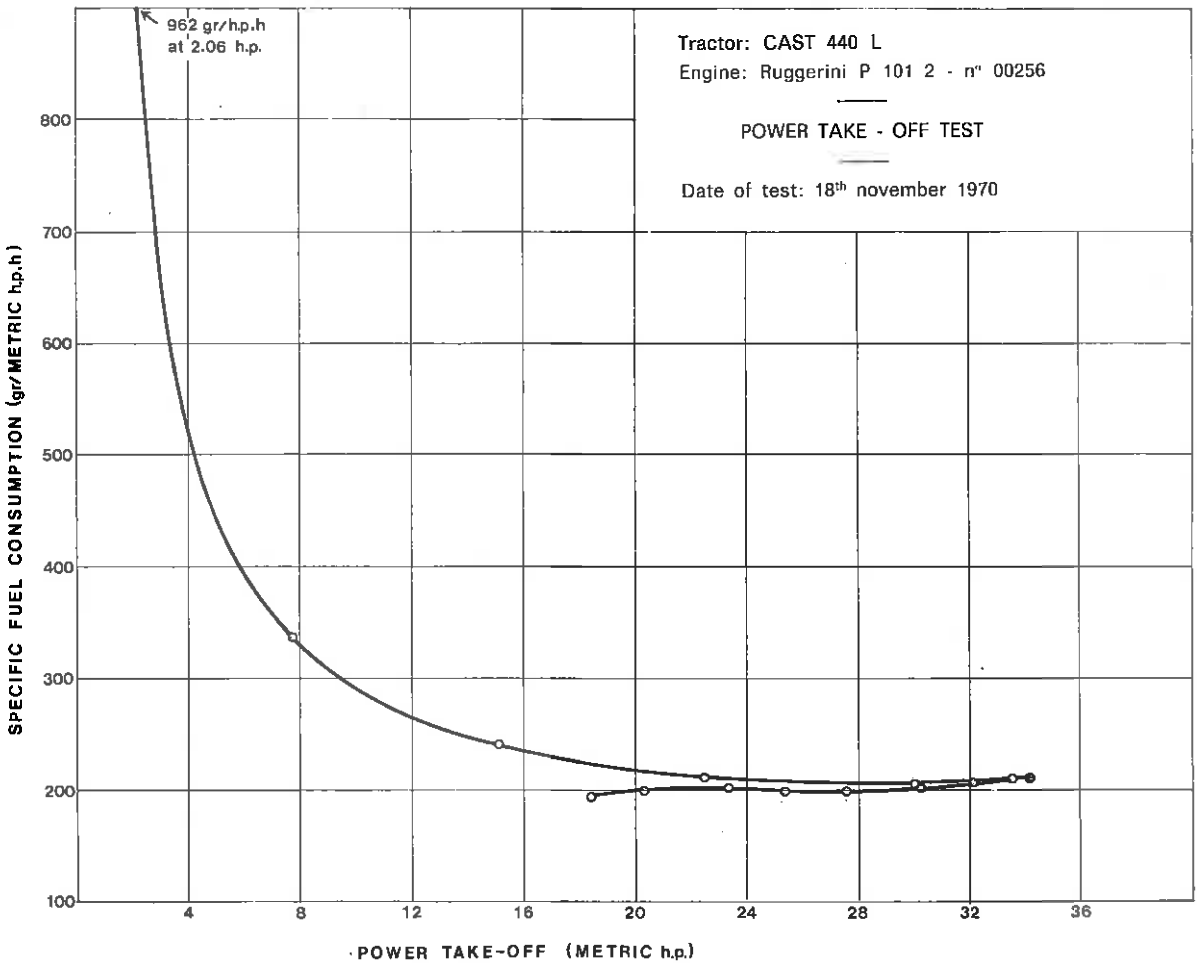
No. load maximum engine speed: 3168 rev/min
Torque (*) at maximum power: 8.15 m kgr
Maximum torque (*): 9.30 m kgr at 1830 rev/min of the engine.

— **Mean atmospheric conditions:**
Temperature: 15°C
Pressure: 1.015 bar
Relative humidity: 54%

— **Maximum temperature of engine:**
Coolant: 58° C
Engine oil: 111° C
Fuel: 17° C

(*) The torque is the equivalent crankshaft torque


Tractor: CAST 440 L
Engine: Ruggerini P 101/2 - nº 00256
POWER TAKE - OFF TEST
Date of test: 18th november 1970
962 gr/hp.h
at 3168 rev/min
542 rev/min p.t.o.
POWER TAKE-OFF
HOURLY FUEL CONSUMPTION
TORQUE
SPECIFIC FUEL CONSUMPTION
POWER TAKE-OFF (METRIC h.p.)
EQUIVALENT CRANKSHAFT TORQUE (mKgr)
SPECIFIC FUEL CONSUMPTION (gr/METRIC h.p.h)
HOURLY FUEL CONSUMPTION (Kgr/h)
ENGINE SPEED (rev/min)
36
30
24
18
12
6
0
15
12
9
6
3
600
550
500
450
400
350
300
250
200
7.5
6.0
4.5
3.0
1.5
1600
1800
2000
2200
2400
2600
2800
3000
3200


962 gr/h.p.h
at 2.06 h.p.
Tractor: CAST 440 L
Engine: Ruggerini P 101 2 - n° 00256
POWER TAKE - OFF TEST
Date of test: 18th november 1970
SPECIFIC FUEL CONSUMPTION (gr/METRIC h.p.h)
800
700
600
500
400
300
200
100
4
8
12
16
20
24
28
32
36
POWER TAKE-OFF (METRIC h.p.)

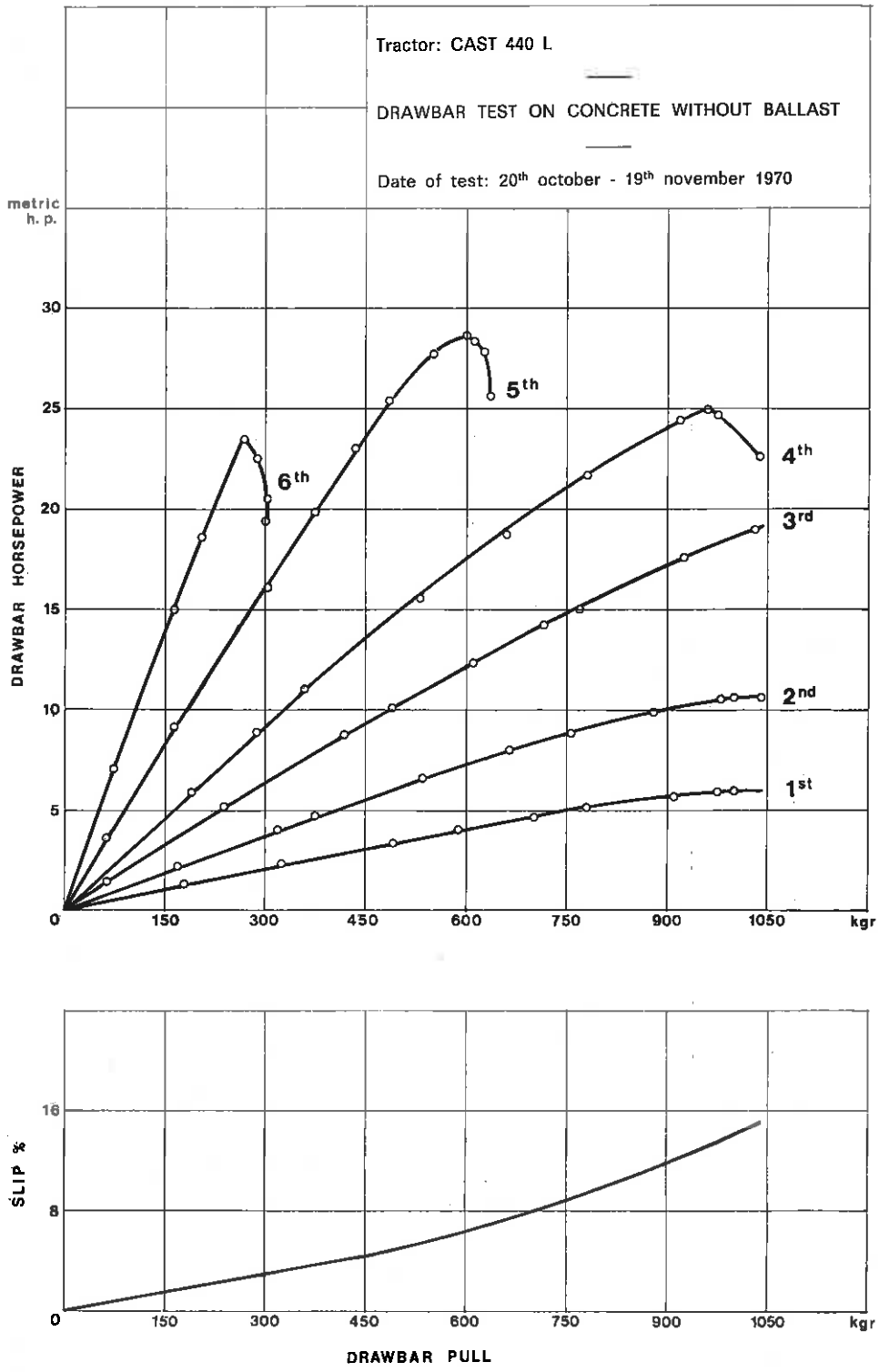
2) DRAWBAR PERFORMANCE

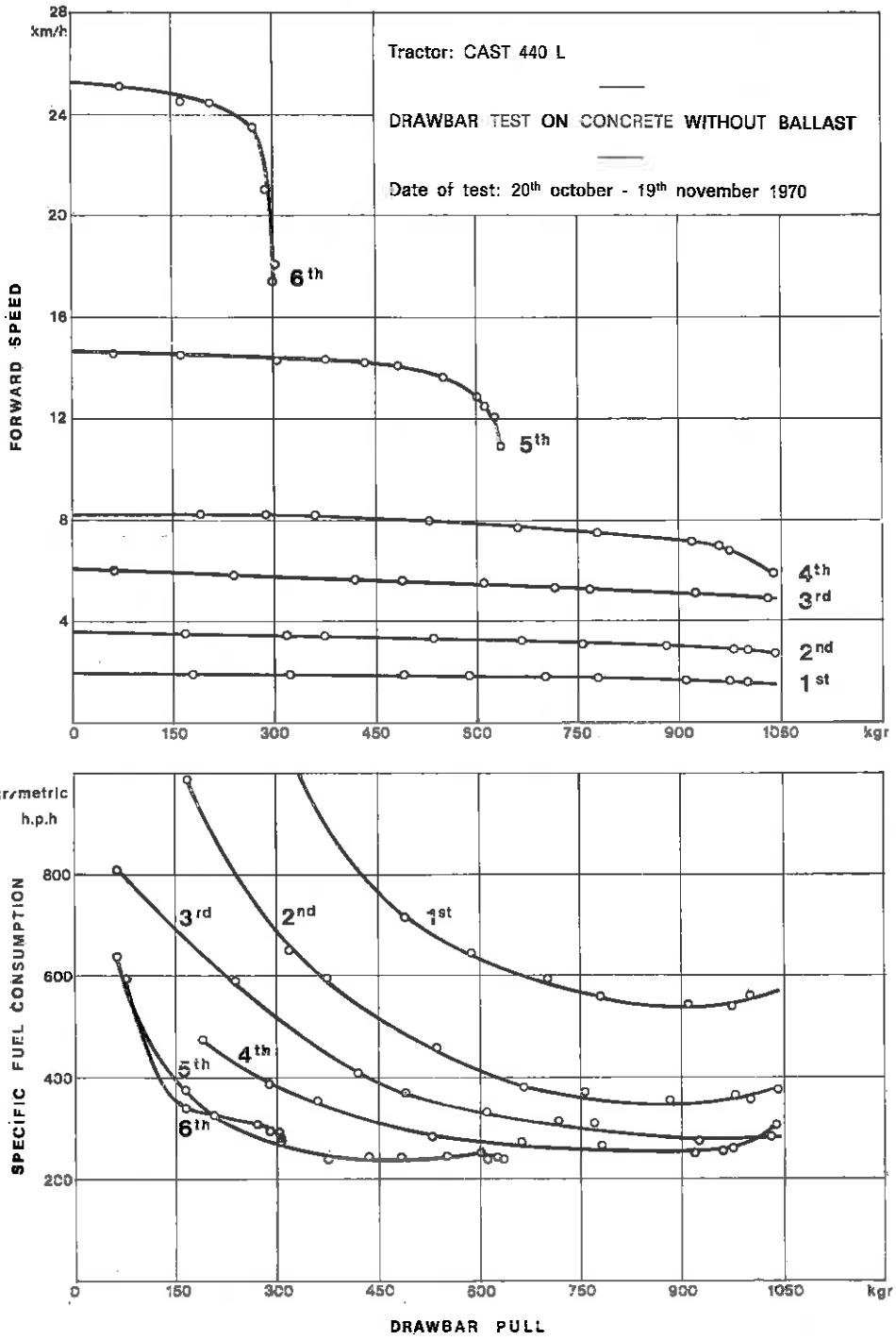
— Date of test: 20th october to 19th november 1970
— Type of track: concrete
— Height of drawbar above ground: 420 mm

Gear	Speed km/h	Power (metric h.p.)	Drawbar pull (kgr)	Engine speed (rev/min)	Wheel slip %	Fuel consumption		Temperature °C			Atmospheric conditions		
						drawbar h.p.h/l	drawbar gr/h.p.h	Fuel	Cooling air	Engine oil	Tempe-rature °C	Relative hum. %	Pressure bar
I) Maximum power (without ballast)													
1st	1.60	5.96	1000	3168	14.8	1.47	560	21	44	72	20	49	0.999
2nd	2.75	10.60	1040	3160	15.1	2.19	377	21	44	72	20	49	0.999
3rd	4.88	19.00	1030	3140	14.8	2.92	283	21	52	94	20	49	0.999
4th	7.00	24.93	960	3148	13.0	3.21	257	16	48	68	14	59	0.999
5th	12.85	28.57	600	2994	5.9	3.27	252	16	48	68	14	59	0.999
6th	23.50	23.50	270	3026	2.6	2.71	304	21	60	82	20	49	0.999
II) Five hour test at 75% of pull at maximum power													
4th	7.55	12.20	435	3160	5.1	2.58	320	15	41	65	13	68	1.023
III) Five hour test at pull corresponding to 15% wheelslip in test I (*)													
2nd	2.86	11.10	1050	3164	13.2	2.29	360	12	38	60	10	74	1.020

Oil consumption during ten hours duration of test II and III: 90 gr/h

(*) Test n. III carried out with 165 kgr ballast.


Tractor: CAST 440 L
DRAWBAR TEST ON CONCRETE WITHOUT BALLAST
Date of test: 20th october - 19th november 1970
metric h. p.
DRAWBAR HORSEPOWER
30
25
20
15
10
5
0
150
300
450
600
750
900
1050
kgr
6th
5th
4th
3rd
2nd
1st
SLIP %
16
8
0
150
300
450
600
750
900
1050
kgr
DRAWBAR PULL


Tractor: CAST 440 L
DRAWBAR TEST ON CONCRETE WITHOUT BALLAST
Date of test: 20th october - 19th november 1970
FORWARD SPEED
km/h
28
24
20
16
12
8
4
6th
5th
4th
3rd
2nd
1st
0
150
300
450
600
750
900
1050
kgr
SPECIFIC FUEL CONSUMPTION
gr/metric h.p.h
800
600
400
200
3rd
2nd
1st
4th
5th
6th
DRAWBAR PULL

3-4) TURNING SPACE AND TURNING CIRCLE

— The tractor CAST 440 L is without indipendent steering brakes; the steering operates on front wheels, or on all four wheels.
— Track width, front and rear axles: 990 mm.

	With two steering wheels		With four steering wheels	
	right hand m	left hand m	right hand m	left hand m
Radius of turning space	4.21	4.24	2.59	2.62
Radius of turning circle	4.00	4.06	2.38	2.44

5) LOCATION OF CENTER OF GRAVITY

	mm
Height above ground	526
Distance forward from the vertical plane containing the axis of the rear wheels	779
Distance from the median plane of tractor	0

6) BRAKING

— Date of test: 25th november 1970 - Cadriano
— Type of track: concrete
— Travelling speed of tractor: 24.4 km/h
— Type of decelerometer: Moto Meter, at maximum, recorder

Cold brakes

Deceleration	m/s^2	7.3
Stopping distance	m	4.7
Force on brake pedal	kgr	34
Force on brake for maximum deceleration of 2.5 m/s^2	kgr	9

Brake fade characteristics (hot tests)

— Deceleration hot/deceleration cold x 100 — 99 %
— Stopping distance cold/stopping distance hot x 100 — 114 %
— Force on pedal cold/force on pedal hot x 100 — 92 %

Efficiency of parking brake

— The tractor facing up the slop: good
facing down the slop: good
— Force to be applied on the hand lever:
the tractor facing up the slop 34 kgr
facing down the slop 38 kgr

7) MEASUREMENT OF AMBIENT NOISE EMITTED BY THE TRACTOR

— Date of test: 28th october 1970 - Cadriano
— Type of sound level meter: Brüel and Kjaer, type 2203
— Type of track: concrete

Results of tests

— Gear: 6th
— Travelling speed: 18.9 km/h
— Sound level: 92 dBA

8) NOISE MEASUREMENT AT THE DRIVER'S EAR LEVEL

— Date of test: 28th october 1970 - Cadriano
— Type of sound level meter and octave filter: Brüel and Kjaer - types: 2203 and 1613.
— Type of frequency analyzer: with eleven octave from 31.5 to 31,500 Hz.
— Type of track: concrete.

Tractor had neither cab nor safety frame.

Result of tests

Gear	Travelling speed (*) km/h	Loudness Sones
4th	7.8	153

(*) The speed relevant to 4th gear is the nearest to 7.25 km/h.

9) POWER LIFT AND EXTERNAL TAPPING POINT

— Date and location of test: 26th november 1970, Experimental Center of Cadriano - Istituto di Meccanica agraria - University of Bologna.
— Hydraulic fluid: ESSOLUBE HDX; viscosity SAE 10 W; viscosity index: 105.
— Type of linkage lock for transport: hydraulic.
— Opening pressure of relief valve: 82 bar (80 kgr/cm^2)

Performances of pump delivery

I) Opening pressure of relief valve: 82 bar (80 kgr/cm²)
II) Pump delivery at minimum pressure: 12 l/min
III) Pump delivery at maximum transmitted power: 11 l/min
pressure: 56 bar (55 kgr/cm²)
hydraulic power: 1.34 metric h.p.

	Height above ground in down position linkage point frame		Vertical movement mm	Maximum force exerted through full range kgr	Pressure bar (kgr/cm²)	Load front axle lifting off the ground kgr
	mm	mm				
Linkage giving maximum mechanical advantage						
— at lower hicht points	144	—	482	350	80 (78)	975
— at standard frame	144	75	420	305	80 (78)	573
Linkage giving minimum mechanical advantage (none fitted)						

Test Engineers

Prof. Ing. Cesare De Zanche

Dr. Agr. Antonio Marocchi

HEAD OF TRACTOR TEST CENTER
Prof. Dr. Giorgio Casini-Ropa

DIRECTOR OF ISTITUTO
OF MECCANICA AGRARIA
UNIVERSITY OF BOLOGNA
Prof. Ing. Enzo Manfredi

Bologna, February 1971

Poligrafici L. PARMA S.p.A. - Bologna