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Test 553: Caterpiller D-2

Nebraska Tractor Test Lab
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The Experiment Station
University of Nebraska College of Agriculture
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Department of Agricultural Engineering
Dates of test: July 25 to July 30, 1955
Manufacturer: CATERPILLAR TRACTOR COMPANY, PEORIA, ILLINOIS
Manufacturer's rating: 38 maximum drawbar horsepower (corrected to standard conditions)

NEBRASKA TRACTOR TEST NO. 553

CATERPILLAR D-2

BELT HORSEPOWER TESTS

Hp	Crank shaft speed rpm	Fuel Consumption: Gal per hour	Fuel Consumption: Hp-hr per gal	Fuel Consumption: Lb per hp-hour	Water used gal per hour	Temp Deg F: Cooling med	Temp Deg F: Air	Barometer inches of mercury
TESTS B AND C—100% MAXIMUM LOAD—TWO HOURS								
41.86	1650	3.402	12.30	0.571	0.00	199	106	28.757
TEST D—RATED LOAD—ONE HOUR								
38.68	1650	2.991	12.93	0.543	0.00	199	106	28.700
TEST E—VARYING LOAD—TWO HOURS (20 minute runs; last line average)								
38.74	1650	2.991	12.95	0.542	...	197	106	.....
3.07	1764	1.184	2.59	2.707	...	154	104	.....
20.75	1755	1.970	10.53	0.667	...	157	104	.....
39.01	1445	3.073	12.69	0.553	...	206	103	.....
10.46	1757	1.509	6.93	1.012	...	157	102	.....
30.38	1732	2.440	12.45	0.564	...	164	100	.....
23.74	1684	2.194	10.82	0.649	0.00	172	103	28.700

TORQUE (At Dynamometer)										
Eng rpm	1647	1567	1478	1392	1305	1225	1142	1052	964	879
Lb-ft	274.4	280.5	287.9	294.0	297.5	302.2	304.9	307.8	306.6	298.9
Dyn rpm	807	767	723	681	638	598	556	511	466	425

DRAWBAR HORSEPOWER TESTS

Hp	Draw bar pull lb	Speed miles per hr	Crank shaft speed rpm	Slip of drive wheels %	Fuel Consumption: Gal per hour	Fuel Consumption: Hp-hr per gal	Fuel Consumption: Lb per hp-hr	Water used gal per hour	Temp Deg F: Cooling med	Temp Deg F: Air	Barometer inches of mercury
TEST H—RATED LOAD—TEN HOURS—2nd Gear											
29.03	4147	2.63	1651	2.69	2.717	10.68	0.657	0.00	177	96	28.854
TESTS F & G—100% MAXIMUM LOAD											
34.55	7413	1.75	1648	4.17	1st gear (part throttle)				173	95	28.840
36.62	5205	2.64	1655	2.81	2nd gear				172	83	28.920
35.84	4223	3.18	1653	2.17	3rd gear				177	87	28.920
35.01	3436	3.82	1652	1.70	4th gear				178	89	28.920
32.85	2234	5.51	1653	0.89	5th gear				180	89	28.920

FUEL, OIL and TIME Diesel fuel Cetane No. 50 (rating taken from oil company's typical inspection data) **weight per gallon** 7.020 lb **Oil** SAE 30 **to motor** 3.022 gal **drained from motor** 2.348 gal **Total time motor was operated** 42 hours.

CHASSIS Type Tracklayer **Serial No.** 5U15427 **Tread width** 50" **Wheel base** 60 13/16" **Measured length of track** 196" **Cleats** integral with shoes **Cleats per track** 32 **Size of cleats** 12" x 1⅞" **Advertised speeds mph** first 1.8 second 2.7 third 3.2 fourth 3.9 fifth 5.5 reverse 2.2 **Belt pulley diam** 12" **Face** 7½" **rpm** 960 **Belt speed** 3015 fpm **Clutch** dry single plate clutch operated by hand lever **Seat** upholstered **Brakes** contracting bands operated by two foot pedals one of which can be locked by latch **Steering** two hand levers controlling multiple disc clutches.

ENGINE Make Caterpillar Diesel **Type** 4 cylinder vertical **Serial No.** 5U15427 **Crankshaft mounted** lengthwise **Head** I **Lubrication** pressure **Bore and stroke** 4" x 5" **Rated rpm** 1650 **Compression ratio** 18.5 to 1 **Displacement** 252 cu. in. **Port diameter valves** inlet 1⅜" exhaust 1⅜" **Governor** variable speed centrifugal **Air cleaner** oil washed wire mesh with precleaner **Muffler** not used **Oil filter** replaceable paper element **Fuel filter** four cotton wound replaceable elements **Cooling medium temperature control** thermostat.

STARTING ENGINE Make Caterpillar **Type** 2 cylinder horizontal opposed **Mounted** behind Diesel engine **Mfg. rating** 10 hp at 3000 rpm **Bore and stroke** 2¾" x 3" **Ignition system** magneto **Air cleaner** oil washed wire mesh **Starting system** rope.

TOTAL WEIGHT AS TESTED (with operator) 8536 lbs.

REPAIRS AND ADJUSTMENTS Track roller guards were mounted on tractor following test A.

REMARKS All test results were determined from observed data and without allowances, additions or deductions. Test F was made with a fuel pump setting, selected by the manufacturer to develop approximately 38 corrected maximum drawbar horsepower in second gear and data from this test were used in determining the horsepower to be developed in tests D and H, respectively. Tests B, C, D, E, G, and H were made with the same setting.

HORSEPOWER SUMMARY

	Drawbar	Belt
1. Sea level (calculated) maximum horsepower (based on 60° F and 29.92" Hg)	38.75	45.43
2. Observed maximum horsepower (tests F and B)	36.62	41.86
3. Seventy-five per cent of calculated maximum drawbar horsepower and eighty-five per cent of calculated maximum belt horsepower (formerly ASAE and SAE ratings)	29.06	38.62

We, the undersigned, certify that this is a true and correct report of official tractor test No. 553.

L. F. LARSEN
Engineer-In-Charge

L. W. Hurlbut
G. W. Steinbruegge
J. J. Sulek
Board of Tractor Test Engineers

EXPLANATION OF TEST REPORT

TEST A: The manufacturer's representative operates the tractor for a minimum of 12 hours using light to heavy drawbar loads in each gear.

This serves as a period for limber up, general observation and adjustments. Adjustments that are permissible include valve tappet clearance, breaker point gap, spark plug gaps, clutch and others of a similar nature. No new parts or accessories can be installed without having mention made of it in the report.

No data are recorded during this preliminary run except the time that the engine is operated.

BELT HORSEPOWER TESTS

TEST B: The throttle valve is held wide open and the belt load on the dynamometer is adjusted so that the engine is at the rated speed recommended by the manufacturer. Carburetor, ignition timing and manifold adjustments are all set for maximum engine power.

This test is designed to determine maximum belt horsepower of the tractor at rated speed and to measure fuel consumption at the maximum power on the belt.

TEST C: For tractors with carburetors the best fuel economy does not always occur when the engine develops maximum power at rated speed. Test C is intended to allow the manufacturer's representative to select a more economical fuel setting even though there is a slight loss of power. *This more practical carburetor setting is used in all later tests except test F.* The throttle valve is held wide open and load adjusted to give rated rpm. Tests B and C are the same for diesel tractors, which have an altogether different fuel system.

TEST D: The throttle control lever is set so that the governor will maintain rated engine speed when rated load is applied. Rated load is 85% of 100% maximum, as obtained in test B, corrected to standard conditions.

This rating is somewhat less than the maximum belt horsepower in order that the operator may have a certain amount of reserve.

TEST E:

Varying load serves to show the range of engine speeds when the engine is controlled by the governor during the following varied loads, of 20 minutes each: rated load, no load, ½ rated load, maximum load at wide open throttle valve, ¼ and ¾ rated load.

The average result of this test shows the average power and fuel consumption. Since the average tractor is subjected to varying loads, these data serve well in predicting fuel consumption and efficiency of a tractor in general use.

Torque, lb-ft at dynamometer, is obtained with wide open throttle and sufficient load is applied to give several readings.

DRAWBAR HORSEPOWER TESTS

In all drawbar tests the pull exerted by the tractor is transmitted by a hydraulic pressure cylinder to a recording instrument in the test car. All tests are made on the same dirt test course which is maintained by grading, sprinkling and rolling so that it remains very nearly the same throughout the season. The same tires, wheels and weights are used for all tests except J and K.

TEST F: A drawbar test, the results of which are used to determine the rated drawbar horsepower in test H. The carburetor is set to develop maximum power as in test B. The rated gear recommended by manufacturer as plow gear is used in this test. The drawbar load is adjusted to give rated engine speed.

TEST G: Maximum drawbar horsepower is determined in each gear when the carburetor is set for fuel economy as in test C. The throttle valve is held wide open and the load is applied so that the engine runs at rated engine speed.

When operating in low gear it is not uncommon for the tractor to develop less drawbar horsepower than in rated gear because of excessive wheel slippage. When excessive wheel slippage occurs the load is reduced until slippage approaches 16%. When the load is reduced it is necessary to operate the tractor engine at part throttle and control engine speed by governor action.

TEST H: Intended to test the ability of the tractor to run continuously for 10 hours at rated drawbar horsepower and to determine the fuel consumption during that time. Rated drawbar horsepower is 75% of 100% maximum drawbar horsepower (Test F), corrected to standard conditions.

When operating at rated load the throttle control lever is set to maintain rated engine speed. This rating is less than maximum drawbar horsepower in order that the operator may have a certain amount of reserve.

TEST J: The tractor is operated in rated gear with all added weight removed. This test shows the effect of the removal of added weight on the performance of the tractor when compared with test G.

Removal of wheel weights generally increases wheel slippage and decreases drawbar horsepower.

TEST K: Similar to test J except that the smallest tires and lightest wheels offered by the manufacturer are used.