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6-23-1956

Test 578: Minneapolis-Moline 445 Universal

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: June 23, 1956 to June 30, 1956
Manufacturer: MINNEAPOLIS-MOLINE COMPANY, MINNEAPOLIS, MINNESOTA
Manufacturer's rating: Not rated

NEBRASKA TRACTOR TEST NO. 578

MINNEAPOLIS-MOLINE 445 UNIVERSAL

BELT HORSEPOWER TESTS

Hp	Crank shaft speed rpm	Fuel Consumption			Temp. Deg. F.			Barometer inches of mercury			
		Gal per hr	Hp-hr per gal	Lb per hp-hr	Cooling medium	Air wet bulb	Air dry bulb				
TEST B—100% MAXIMUM LOAD—TWO HOURS											
41.95	1550	3.997	10.50	0.587	160	70	74	28.783			
TEST C—OPERATING MAXIMUM LOAD—ONE HOUR											
39.87	1550	3.333	11.96	0.515	163	69	75	28.800			
TEST D—RATED LOAD—ONE HOUR											
37.95	1550	3.196	11.87	0.519	168	71	79	28.800			
TEST E—VARYING LOAD—TWO HOURS—(20 minute runs; last line average)											
37.49	1552	3.172	11.82	0.521	170	72	80			
1.99	1723	1.452	1.37	4.492	137	72	81			
17.50	1613	2.232	7.84	0.785	158	72	82			
58.01	1445	3.196	11.89	0.518	184	74	84			
9.93	1628	1.769	5.61	1.097	149	76	84			
29.01	1591	2.699	10.75	0.573	168	78	85			
22.52	1592	2.420	9.22	0.668	161	74	83	28.818			
TEST L—OPERATING MAXIMUM TORQUE											
% of rated rpm (engine)		99	95	90	85	80	75	70	65	60	55
% of rated-speed torque		100	103	105	106	106	107	108	107	105	104

DRAWBAR HORSEPOWER TESTS

Hp	Draw bar pull lbs	Speed miles per hr	Crank shaft speed rpm	Slip of drive wheels %	Fuel Consumption			Temp. Deg. F.			Barometer inches of mercury
					Gal per hr	Hp-hr per gal	Lb per hp-hr	Cool- ing med	Air wet bulb	Air dry bulb	
TEST H—RATED LOAD—TEN HOURS—2nd Gear											
30.86	2732	4.24	1550	5.03	2.834	10.89	0.565	166	69	81	28.877
TEST F—100% MAXIMUM LOAD											
38.48	3464	4.17	1554	6.51	2nd gear.....			170	70	80	28.750
TEST G—OPERATING MAXIMUM LOAD											
34.25	5164	2.49	1551	14.53	1st gear.....			185	73	92	28.730
37.23	3336	4.19	1553	6.05	2nd gear.....			173	70	80	28.730
37.33	2147	6.52	1550	3.78	3rd gear.....			171	76	81	28.745
36.20	1325	10.25	1553	2.57	4th gear.....			180	74	94	28.680
30.73	723	15.94	1551	1.10	5th gear.....			182	74	95	28.680
18.30	5233	1.31	1556	14.48	1st gear A.T. (prt-thrtl)			171	73	92	28.730
27.68	5240	1.98	1548	15.03	2nd gear A.T. (prt-thrtl)			175	73	92	28.730
36.42	4191	3.26	1554	8.78	3rd gear ampli-torc. . .			182	69	85	28.740
36.88	2630	5.26	1549	4.68	4th gear ampli-torc. . .			182	72	90	28.735
35.38	1624	8.17	1551	3.35	5th gear ampli-torc. . .			180	73	93	28.680
TEST J—OPERATING MAXIMUM LOAD											
34.19	3287	3.90	1554	13.87	2nd gear.....			160	70	78	28.605
TEST K—OPERATING MAXIMUM LOAD											
31.16	3135	3.73	1553	14.78	2nd gear.....			154	75	82	28.610

TIRES, WHEELS AND WEIGHT

	Tests F, G, & H	Test J	Test K
Rear wheels			
Type	Pressed steel	Pressed steel	Pressed steel
Liquid ballast	604 lb each	None	None
Added cast iron	816 lb each	None	None
Rear tires			
No. and size	Two 12-38	Two 12-38	Two 11-38
Ply	6	6	4
Air pressure	16 lb	14 lb	12 lb
Front wheels			
Type	Pressed steel	Pressed steel	Pressed steel
Liquid ballast	None	None	None
Added cast iron	124 lb each	None	None
Front tires			
No. and size	Two 5.50-16	Two 5.50-16	Two 5.50-16
Ply	4	4	4
Air pressure	32 lb	32 lb	32 lb
Height of drawbar	20½ inches	21½ inches	20 inches
Static weight			
Rear end	6070 lb	3230 lb	3140 lb
Front end	1640 lb	1376 lb	1380 lb
Total weight as tested with operator	7885 lb	4781 lb	4695 lb

FUEL, OIL, WATER and TIME Fuel Gasoline Octane No. ASTM 82.0 Research 87.2 (rating taken from oil company's typical inspection data) **Weight** per gallon 6.157 lb Oil SAE 30 To motor 1.960 gal Drained from motor 1.204 gal **Total time** motor was operated 43 hours.

CHASSIS TYPE Standard Serial No. 10101395 Tread width rear 56" to 88" Front 56" to 84" Wheel base 93 13/16" Hydraulic control system direct engine drive Advertised speeds mph first 2.78 second 4.26 third 6.48 fourth 10.05 fifth 15.40 reverse 4.26 Using ampli-torc first 1.46 second 2.28 third 3.40 fourth 5.28 fifth 8.09 reverse 2.23 Belt pulley diam 8⅝" face 6½" rpm 1468 Belt speed 3220 fpm Belt flat Length 71' Width 6" Thickness 0.215" Maximum slip 0.77% Clutch single plate dry disc operated by foot pedal Seat upholstered seat with back rest Brakes double disc operated by two foot pedals Equalized no Power take-off continuous running independently clutched.

ENGINE Make Minneapolis-Moline Type 4 cylinder vertical Serial No. 10002109 Crankshaft mounted lengthwise Head 1 Lubrication pressure Bore and stroke 3⅝" x 5" Rated rpm 1550 Compression ratio 7.3 to 1 Displacement 206 cu in Port diameter valves Inlet 1¼" Exhaust 1 11/64" Governor variable speed centrifugal Carburetor size 1" Ignition system battery Starting system 12 volt battery Air cleaner oil washed rolled screen Muffler was used Oil filter replaceable paper element Cooling medium temperature control thermostat.

REPAIRS AND ADJUSTMENTS No adjustments or repairs.

REMARKS All test results were determined from observed data and without allowances, additions or deductions. Tests B and F were made with carburetor set for 100% 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 and L were made with an operating setting of the carburetor (selected by the manufacturer) of 95.1% of maximum belt horsepower.

HORSEPOWER SUMMARY

	Drawbar	Belt
1. Sea level (calculated) maximum horsepower (based on 60° F. and 29.92" Hg)	40.81	44.19
2. Observed maximum horsepower (tests F and B)	38.48	41.95
3. Seventy-five per cent of calculated maximum drawbar horsepower and eighty-five per cent of calculated maximum belt horsepower (ASAE and SAE ratings)	30.61	37.56

We, the undersigned certify that this is a true and correct report of official Tractor Test No. 578.

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 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 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.

TEST L: This torque test is run with wide open throttle. Loads are applied to reduce engine speed in approximately ten 5% increments. Rated speed equals 100%. The corresponding dynamometer torque is recorded as a per cent of torque at rated speed.

DRAWBAR HORSEPOWER TESTS

In all drawbar tests the pull exerted by the tractor is transmitted by a hydraulic pressure cylinder to a recording instru-

ment in the test car. When rubber tires are used, all tests are made on the concrete test course. All crawler type tractors are tested on a 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.

