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Test 535: International Model W-400 (Diesel)

Nebraska Tractor Test Lab

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Department of Agricultural Engineering
Dates of test: April 8 to April 20, 1955
Manufacturer: INTERNATIONAL HARVESTER
COMPANY, CHICAGO, ILLINOIS
Manufacturer's rating: Drawbar 43.8 Hp, Belt 48.5 Hp
(Corrected to standard conditions)

NEBRASKA TRACTOR TEST NO. 535

INTERNATIONAL W-400 DIESEL

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								
46.61	1452	3.419	13.63	0.515	0.00	184	68	28.940
TEST D—RATED LOAD—ONE HOUR								
41.63	1451	2.998	13.89	0.506	0.00	169	65	28.950
TEST E—VARYING LOAD—TWO HOURS (20 minute runs; last line average)								
41.61	1450	2.998	13.88	0.506	...	170	65
1.37	1517	1.046	1.31	5.365	...	126	62
21.56	1499	1.926	11.19	0.628	...	139	63
46.45	1385	3.400	13.66	0.505	...	175	62
10.93	1510	1.448	7.55	0.930	...	132	59
31.99	1483	2.447	13.07	0.537	...	143	60
25.65	1474	2.201	11.65	0.603	0.00	147	62	28.950

TORQUE (At Dynamometer)

Eng rpm	1450	1373	1298	1228	1153	1073	1000	916	844	768
Lb-ft	352.3	364.9	374.5	380.8	385.7	388.5	387.6	385.0	375.4	369.8
Dyn rpm	694	657	622	588	551	514	478	438	404	367

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—3rd Gear											
33.58	2506	4.87	1449	3.51	2.759	12.17	0.577	0.00	177	69	28.637
TESTS F & G—100% MAXIMUM LOAD											
38.64	6476	2.24	1447	14.32	1st Gear (Part Throttle)				183	72	28.780
42.74	4262	3.76	1448	6.35	2nd Gear				182	67	28.780
42.85	3336	4.82	1448	4.37	3rd Gear				193	73	28.690
43.29	2377	6.83	1452	3.14	4th Gear				194	74	28.680
35.43	760	17.48	1451	0.62	5th Gear				172	54	28.800
26.51	6632	1.50	1452	15.07	1st Gear TA (Part Throttle)				172	72	28.780
40.09	6300	2.39	1450	12.22	2nd Gear Torque Amplifier				181	72	28.780
41.66	5008	3.12	1449	8.56	3rd Gear Torque Amplifier				180	71	28.780
42.32	3510	4.52	1452	4.91	4th Gear Torque Amplifier				194	74	28.680
41.98	1355	11.62	1448	1.31	5th Gear Torque Amplifier				176	54	28.800
TEST J—OPERATING MAXIMUM LOAD											
41.20	3281	4.71	1449	9.55	3rd Gear				195	78	28.560
TEST K—OPERATING MAXIMUM LOAD											
33.65	3274	3.85	1450	17.77	3rd Gear (Part Throttle) . . .				175	67	28.850

TIRES, WHEELS AND WEIGHT

	Tests F, G & H	Test J	Test K
Rear wheels			
Type	Cast iron	Cast iron	Cast iron
Liquid ballast	1179 lb each	None	None
Added cast iron	700 lb each	None	None
Rear tires			
No. and size	Two 15-30	Two 15-30	Two 13-30
Ply	6	6	6
Air pressure	12 lb	12 lb	12 lb
Front wheels			
Type	Cast iron	Cast iron	Cast iron
Liquid ballast	None	None	None
Added cast iron	None	None	None
Front tires			
No. and size	Two 6.50-18	Two 6.50-18	Two 6.50-18
Ply	4	4	4
Air pressure	28 lb	28 lb	28 lb
Height of drawbar	19 inches	21½ inches	18 inches
Static weight			
Rear end	7584 lb	3827 lb	3706 lb
Front end	2694 lb	2697 lb	2669 lb
Total weight as tested with operator	10,453 lb	6699 lb	6550 lb

FUEL, OIL and TIME Diesel fuel Cetane No. 50 (rating taken from oil company's typical inspection data): weight per gallon 7.025 lb OIL SAE 20; to motor 2.323 gal; drained from motor 1.844 gal Total time motor was operated 39 hours.

CHASSIS Type Standard Serial No. 646-S Tread width rear 60¼" front 50¼" Wheel base 82" Hydraulic control system direct engine drive Advertised speeds mph first 2.42 second 3.72 third 4.67 fourth 6.49 fifth 16.15 reverse 3.22 Using torque amplifier (planetary underdrive) first 1.63 second 2.51 third 3.15 fourth 4.38 fifth 10.90 reverse 2.17 Belt pulley diam 11" face 7½" rpm 899 Belt speed 2588 fpm Clutch single plate dry disc operated by foot pedal Seat upholstered seat on conical spring with shock absorber Brakes double disc brakes operated by two foot pedals Equalized by locking pedals together Power take-off direct engine drive with independent clutch.

ENGINE Make International Harvester Type 4 cylinder vertical Diesel Serial No. D 264 13392 Crankshaft mounted lengthwise Head 1 Lubrication pressure Bore and stroke 4" x 5¼" Rated rpm 1450 Compression ratio 16.5 to 1 Displacement 264 cu. in. Port diameter valves inlet 1.500" exhaust 1.316" Governor centrifugal variable speed Carburetor size ¾" (for starting only) Ignition system battery (for starting only) Starting system 12 volt battery Air cleaner oil washed wire screen Muffler was used Oil filter replaceable treated paper element Fuel filter one cotton auxiliary filter and one treated paper element Cooling medium temperature control thermostat.

REPAIRS AND ADJUSTMENTS No repairs or adjustments.

REMARKS All test results were determined from observed data and without allowances, additions or deductions. Tests B and F were made with fuel pump set to develop approximately 48.5 corrected maximum belt horsepower and data from these tests were used in determining the horsepower to be developed in tests D and H, respectively. Tests C, D, E, G, H, J & K were made with the same setting (selected by the manufacturer).

HORSEPOWER SUMMARY

	Drawbar	Belt
1. Sea level (calculated) maximum horsepower (based on 60° F and 29.92" HG)	45.24	48.56
2. Observed maximum horsepower (tests F and B)	42.85	46.61
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)	33.93	41.28

We, the undersigned, certify that this is a true and correct report of official tractor test No. 535.

L. F. LARSEN
Engineer-in-Charge

C. W. SMITH
L. W. HURLBUT
F. D. YUNG
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.

