UNIVERSITÀ DEGLI STUDI DI MILANO
ISTITUTO DI INGEGNERIA AGRARIA

O.E.C.D. No. 721
Printed: 2

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



SAME AGRICULTURAL TRACTOR HERCULES 160/VDT

Manufactured by: Same trattori S.p.A. TREVIGLIO (BG) ITALY

Date of approval O.E.C.D.: 2th July 1981

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Date of tests January 1980 till July 1980

Tractor manufacturer:	Same Trattori S.p.A. - Treviglio (BG) Italy
Submittes for test by:	Manufacturer
Selected by:	Manufacturer with agreement by I.I.A.
Place of running in:	Treviglio
Duration of running in:	50 hours

SPECIFICATION OF TRACTOR

Tractor

Make:	Same Trattori S.p.A.
Model:	Hercules 160/VDT
Type:	Wheel tractor unit construction, all wheel driven;
Serial no:	1012

Engine

Make:	Same Trattori S.p.A.;
Model:	1056 PT;
Type:	4-stroke Diesel engine, direct injection, air cooled, turbo surcharged;
Serial no:	1018;
Cylinders:	6-cylinders, vertical, in line, bore 105 mm, stroke 120 mm., capacity 6231 cm^3, compression ratio 17:1, without liners;
Valves:	Overhead;
Fuel system:	Ac Corona fuel feed pump two CIPA distributor injecting pumps CPFR 3K 90/1109, manufacturer's production setting 79 mm^3./stoke at rated engine speed injection timing 20° before TDC Bosch multihole injection nozzles DLLA ISO S. 830, injection pressure 196 bar two CAV filters with replaceable cartridge capacity of fuel tanks 240 1;
Governor:	Own make centrifugal variable speed governor governor range: from 600 to 2360 rev/min rated engine speed: 2200 rev/min.

Changer:	Exhaust driven surcharger KKK K27 type surcharge pressure 930 mbar cooled from engine oil circuit 2 l/min. delivery;
Air cleaner:	Donaldson EGB 10-0035 dry paper element filter with precleaner replaceable cartridge;
Exhaust silencer:	Own make 5 chambers reflection absorption type, 95 mm. deep, 194 mm. width, 1461 mm. long on the right hand side of engine cowling, mouth showing upwards;
Lubrication system:	Forced feed from gear pump FIAMM FT 4927 IN oil filter in full flow with replaceable cartridge; change period 250 hours reccomended oil AGIP FI DIESEL SIGMA SAE 30 MIL-L-2104C oil capacity 16.2 l, change period 125 hours;
Cooling system:	Air cooling with axial blower, V-belt driven, fan dia 299 mm., 6000 m^3/h delivery at rated engine speed;
Starting system:	Electrical Marelli screw push starter motor MT 68 P. 3 KW;
Electrical system:	12 V, negative earth Bosch 3-phase alternator K1 14 V, 55 A 1 battery, Far Marelli lead acid type 6DE 10 MF 6 ATP 33, capacity 176 Ah at 20 hours rating
Trasmission	
Clutch:	Own make 350 mm. dia, single plate dry clutch, pedal operated for travel drive only;
Gearbox:	Own make synchromesh speed change gear with 3 speed forward and 1 speed reverse group gear with 4 groups: reduced, slow, normal and fast, total 12 speed forward and 4 speed reverse;
Rear axle and final drive:	Bevel gear drive with crown wheel and pinion, bevel gear differential with lock, pedal operated, self disengaging, epicyclic final;

Driven front axle:	Own make driven by shaft situated in tractor's median plane, engageable and disengageable by slading gear, not in motion hand lever operated, bevel gear drive with crown wheel and pinion, bevel gear type differential without lock epicyclic final drive;
Oil capacity	Gearbox in common with rear axle differential and rear axle final drive: 101 1 front axle differential: 20 1 front axle final drive: 6 1;
Oil change period:	Gearbox, rear and front drive 3000 hours;
Recommended oil:	Gearbox, rear and front drive AGIP F 1 ROTRA MP S SAE 80 W API GL 5.

Total ratio and speed (Tyres 20.8-38)

Group	Gear	Number of engine revolutions for one revolution wheel	(*) Nominal travelling speed for rated speed of engine Km/h
Forwards speeds			
reduced	1	292.421	2.51
	2	236.166	3.11
	3	192.770	3.81
slow	1	142.542	5.15
	2	115.120	6.37
	3	93.967	7.81
normal	1	75.152	9.77
	2	60.694	12.09
	3	49.542	14.81
fast	1	36.633	20.04
	2	29.586	24.81
	3	24.149	30.39
Reverse speeds			
reduced	R	237.603	3.09
slow	R	115.821	6.34
normal	R	61.064	11.87
fast	R	29.766	24.66

(*) Calculated with the radius index 885 mm as per E.T.R.T.O. Norm

Power take-off

indipendent p.t.o., at rear of tractor, in tractor's median plane
engaged and disengaged through hand lever hydraulically operated wet multidisc clutch, ISO standard 500-1979
two p.t.o. shafts for 540 rev/min. and 1000 rev/min.
direction of rotation clockwise winwed from driving end 540 rev/min. p.t.o.
910 mm. above ground
34.9 mm. dia, 6 splines SAE standard
604 rev/min. at rated engine speed, standard p.t.o. speed at 1967 rev/min engine speed;
1000 rev/min p.t.o.
740 mm above ground
34.9 mm dia, 21 spines SAE standard
993 rev/min at rated engine speed
standard p.t.o. speed at 2214 rev/min engine speed

Power lift:

Own make
hydraulic rotary piston pump driven from engine shaft, indipendent of clutch
metallic net oil filter
oil capacity 30 l.
recommended oil AGIP F 1 ROTRA MP/S
SAE 80
API GL/5
delivery 38 l/min at rated engine speed
Same control valve for lifting lowering, draf. control, position control and floating position
maximum working pressure 186 bar
cylinder in power lift unit with 120 mm bore 150 mm stroke
1 relief valve antishock on the distributor, opening pressure 190 bar,
1 relief valve on delivery circuit, opening pressure 176 bar;

Additional oil tep:

Bosch HY/ZFS 11/225 C 124 gear type pump for auxiliary hydraulic system
60 l/min delivery at rated engine speed, driven from engine shaft, double effect 6 way distributor, working pressure 127 bar
amount of oil which can be taken out without provoking damage 10÷12 l

Implement linkage:
Three point linkage category II
two holes in the lower links for fitting the lift rods
hole 1 at 455 mm
hole 2 at 495 mm distance of pivot of lower links

Trailer hitch:
Own make
height above ground adjustable by shifting from 645 mm to 855 mm
hitch hole 30 mm., distance of hitch hole centre to rear axle centre 610 mm,
permissible vertical load 1500 Kg;

Swinging drawbar:
Height above ground 540 mm
hitch hole 33 mm.
distance of hitch hole centre:
from 540 rev/min p.t.o. shaft end 370 mm below, 350 mm. behind
from 1000 rev/min p.t.o. shaft end 200 mm below, 410 mm behind
from rear axle 1160 mm behind
lateral adjustement: 275 mm
pivot point 100 mm fore ward rear axle

Steering:
Danfoss hydrostatic steering model OSBP 100 own oil circuit, Bosch hydraulic gear pump HY/2FS 11/14L 201 driven from engine shaft delivery 24 l/min at rated engine speed 2 rams acting directly on front axle, bore 22 mm. stroke 190 mm
oil capacity 2 l
specified oil AGIP F1 ATF DEXTRON
oil change period 1000 hours

Brakes

Parking brake:
Mechanically acting on the discs of the service brakes
operated by hand lewer with ratchet;

Service brake:
Hydraulically acting oil 6 oil bath disc type brake
discs dia 222 mm, mounted on rear differential half shafts
pedal operated, indipendently or together

Wheels

Steering wheel:
2 at front
16.9-30 radial tyre, 6 ply rating
maximum permissible weight on each tyre 1900 Kg. at 1.3 bar
track width: 1930-2000-2130 changed by turning wheels;

Driving wheels:	at front and at rear specification of driving front wheels (see at steering wheels) driving rear wheels: 2, 20.8-38 radial tyre, 8 ply rating maximum permissible weight on each tyre 3090 Kg. at 1.3 bar track width: from 1900 to 2200 mm in steps of 100 mm each, changed by turning wheels rim size X 18 Lx38''
Wheelbase	2860 mm
Cab:	Own make safety cab model C 19, OECD tested approval No CSD 0261/2-a (C) the cab is joined with the tractor by means of four rubber supports, the superior and inferior structures of the cab are bolted windscreen and rear window tiltable inside of cab covered with noise damping materials doors on both side of the cab, each entry with three steps, lower step 500 mm, upper step 940 mm heater Eberspaecher D1L type ventilators Borletti T 31 type air conditioner Borletti T 39 type
Seat:	Sablè VF 100RG60 type upholstered seat with back rest adjustable spring with shock absorber height unloaded seat above platform from 500 to 660 mm fore-and-aftadjustable about 150 mm
Number of grease points:	20
Track setting during tests:	front axle 2000 mm, rear axle 2000 mm
Overhall dimension:	total length 5000 mm with ballast 4750 mm without ballast total width 2240 mm min 2540 mm max total height 2900 mm to top of the cab ground clearance 500 mm below swinging drawbar pivot.

Weights

tractor without driver. with full tanks and cab fitted

without ballast: front 2590 Kg.
rear 3610 Kg.
total 6200 Kg.

with ballast: front 2890 Kg.
rear 4010 Kg.
total 6900 Kg.

ballast: front 7 more support,
total weight 300 Kg.
rear 8, total weight
400 Kg.

Lighting

Lighting system in accordance with CEE 78/933

	Height above ground of centre mm	Dimensions mm	Distance from outside edge of tractor to centre mm
Head lights	1145	110x110	920
Side lights	2040	70x110	180
Red tail lights	1860	60x 90	225
Reflectors	1460	80x 80	210

Fuel and lubricants used in tests

laboratory and track test

fuel: Diesel fuel, specific gravity at 15° C 0,828 Kg/dm³ at p.t.o. test 0,840 Kg/dm³ at drawbar test Cetane No 48

engine oil: AGIP F1 DIESEL SIGMA SAE 30 MIL-L-2104 C

transmission and rear axle power lift, front axle differential: AGIP F1 ROTRA MP/S SAE 80 W API GL-5

steering: AGIP F1 ATF DEXTRON

Same Hercules 160/VDT

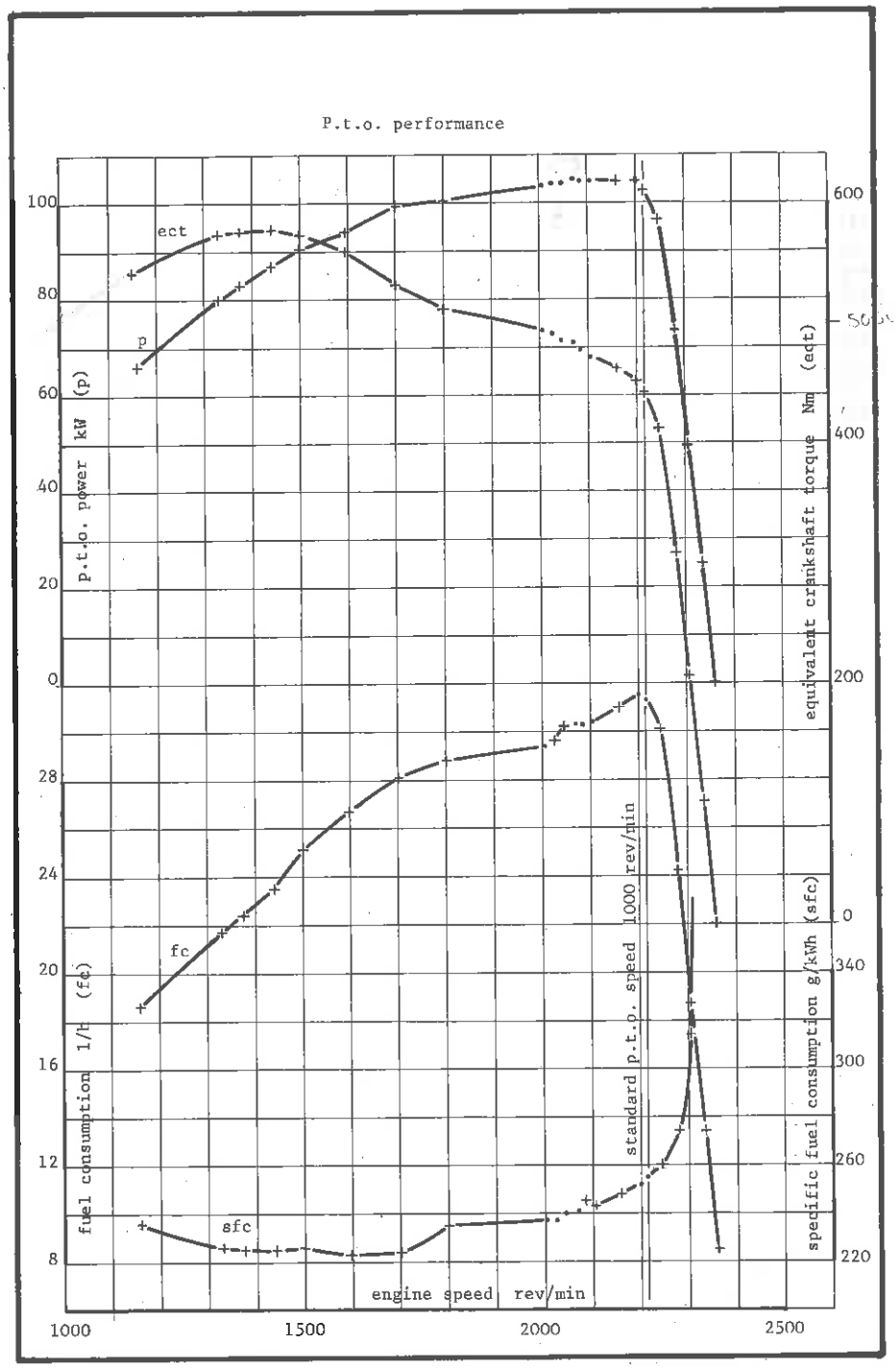
COMPULSORY TESTS

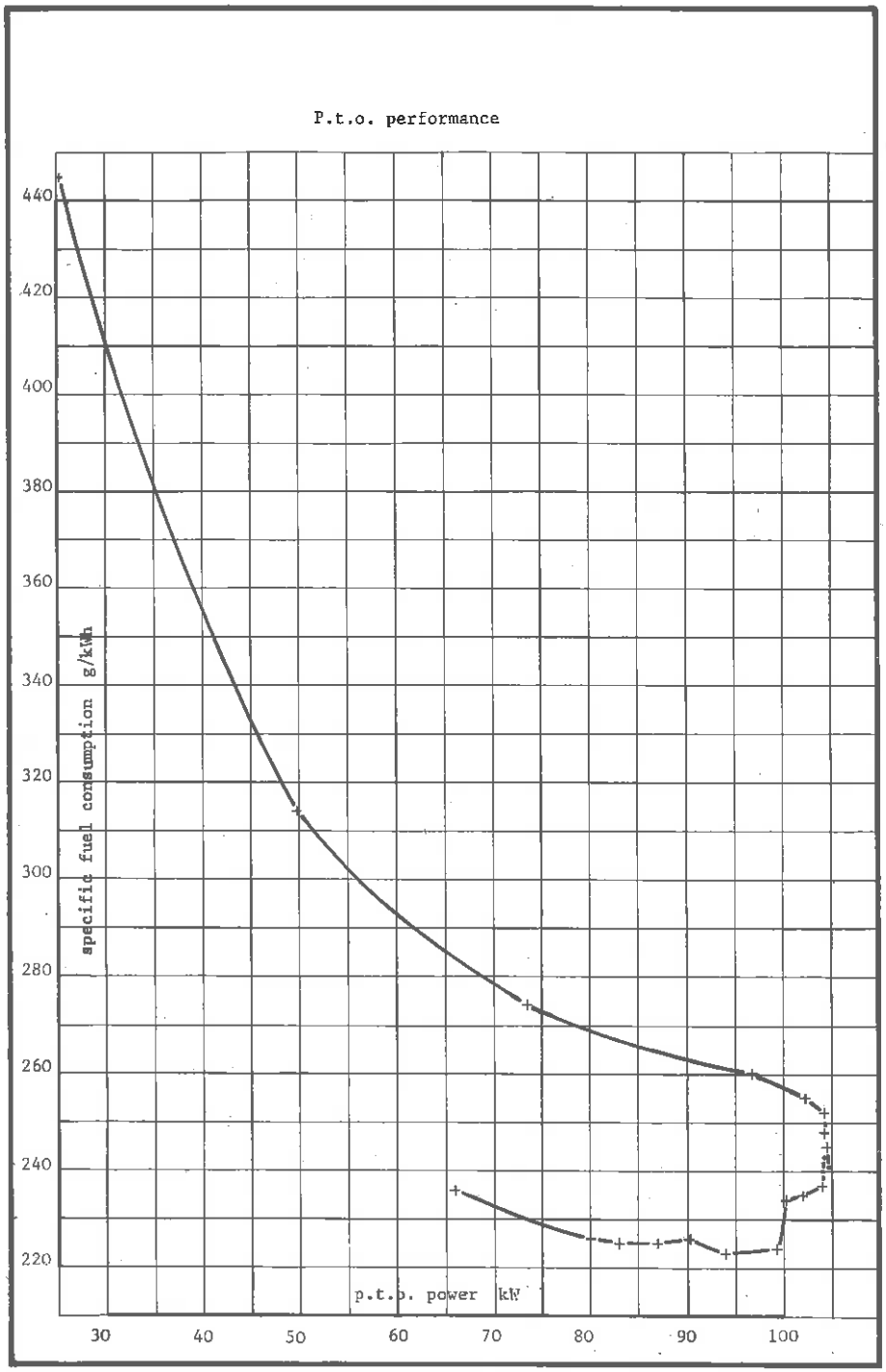
(1) **POWER TAKE - OFF PERFORMANCE** (1000 rev/min)
Date and location of test: 31st January 1980 - Treviglio
Type of dynamometer: Zöllner magnetoelectric dynamometer

Power kw	Speed		Fuel consumption		Specific energy kwh/l
	Engine rev/min	p.t.o. rev/min.	hourly l/h	specific g/kwh	
MAXIMUM POWER - 2 hour test					
104.83	2070	934	30.342	241	3.45
SPEED RECOMMENDED BY THE MANUFACTURER FOR DRAWBAR WORK					
104.29	2200	993	31.487	252	3.31
STANDARD SPEED OF THE P.T.O.					
102.38	2215	1000	31.310	255	3.27
PARTS LOADS - MAXIMUM POWER					
(i) 85% of the torque obtained at maximum power					
96.741	2246	1014	30.137	260	3.21
(ii) unloaded					
–	2357	1064	8.513	–	–
(iii) half the load defined in (i)					
49.66	2306	1041	18.716	314	2.65
(iv) a load corresponding to maximum power					
104.83	2070	934	30.342	241	3.45
(v) one quarter of the load defined in (i)					
25.14	2335	1054	13.392	444	2.42
(vi) three quarters of the load defined in (i)					
73.62	2280	1029	24.173	274	3.04

Standard specific fuel consumption g/kWh: 260/314/260/314
No load maximum engine speed: 2357 rev/min
Torque (°) at maximum power: 483.78 Nm
Maximum torque (°): 577.63 Nm at 1440 rev/min of the engine
Mean atmospheric conditions: temperature: 15° C; pressure: 1004 mbar; relative humidity 67%
Maximum temperatures: coolant: 57° C; engine oil: 113° C; fuel: 17° C; engine air intake: 23° C

(°) The torque is the equivalent crankshaft torque


P.t.o. performance
ect
p
fc
sfc
p.t.o. power kW (p)
fuel consumption l/h (fc)
standard p.t.o. speed 1000 rev/min
equivalent crankshaft torque Nm (eqt)
specific fuel consumption g/kWh (sfc)
engine speed rev/min
100
80
60
40
20
0
28
24
20
16
12
8
600
400
200
0
340
300
260
220
1000
1500
2000
2500


P.t.o. performance
specific fuel consumption g/kWh
440
420
400
380
360
340
320
300
280
260
240
220
p.t.o. power kW
30
40
50
60
70
80
90
100

(2) DRAWBAR PERFORMANCE

Date of tests: 1st still 10th July 1980
Type of track: concrete
Height of drawbar above ground for both test series: 855 mm

Gear No and group	Speed Km/h	Power KW	Drawbar pull daN	Engine speed rev/min	Slip of wheels %	Specific energy kwh/l	Specific fuel consumption g/KWh	Temperatures			Atmospheris condition		
								Fuel °C	Coolant °C	Engine oil °C	Tempe-rature °C	Relative humidity %	Press. mbar
(i) MAXIMUM POWER with ballast													
1 reduced	2.27	40.44	6410	2302	15.0	2.37	354	28	57	86	26	64	1020
2 reduced	2.85	50.70	6400	2295	15.0	2.53	333	28	55	88	26	64	1020
3 reduced	3.35	59.32	6370	2280	15.0	2.57	327	29	61	92	27	58	1020
1 slow	4.48	79.08	6350	2247	15.0	2.71	310	30	61	92	28	59	1020
2 slow	5.90	87.11	5310	2232	8.9	2.79	301	30	60	93	29	60	1020
3 slow	7.40	86.68	4220	2232	7.7	2.78	303	30	66	98	29	60	1020
1 normal	9.10	86.51	3420	2216	6.5	2.75	306	30	69	99	29	60	1020
2 normal	11.60	87.53	2720	2223	5.3	2.81	300	30	55	99	29	60	1020
3 normal	14.40	82.77	2070	2219	4.0	2.63	320	30	61	96	29	60	1020
(ii) FIVE HOUR TEST at 75% of pull at maximum power in 2nd slow gear													
2 slow	6.10	67.55	3990	2265	6.5	2.55	330	31	64	75	29	66	1009
(iii) FIVE HOUR TEST at pull corresponding to 15% Weel slip in test (i)													
1 slow	4.70	83.73	6410		–	–	–	31	71	90	29	66	1009
(iv) MAXIMUM POWER without ballast													
1 reduced	2.26	36.38	5800	2317	15.0	2.09	403	20	42	73	19	74	1009
2 reduced	2.76	45.03	5870	2313	15.0	2.42	348	20	46	77	19	74	1009
3 reduced	3.35	51.60	5540	2295	15.0	2.41	349	21	48	51	20	74	1009
1 slow	4.53	70.34	5590	2267	15.0	2.47	340	22	49	53	20	74	1009
2 slow	5.44	78.39	5190	2216	15.0	2.50	336	23	49	54	21	75	1009
3 slow	7.20	83.36	4170	2230	8.9	2.76	305	24	52	56	21	75	1009
1 normal	9.36	84.40	3240	2233	6.5	2.78	303	24	55	58	21	75	1009
2 normal	11.47	83.42	2620	2220	5.3	2.67	315	24	57	58	22	68	1009
3 normal	14.22	80.96	2050	2227	5.3	2.62	321	25	56	60	22	68	1009

Total oil consumption during ten hours duration of test (ii) and (iii): 325 g/h
Tyre inflation pressure for both test series: front 1.3 bar - rear 1.3 bar
Test (iii) was carried out with additional ballast, the figures not quoted are therefore irrilevant.

(3) **TURNING SPACE AND TURNING CIRCLE**

Details of wheel equipment: 20.8-38 8 plies rear; 16.9-30 6 plies forward
Track: front 2000 mm
rear 2000 mm
Front axle engaged

	With brakes		Without brakes	
	right-hand m	left-hand m	right-hand m	left-hand m
Radius of turning space	5.2	5.2	5.9	5.9
Radius of turning circle	5.0	5.0	5.7	5.7

(4) **LOCATION OF CENTRE OF GRAVITY**

	mm
Height above ground	927
Distance forward from the vertical plane containing the axis of the rear wheels	1247
Distance from the median plane	0

(5) BRAKING

Date of tests: 14th July 1980
Type of track: concrete
Type of decelerometer: Motometer
Mass of ballasted tractor with driver: 6970 Kg.

Cold brakes:

	Ballasted	Without Ballast
Travelling speed of the tractor Km/h	25	25
(i) Deceleration m/s²	3.5	3.8
(ii) Stopping distance m	6.9	6.3
(iii) Force exerted on the brake pedal daN	59	54
(iv) Force exerted on the brake pedal to achieve a deceleration of 2.5 m/s² daN	44	39

Brake Fade Characteristics (hot tests):

	Ballasted	Without Ballast
Deceleration, hot/deceleration, cold x 100	97	98
Stopping distance cold/stopping distance hot x 100	94	97
Force on pedal, cold/force on pedal, hot x 100	102	102

Parking brake:

Efficacy of handbrake/parking latch, facing up 16% slope: tractor does not roll
down 16% slope: tractor does not roll

Pull on handbrake: 29 daN

(6) **MEASUREMENT OF AMBIENT NOISE**

Date of tests: 15th July 1980
Type of sound level meter: Brüel & Kjaer 2209
Type of trake: concrete
Results of tests:
Gear: 3rd fast
Travelling speed before acceleration: 23 Km./h
Sound level: 88.5 dB (A)

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

Date of tests: February 1979 - April 1980
Type of sound level meter and octave filter: Brüel & Kjaer 2209-1613
Type of track: tarmacadam
Type of frequency analyser: Brüel & Kjaer 1613
the tractor was fitted with Same C 19 safety cab

Results of tests:

Gear	Travelling speed (x) Km/h	dB (A)
2 slow	7.71	85.5
1 normal	9.64	85.5
2 normal	11.94	86.0
3 normal	14.62	86.5
1 fast	19.78	85.5
2 fast	24.49	85.5

(°) Data taken from O.E.C.D. test report No CSD 0261/2-a(C)
(x) The first gear tested corresponds to the nominal travelling speed nearest to 7.5 Km/h.

(8) POWER LIFT AND HYDRAULIC PUMP PERFORMANCE

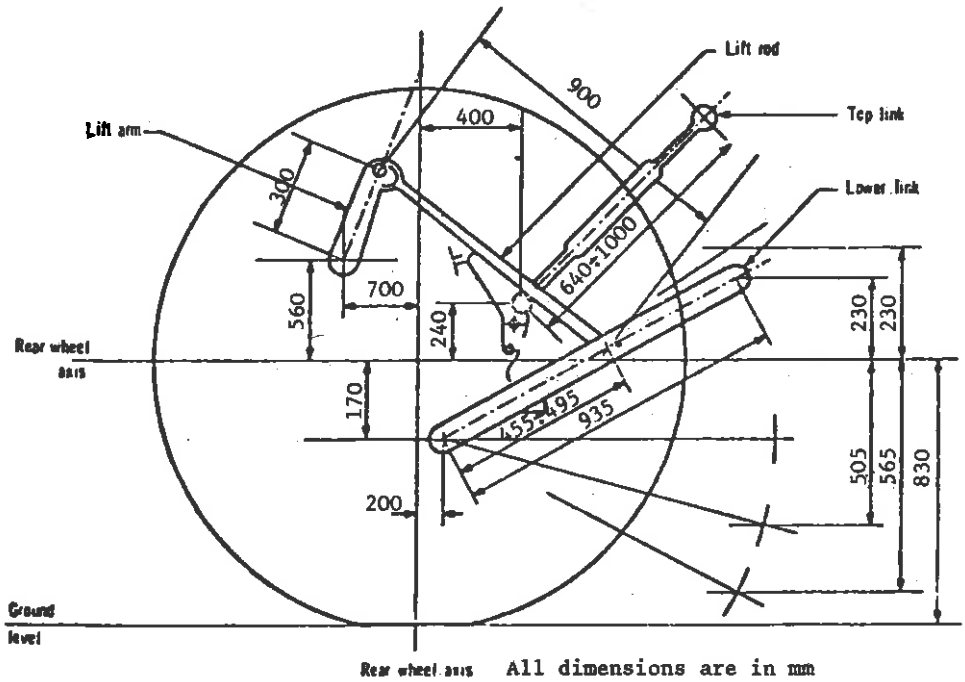
Date and location of test: 23rd July 1980 - Treviglio

Pump characteristics:

(i) opening pressure of the relief valve: 176 bar
sustained pressure by the opened relief valve: 186 bar
(ii) pump delivery rate at minimum pressure and
rated engine speed: 38 l/min
(iii) pump delivery rate at maximum hydraulic power: 37.5 l/min.
corresponding delivery pressure: 172 bar
power: 10.72 KW.

Power lift

Dimensions of linkage geometry for the table on page. 20



All dimensions are in mm

Linkage geometry when connected to the standard frame

	Maximum mechanical advantage		Minimum mechanical advantage	
Projected length in side view				
lower links, mm	935		935	
lift arms, mm	300		300	
lift rods, mm	900		900	
top link, mm	640÷1000		640÷1000	
Distance of lift rod connection point from pivot point of lower link, mm	495		465	
The following dimensions are given relative to the rear wheel centre line, situated 830 mm above the ground level				
Lower link pivot point	200 mm behind,	170 mm below	200 mm behind,	170 mm below
Top link pivot point	400 mm behind,	240 mm above	400 mm behind,	240 mm above
Lift arm pivot point	700 mm forward,	560 mm above	700 mm forward,	560 mm above
Maximum and minimum height of lower link hitch points	230 mm above,	505 mm below	230 mm above,	565 mm below
Height of lower link hitch points when locked in transport position	230 mm above,	–	230 mm above,	–

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

		mm.	–360	–330	–310	–250	–200	–160	–100	–50	0	+50	+100	+150	+200	+250	+300	+360
Lifting force with the pressure at maximum hydraulic power 172 bar calculated from measurements made at the maximum pressure 181 bar	AT THE HITCH POINTS	Max. mech. advantage daN	–	–	–	4370	4710	4890	4980	5120	5250	5310	5350	5420	5510	5660	5750	–
		Min. mech. advantage daN	–	–	3960	4220	4310	4580	4700	4770	4850	4960	5040	5170	5150	5280	5370	–
		Maximum force exerted throughout whole range: 4370/3960 daN																
	ON THE FRAME	Max. mech. advantage daN	4420	4630	4710	5810	4870	4880	4920	4940	4890	4860	4800	4750	4710	4660	–	–
		Max. mech. advantage daN	–	4250	4290	4390	4460	4530	4590	4590	4600	4560	4510	4480	4460	4440	4430	–
		Maximum force exerted throughout whole range: 4420/4250 daN Force at which front of tractor is calculated to lift with maximum allowable front ballast: 4160 daN																

Test Officers

(Sergio Mancastroppa)

(Luigi Viola)

(Claudio Trolli)

Officer in charge
(Pierluigi Febo)

Head of I.I.A.
(Ettore Gasparetto)