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Test 554: Caterpillar D-4

Nebraska Tractor Test Lab

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The Experiment Station
University of Nebraska College of Agriculture
W. V. Lambert, Director, Lincoln, Nebraska

Department of Agricultural Engineering
Dates of test: July 25 to August 10, 1955
Manufacturer: CATERPILLAR TRACTOR COMPANY, PEORIA, ILLINOIS
Manufacturer's rating: 48 maximum drawbar horsepower (corrected to standard conditions)

NEBRASKA TRACTOR TEST NO. 554

CATERPILLAR D-4

BELT HORSEPOWER TESTS

Hp	Crank shaft speed rpm	Fuel Consumption			Water used gal per hour	Temp Deg F		Barometer inches of mercury		
		Gal per hour	Hp-hr per gal	Lb per hp-hour		Cooling med	Air			
TESTS B AND C—100% MAXIMUM LOAD—TWO HOURS										
58.88	1601	4.423	13.31	0.527	0.00	162	83	28.870		
TEST D—RATED LOAD—ONE HOUR										
53.20	1600	3.815	13.94	0.503	0.00	160	90	28.870		
TEST E—VARYING LOAD—TWO HOURS (20 minute runs; last line average)										
52.92	1600	3.795	13.94	0.503	...	161	92		
1.51	1729	1.316	1.15	6.119	...	144	91		
27.98	1685	2.423	11.55	0.608	...	150	93		
52.53	1398	3.859	13.61	0.516	...	171	95		
14.04	1685	1.829	7.68	0.915	...	148	95		
39.61	1653	2.966	13.35	0.526	...	155	95		
31.43	1625	2.698	11.65	0.603	0.00	155	93	28.900		
TORQUE (At Dynamometer)										
Eng rpm	1596	1492	1387	1299	1202	1105	1000	894	803	705
Lb-ft	375.4	385.4	396.9	406.2	413.5	415.3	421.4	411.3	396.9	391.8
Dyn rpm	812	758	705	660	611	561	508	454	408	359

DRAWBAR HORSEPOWER TESTS

Hp	Draw bar pull lb	Speed miles per hr	Crank shaft speed rpm	Slip of drive wheels %	Fuel Consumption			Water used gal per hour	Temp Deg F		Barometer inches of mercury
					Gal per hour	Hp-hr per gal	Lb per hp-hr		Cool- ing med	Air	
TEST H—RATED LOAD—TEN HOURS—2nd Gear											
39.35	5585	2.64	1600	2.31	3.418	11.51	0.610	0.00	167	93	28.916
TESTS F & G—100% MAXIMUM LOAD											
48.07	9976	1.81	1596	7.19	1st gear.....				177	100	28.980
48.72	6930	2.64	1598	2.38	2nd gear.....				173	100	28.980
47.59	5354	3.33	1606	2.34	3rd gear.....				170	90	28.850
45.65	4118	4.16	1599	1.94	4th gear.....				166	89	28.850
42.36	2607	6.09	1603	1.33	5th gear.....				169	91	28.850

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 2.857 gal drained from motor 2.492 gal Total time motor was operated 50 hours.

CHASSIS Type Tracklayer Serial No. 7U32017 Tread width 60" Wheel Base 61½" Measured length of track 209" Cleats integral with shoes Cleats per track 31 Size of cleats 20" x 1½" Advertised speeds mph first 1.9 second 2.7 third 3.4 fourth 4.2 fifth 6.1 reverse 2.2 Belt pulley diam 12" face 8½" 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. 7U32017 Crankshaft mounted lengthwise Head I Lubrication pressure Bore and Stroke 4½" x 5½" Rated rpm 1600 Compression ratio 18 to 1 Displacement 350 cu in Port Diameter Valves Inlet 1.750" Exhaust 1 3/16" Governor variable speed centrifugal Air Cleaner oil washed wire mesh with precleaner Muffler not used Oil Filter one 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 & Stroke 2¾" x 3" Ignition System magneto Air Cleaner oil washed wire mesh Starting System rope.

TOTAL WEIGHT AS TESTED (with operator) 12,531 lbs.

REPAIRS AND ADJUSTMENTS Following test A track roller guards were installed; the 13" shoes were removed and 20" shoes were installed.

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 52 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 & 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)	52.19	62.36
2. Observed maximum horsepower (tests F and B)	48.72	58.88
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)	39.14	53.01

We, the undersigned, certify that this is a true and correct report of official tractor test No. 554.

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, $\frac{1}{2}$ rated load, maximum load at wide open throttle valve, $\frac{1}{4}$ and $\frac{3}{4}$ 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.