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Test 746: Caterpillar D-4 (Diesel)

Nebraska Tractor Test Lab

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NEBRASKA TRACTOR TEST 746 - CATERPILLAR D4 DIESEL

The University of Nebraska Agricultural Experiment Station

E. F. Frolik, Director; Lincoln, Nebraska

BELT PERFORMANCE

Hp	Crank shaft speed rpm	Fuel Consumption		Hp-hr per gal	Temp Degrees F			Barometer inches of mercury
		Gal per hr	Lb per hp-hr		Cooling med	Air wet bulb	Air dry bulb	
MAXIMUM POWER AND FUEL CONSUMPTION								
Rated Engine ^a Speed—Two Hours								
56.54	1600	4.310	0.534	13.12	172	72	81	28.828
VARYING POWER AND FUEL CONSUMPTION—TWO HOURS								
50.10	1667	3.728	0.522	13.44	178	73	84	.....
0.00	1805	1.391	.....	.....	171	73	84	.....
26.51	1759	2.504	0.662	10.59	174	73	84	.....
57.06	1600	4.327	0.532	13.19	183	75	85	.....
13.39	1774	1.986	1.040	6.74	182	74	84	.....
38.92	1723	3.073	0.553	12.67	172	75	86	.....
Av 31.00	1721	2.835	0.641	10.93	176	74	84	28.800

DRAWBAR PERFORMANCE

Hp	Draw-bar pull lbs	Speed miles per hr	Crank shaft speed rpm	Slip of drivers %	Fuel Consumption		Hp-hr per gal	Temperature Degrees F			Barometer inches of mercury
					Gal per hr	Lb per hp hr		Cooling medium	Air wet bulb	Air dry bulb	
VARYING DRAWBAR POWER AND FUEL CONSUMPTION WITH BALLAST											
Maximum Available Power—Two Hours—2nd Gear											
49.31	8072	2.29	1607	2.46	4.170	0.593	11.82	178	70	84	28.775
75% of Pull at Maximum Power—Ten Hours—2nd Gear											
39.78	6129	2.43	1688	1.40	3.453	0.609	11.52	178	69	77	28.750
50% of Pull at Maximum Power—Two Hours—2nd Gear											
27.46	4104	2.51	1735	1.04	2.826	0.721	9.72	186	72	89	28.905
MAXIMUM POWER WITH BALLAST											
48.76	11694	1.56	1599	4.76	1st Gear.....		182	70	86	28.780	
50.18	8250	2.28	1601	2.58	2nd Gear.....		177	67	79	28.790	
49.30	5790	3.19	1598	1.91	3rd Gear.....		185	75	85	28.750	
47.25	4238	4.18	1603	1.66	4th Gear.....		185	72	79	28.750	
44.06	3005	5.50	1599	1.07	5th Gear.....		185	72	79	28.750	
VARYING DRAWBAR PULL AND TRAVEL SPEED WITH BALLAST—2nd Gear											
Pounds pull			8250	8650	9050	9150	9100	9200			
Horsepower			50.2	46.1	43.4	39.0	34.0	27.0			
Miles per hour			2.3	2.0	1.8	1.6	1.4	1.1			

Department of Agricultural Engineering

Dates of Test: June 14 to June 29, 1960

Manufacturer: CATERPILLAR TRACTOR COMPANY, PEORIA, ILLINOIS

Manufacturer's Power Rating: 52 Drawbar Horsepower (Corrected to standard conditions)

FUEL, OIL and TIME Fuel No. 2 Diesel Cetane No 50 (rating taken from oil company's typical inspection data) Specific gravity converted to 60°/60° 0.8419 Weight per gallon 7.010 lb Oil SAE 30 API Service classification DS To motor 3.981 gal Drained from motor 4.030 gal Transmission and final-drive lubricant SAE 30 Type engine oil Total time engine was operated 41½ hours.

ENGINE Make Caterpillar Diesel Type 4 cylinder vertical Serial No 40A796 Crankshaft mounted lengthwise Rated rpm 1600 Bore and stroke 4½" x 5½" Compression ratio 18 to 1 Displacement 350 cu in Lubrication pressure Air cleaner dry type, 2 replaceable paper elements Oil filter replaceable paper element Fuel filter one edge type filter, one replaceable paper element Muffler was used Cooling medium temperature control thermostat.

STARTING ENGINE Make Caterpillar Type 2 cylinder vertical Mounted right side of diesel engine Mfg rating 15 hp at 6000 rpm Bore and stroke 2½" x 2½" Ignition system magneto Air cleaner dry type replaceable paper element Starting system 12 volt electrical plus hand operated recoil starter.

CHASSIS Type tracklayer Serial No 40A796 Tread width 60" Wheel base 72¾" Drawbar height 12½" Measured length of track 19.69 ft Cleats integral with shoes Cleats per track 35 Size of cleats 13" x 1½" 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 sprockets 33⅝" Vertical distance above roadway 25⅝" Horizontal distance from center of tread 0" to the right/left Hydraulic control system direct engine drive Transmission selective gear fixed-ratio Advertised speeds mph first 1.6 second 2.3 third 3.2 fourth 4.2 fifth 5.5 reverse first 1.9 second 2.7 third 3.8 fourth 4.9 Clutch multiple disc operated by hand lever Brakes contracting bands operated by two foot pedals, one of which can be locked Steering hand levers controlling multiple disc clutches Turning space diameter (with brake applied) right 177" left 177" Belt pulley 808 or 949 rpm at 1600 engine rpm diam 14" face 8½" Belt speed 2957 or 3473 fpm Belt type flat length 75' width 8" Thickness 0.216" Maximum slip 0.74%.

TOTAL WEIGHT WITH OPERATOR 14,825 lb including hydraulic control unit 320 lb, bulldozer trunions and hydraulic cylinders 1180 lb, belt pulley 222 lb.

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.

We, the undersigned, certify that this is a true and correct report of official Tractor Test 746.

L. F. LARSEN

Engineer-in-Charge

L. W. HURLBUT, Chairman

G. W. STEINBRUEGGE

J. J. SULEK

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 lead 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, $\frac{1}{2}$ 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 transmissions, etc.) on horsepower, speed and fuel consumption. These runs are made around the entire test course which has two 180 degree

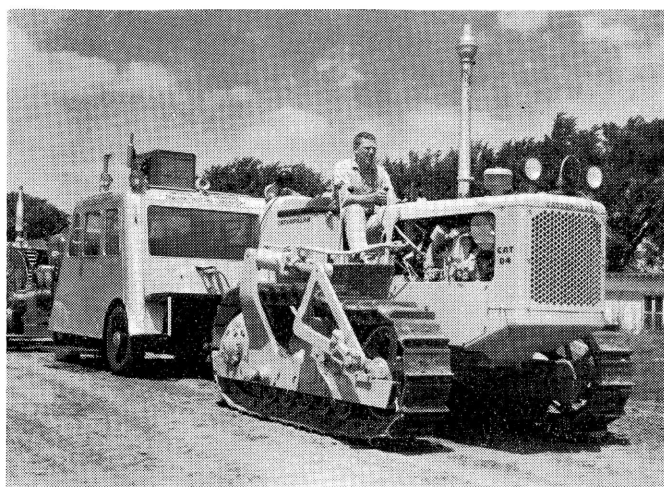
turns with a minimum radius of 50 feet. The drawbar pull is set at 3 different levels as follows: (1) as near to the pull at maximum power as possible and still have the tractor maintain the travel speed at maximum horsepower on the straight sections of the test course; (2) 75% of the pull at maximum 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 Power Without Ballast. All added ballast is removed from the tractor. The maximum drawbar power of the tractor is determined by the same procedure used for getting maximum power with ballast. The gear (or travel speed) is the same as that used in the 10-hour test.

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.



Caterpillar D4 Diesel