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Test 651: Minneapolis-Moline 5 Star (LPG)

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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: May 13 to 24, 1958
Manufacturer: MINNEAPOLIS-MOLINE COMPANY, MINNEAPOLIS, MINNESOTA
Manufacturer's rating: Not Rated

NEBRASKA TRACTOR TEST NO. 651

MINNEAPOLIS-MOLINE 5 STAR LPG

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 POWER—TWO HOURS								
54.96	1500	6.254	8.79	0.484	181	57	70	29.042
* TEST C—OPERATING MAXIMUM POWER—ONE HOUR								
53.47	1500	5.671	9.43	0.451	184	56	74	29.088
TEST D—RATED POWER—ONE HOUR								
48.58	1546	5.228	9.29	0.457	181	58	76	29.083
TEST E—VARYING POWER—TWO HOURS (20 minute runs; last line average)								
48.60	1545	5.259	9.24	0.460	183	60	79	29.083
1.72	1656	1.976	0.87	4.884	143	58	76	29.083
25.10	1592	3.607	6.96	0.611	167	59	77	29.083
53.68	1501	5.774	9.30	0.457	185	59	76	29.083
12.85	1626	2.746	4.68	0.908	156	60	79	29.083
37.00	1567	4.461	8.29	0.512	175	60	78	29.083
29.83	1581	3.971	7.51	0.566	168	59	77	29.067

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	Cooling med	Air wet bulb	Air dry bulb		
TEST H—RATED POWER—TEN HOURS—2nd Gear												
39.57	3032	4.89	1571	3.76	4.942	8.01	0.531	166	58	68	28.960	
TEST F—100% MAXIMUM POWER												
49.36	4025	4.60	1500	5.21	2nd Gear			179	68	75	28.775	
TEST G—OPERATING MAXIMUM POWER												
46.23	6023	2.88	1503	9.60	1st Gear			175	68	74	28.725	
48.16	3919	4.61	1500	5.14	2nd Gear			177	68	75	28.775	
47.34	2467	7.20	1506	3.06	3rd Gear			152	61	69	28.840	
44.64	1479	11.32	1510	1.98	4th Gear			163	61	69	28.840	
36.00	771	17.51	1510	0.73	5th Gear			163	61	69	28.840	
27.18	7152	1.43	1503	14.78	1st Gear AT (prt thrtle)			156	68	73	28.710	
41.54	7096	2.20	1507	14.34	2nd Gear AT (prt thrtle)			178	68	73	28.710	
46.53	4812	3.63	1500	6.68	3rd Gear Ampli-Torc			180	68	74	28.725	
46.91	3048	5.77	1496	3.90	4th Gear Ampli-Torc			175	68	75	28.775	
44.52	1847	9.04	1508	2.41	5th Gear Ampli-Torc			148	61	69	28.840	
TEST J—OPERATING MAXIMUM POWER												
45.95	3796	4.54	1505	9.53	2nd Gear			184	72	82	28.735	
TEST K—SPEED-PULL CHARACTERISTIC												
Pounds Pull		3032		3919		4050		4150		4350		4200
Horsepower		39.57		48.16		45.4		40.9		37.1		31.4
Miles Per Hour		4.89		4.61		4.2		3.7		3.2		2.8

TIRES, WHEELS AND WEIGHT

	Tests F, G, H & K	Test J
Rear wheels		
Type	Cast iron	Cast iron
Liquid ballast	521 lb each	None
Added cast iron	700 lb each	None
Rear tires		
No. and size	Two 15.5-38	Two 15.5-38
Ply	6	6
Air pressure	18 lb	14 lb
Front wheels		
Type	Pressed steel	Pressed steel
Liquid ballast	None	None
Added cast iron	62 lb each	None
Front tires		
No. and size	Two 6.00-16	Two 6.00-16
Ply	6	6
Air pressure	36 lb	36 lb
Height of drawbar	21 inches	22 inches
Static weight		
Rear end	6960 lb	4518 lb
Front end	2070 lb	1962 lb
Total weight as tested with operator	9205 lb	6655 lb

FUEL, OIL, WATER and TIME Fuel Commercial Propane Weight per gallon 4.25 lb Oil SAE 20-20W To motor 2.227 gal Drained from motor 1.873 gal Water used 0.103 gal Total time motor was operated 43½ hours.

CHASSIS Type Tricycle Serial No. 11001464 Tread width rear 56" to 88" front 8" and 13" Wheel base 94" Hydraulic control system direct engine drive Advertised speeds mph first 3.14 second 4.80 third 7.31 fourth 11.34 fifth 17.37 reverse 4.80 (Using Ampli-Torc) first 1.65 second 2.52 third 3.84 fourth 5.95 fifth 9.12 reverse 2.52 Belt pulley diam. 12" face 7" rpm 1091 Belt speed 3427 fpm Belt flat Length 72" width 7" Thickness 0.216" Maximum slip 0.69% Clutch single plate dry disc operated by foot pedal Seat upholstered seat with back rest Brakes double disc operated by two foot pedals Equalized by foot action Power take-off continuous running independently clutched Steering aided by hydraulic power steering.

ENGINE Make Minneapolis-Moline LPG Type 4 cylinder vertical Serial No. 10901472 Crankshaft mounted lengthwise Head I Lubrication pressure Bore and stroke 4¼" x 5" Rated rpm 1500 Compression ratio 8.3 to 1 Displacement 283 cu. in. Valves port diameter Inlet 1½" Exhaust 1¾" Governor variable speed centrifugal Carburetor size 1¼" Ignition system battery Starting system 12 volt battery Air cleaner oil washed wire mesh Muffler was used Oil filter replaceable paper element Cooling medium temperature control thermostat.

REPAIRS AND ADJUSTMENTS During Test D the throttle control linkage was lengthened to eliminate engine hunting.

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 and K were made with an operating setting of the carburetor (selected by the manufacturer) of 97.5% of maximum belt horsepower.

HORSEPOWER SUMMARY

	Drawbar	Belt
1. Sea level (calculated) maximum horsepower (based on 60° F and 29.92" Hg)	52.06	57.16
2. Observed maximum horsepower (tests F and B)	49.36	54.96
3. Seventy-five per cent of calculated maximum drawbar horsepower and eighty-five per cent of calculated maximum belt horsepower (ASAE and SAE ratings)	39.05	48.59

We, the undersigned, certify that this is a true and correct report of official Tractor Test No. 651.

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

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 manual throttle control lever is set so that 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 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 manual throttle control lever is set the same as for tests B and C allowing the governor to control engine speed at part throttle. Load is applied until 85% of maximum corrected horsepower found in test B is obtained.

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.

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. When rubber tires are used, all tests are made on the concrete test course. The same tires, wheels and weights are used for all tests except J. All crawler type tractors are tested on an earthen test course which is maintained by grading, sprinkling and rolling so that it remains very nearly the same for each test.

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 the 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 manual throttle control lever is set so that 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 15%. 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 horsepower the manual throttle control lever is set the same as in tests F and G allowing the governor to maintain engine speed at part throttle. 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: This is intended to show the pull, horsepower, and travel speed of the tractor at rated horsepower (taken from test H); maximum horsepower (taken from test G); and at least four other conditions obtained by reducing travel speed in 10% increments by overload.

