

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Nebraska Tractor Tests

Tractor Test and Power Museum, The Lester F.
Larsen

January 1969

Test 1024: John Deere 4020 Power Shift

Follow this and additional works at: <http://digitalcommons.unl.edu/tractormuseumlit>



Part of the [Applied Mechanics Commons](#)

"Test 1024: John Deere 4020 Power Shift" (1969). *Nebraska Tractor Tests*. 433.
<http://digitalcommons.unl.edu/tractormuseumlit/433>

This Article is brought to you for free and open access by the Tractor Test and Power Museum, The Lester F. Larsen at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Nebraska Tractor Tests by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

NEBRASKA TRACTOR TEST 1024 - JOHN DEERE 4020 POWER SHIFT DIESEL

POWER TAKE-OFF PERFORMANCE

Hp	Crankshaft speed rpm	Fuel Consumption			Temperature Degrees F			
		Gal per hr	Lb per hp-hr	Hp-hr per gal	Cooling medium	Air wet bulb	Air dry bulb	Barometer inches of Mercury
MAXIMUM POWER AND FUEL CONSUMPTION								
Rated Engine Speed—Two Hours								
95.83	2200	6.486	0.471	14.77	198	72	75	28.922
Standard Power Take-off Speed (1000 rpm)—One Hour								
89.93	1894	6.047	0.468	14.87	206	72	75	28.935
VARYING POWER AND FUEL CONSUMPTION—TWO HOURS								
83.93	2264	5.662	0.469	14.82	186	73	76	.....
0.00	2410	1.966	.....	.....	170	71	74	.....
43.23	2341	3.782	0.609	11.43	175	71	74	.....
95.92	2200	6.580	0.477	14.58	197	72	75	.....
22.02	2369	2.945	0.931	7.48	171	71	74	.....
63.96	2303	4.692	0.510	13.63	178	72	74	.....
Av 51.51	2315	4.271	0.577	12.06	179	72	74	28.943

DRAWBAR PERFORMANCE

Hp	Drawbar pull lbs	Speed miles per hr	Crankshaft speed rpm	Slip of drivers %	Fuel Consumption			Temp Degrees F			Barometer inches of Mercury
					Gal per hr	Lb per hp-hr	Hp-hr per gal	Cooling med	Air wet bulb	Air dry bulb	

VARYING DRAWBAR POWER AND FUEL CONSUMPTION WITH BALLAST

Maximum Available Power—Two Hours—4th Gear											
83.09	6446	4.83	2202	7.64	6.573	0.550	12.64	173	38	45	29.100
75% of Pull at Maximum Power—Ten Hours—4th Gear											
67.63	4871	5.21	2327	5.78	5.411	0.557	12.50	169	43	45	28.755
50% of Pull at Maximum Power—Two Hours—4th Gear											
49.19	3439	5.36	2357	4.31	4.496	0.636	10.94	152	38	42	29.235
MAXIMUM POWER WITH BALLAST											
68.95	11104	2.33	2320	14.89	2nd Gear	.....	158	37	41	.....	29.250
81.53	8429	3.63	2200	10.21	3rd Gear	.....	171	42	49	.....	29.060
83.71	6494	4.83	2205	7.64	4th Gear	.....	170	42	49	.....	29.010
84.13	4973	6.34	2202	5.78	5th Gear	.....	171	43	51	.....	29.060
82.48	3707	8.34	2204	4.05	6th Gear	.....	170	43	51	.....	29.010
83.78	2802	11.13	2202	3.47	7th Gear	.....	170	42	49	.....	29.010

MAXIMUM PULL WITHOUT BALLAST

72.35	7648	3.55	2267	14.97	3rd Gear	170	37	43	29.140
-------	------	------	------	-------	----------	-------	-----	----	----	-------	--------

VARYING DRAWBAR PULL AND TRAVEL SPEED WITH BALLAST—4th Gear

Pounds Pull	6494	7076	7379	7455	7508	7057
Horsepower	83.71	81.42	74.64	66.12	57.40	44.69
Crankshaft speed rpm	2205	1983	1752	1540	1327	1094
Miles per hour	4.83	4.31	3.79	3.33	2.87	2.38
Slip of drivers, %	7.64	8.52	8.91	9.18	9.04	8.52

TIRES, BALLAST and WEIGHT

		With Ballast	Without Ballast
Rear tires	—No, size, ply & psi	Two 18.4-34; 8; 20	Two 18.4-34; 8; 16
	Ballast	930 lb each	None
	Cast iron	1260 lb each	None
Front tires	—No, size, ply & psi	Two 7.5L-15; 6; 32	Two 7.5L-15; 6; 32
	Ballast	None	None
	Cast iron	20 lb each	None
Height of drawbar		19½ inches	20 inches
Static weight with operator—Rear		11280 lb	6900 lb
	Front	2700 lb	2660 lb
	Total	13980 lb	9560 lb

The University of Nebraska Agricultural Experiment Station
E. F. Frolik, Dean; H. W. Ottoson, Director; Lincoln, Nebraska

Department of Agricultural Engineering

Dates of Test: September 30, 1969 to October 17, 1969

Manufacturer: JOHN DEERE WATERLOO TRACTOR WORKS, WATERLOO, IOWA

FUEL, OIL and TIME Fuel diesel Cetane No 52.2 (rating taken from oil company's typical inspection data) Specific gravity converted to 60°/60° 0.8355 Weight per gallon 6.957 lb Oil SAE 30 API service classification MS, DS To motor 2.722 gal Drained from motor 2.247 gal Transmission and final-drive lubricant John Deere Special 303 oil Total time engine was operated 43½ hours.

ENGINE Make John Deere Diesel Type 6 cylinder vertical Serial No M23R0245580R Crankshaft mounted lengthwise Rated rpm 2200 Bore and stroke 4.25" x 4.75" Compression ratio 16.5 to 1 Displacement 404 cu in Cranking system 12 volt (two 6-volt batteries) Lubrication pressure Air cleaner Dry type with replaceable paper element Oil filter replaceable paper element Oil cooler Engine coolant heat exchanger for crankcase oil and radiator for transmission and hydraulic oil Fuel filter Screen in fuel pump, replaceable paper elements for 1st and 2nd stage Muffler was used Cooling medium temperature control dual thermostats.

CHASSIS Type standard Serial No T213-P222056R Tread width rear 60" to 91" front 50.8" to 79.9" Wheel base 100.25" Center of gravity (without operator or ballast, with minimum tread, with fuel tank filled and tractor serviced for operation) Horizontal distance forward from center-line of rear wheels 27.18" Vertical distance above roadway 38.60" Horizontal distance from center of rear wheel tread 0.36" to the right Hydraulic control system direct engine drive Transmission fixed ratio operator controlled full range shifting Advertised speeds mph first 1.8 second 2.5 third 3.8 fourth 5.1 fifth 6.6 sixth 8.5 seventh 11.2 eighth 18.7 reverse 2.1, 3.0, 4.6 and 5.9 Clutch multiple disc wet clutches within transmission, hydraulically operated Brakes wet disc hydraulically power actuated by two foot pedals which can be locked together Steering hydrostatic Turning radius (on concrete surface with brake applied) right 128" left 128" (on concrete surface without brake) right 150" left 150" Turning space diameter (on concrete surface with brake applied) right 256" left 256" (on concrete surface without brake) right 335" left 335" Belt pulley 966 rpm at 1900 engine rpm diam 12" face 8.5" Belt speed 3035 fpm Power take-off 1003 rpm at 1900 engine rpm.

REPAIRS and ADJUSTMENTS: No repairs or adjustments.

REMARKS: All test results were determined from observed data obtained in accordance with the SAE and ASAE test code. First gear was not run as it was necessary to limit the pull in second gear to avoid excessive wheel slippage. Eighth gear was not run because it exceeded 15 mph.

We, the undersigned, certify that this is a true and correct report of official Tractor Test 1024.

L. F. LARSEN

Engineer-In-Charge

G. W. STEINBRUEGGE, Chairman

W. E. SPLINTER

D. E. LANE

Board of Tractor Test Engineers

EXPLANATION OF TEST REPORT

GENERAL CONDITIONS

Each tractor is a production model equipped for common usage. Power consuming accessories can be disconnected only when it is convenient for the operator to do so in practice. Additional weight can be added as ballast if the manufacturer regularly supplies it for sale. The static tire loads and the inflation pressures must conform to recommendations in the Tire Standards published by the Society of Automotive Engineers.

PREPARATION FOR PERFORMANCE RUNS

The engine crankcase is drained and refilled with a measured amount of new oil conforming to specifications in the operators manual. The fuel used and the maintenance operations must also conform to the published information delivered with the tractor. The tractor is then limbered-up for 12 hours on drawbar work in accordance with the manufacturer's published recommendations. The manufacturer's representative is present to make appropriate decisions regarding mechanical adjustments.

The tractor is equipped with approximately the amount of added ballast that is used during maximum drawbar tests. The tire tread-bar height must be at least 65% of new tread height prior to the maximum power run.

BELT OR POWER TAKE-OFF PERFORMANCE

Maximum Power and Fuel Consumption. The manufacturer's representative makes carburetor, fuel pump, ignition and governor control settings which remain unchanged throughout all subsequent runs. The governor and the manually operated governor control lever is set to provide the high-idle speed specified by the manufacturer for maximum power. Maximum power is measured by connecting the belt pulley or the power take-off to a dynamometer. The dynamometer load is then gradually increased until the engine is operating at the rated speed specified by the manufacturer for maximum power. The corresponding fuel consumption is measured.

Varying Power and Fuel Consumption. Six different horsepower levels are used to show corresponding fuel consumption rates and how the governor causes the engine to react to the following changes in dynamometer load: 85% of the dynamometer torque at maximum power; minimum dynamometer torque, $\frac{1}{2}$ of the 85% torque; maximum power, $\frac{1}{4}$ and $\frac{3}{4}$ of the 85% torque. Since a tractor is generally subjected to varying loads the average of the results in this test serve well for predicting the fuel consumption of a tractor in general usage.

DRAWBAR PERFORMANCE

All engine adjustments are the same as those used in the belt or power take-off tests. If the manufacturer specifies a different rated crankshaft speed for drawbar operations, then the position of the manually operated governor control is changed to provide the high-idle speed specified by the manufacturer in the operating instructions.

Varying Power and Fuel Consumption With Ballast. The varying power runs are made to show the effect of

speed-control devices (engine, governor, automatic transmission, etc.) on horsepower, speed and fuel consumption. These runs are made around the entire test course which has two 180 degree turns with a minimum radius of 50 feet. The drawbar pull is set at 3 different levels as follows: (1) as near to the pull at maximum power as possible and still have the tractor maintain the travel speed at maximum horsepower on the straight sections of the test course; (2) 75% of the pull at maximum power; and (3) 50% of the pull at maximum power. Prior to 1958, fuel consumption data (10 hour test) were shown only for the pull obtained at maximum power for tractors having torque converters and at 75% of the pull obtained at maximum power for gear-type tractors.

Maximum Power with Ballast. Maximum power is measured on straight level sections of the test course. Data are shown for not more than 12 different gears or travel speeds. Some gears or travel speeds may be omitted because of high slippage of the traction members or because the travel speed may exceed the safe-limit for the test course. The maximum safe speed for the Nebraska Test Course has been set at 15 miles per hour. The slippage limits have been set at 15% and 7% for pneumatic tires and steel tracks or lugs, respectively. Higher slippage gives widely varying results.

Maximum Pull without Ballast. All added ballast is removed from the tractor. The drawbar pull is determined at slip limits of 15% for pneumatic tires or 7% for steel tracks or lugs. The tractor is operated at the fastest possible travel speed.

Varying Power and Travel Speed with Ballast. Travel speeds corresponding to drawbar pulls beyond the maximum power range are obtained to show the "lugging ability" of the tractor. The run starts with the pull at maximum power; then additional drawbar pull is applied to cause decreasing speeds. The run is ended by one of three conditions: (1) maximum pull is obtained, (2) the maximum slippage limit is reached, or (3) some other operating limit is reached.

For additional information about the Nebraska Tractor Tests write to the Department of Agricultural Engineering, University of Nebraska, Lincoln, Nebraska.



JOHN DEERE 4020 POWER SHIFT DIESEL