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## Test 790: Minneapolis-Moline 4 Star (LPG)

Nebraska Tractor Test Lab

University of Nebraska-Lincoln, [tractortestlab@unl.edu](mailto:tractortestlab@unl.edu)

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# NEBRASKA TRACTOR TEST 790 - MINNEAPOLIS - MOLINE 4 STAR LPG

The University of Nebraska Agricultural Experiment Station

E. F. Frolik, Dean; A.W. Epp, Acting Director, Lincoln, Nebraska

## POWER TAKE-OFF PERFORMANCE

Hp	Crank shaft speed rpm	Fuel Consumption		Hp-hr per gal	Temp. Degrees F			Barometer inches of mercury
		Gal per hr	Lb per hp-hr		Cool- ing med	Air wet bulb	Air dry bulb	
MAXIMUM POWER AND FUEL CONSUMPTION								
Rated Engine Speed—Two Hours								
45.54	1750	5.109	0.477	8.91	180	57	75	28.738
Standard Power Take-off Speed (540 rpm)—One Hour								
42.19	1524	4.598	0.463	9.18	180	56	76	28.730
VARYING POWER AND FUEL CONSUMPTION—TWO HOURS								
40.68	1840	4.687	0.490	8.68	178	56	76	.....
0.00	1939	1.842	.....	.....	168	55	75	.....
20.92	1893	3.360	0.683	6.23	170	55	76	.....
45.95	1751	5.188	0.480	8.86	179	56	77	.....
10.60	1918	2.513	1.008	4.22	167	54	75	.....
30.91	1867	4.108	0.565	7.52	172	55	75	.....
Av 24.84	1868	3.616	0.619	6.87	172	55	76	28.723

## DRAWBAR PERFORMANCE

Hp	Draw-bar pull lbs	Speed miles per hr	Crank shaft speed rpm	Slip of driv- ers %	Fuel Consumption		Hp-hr per gal	Temperature Degrees F			Barometer inches of mercury
					Gal per hr	Lb per hp-hr		Cooling medium	Air wet bulb	Air dry bulb	
VARYING DRAWBAR POWER AND FUEL CONSUMPTION WITH BALLAST											
Maximum Available Power—Two Hours—2nd Gear											
40.96	3219	4.77	1753	4.79	5.265	0.546	7.78	174	47	55	28.985
75% of Pull at Maximum Power—Ten Hours—2nd Gear											
32.75	2411	5.09	1851	3.81	4.529	0.588	7.23	168	42	50	29.251
50% of Pull at Maximum Power—Two Hours—2nd Gear											
22.73	1612	5.29	1896	2.51	3.794	0.709	5.99	167	44	49	28.990
MAXIMUM POWER WITH BALLAST											
40.51	5099	2.98	1749	8.84	1st Gear	.....	.....	170	52	62	29.000
41.05	3245	4.74	1750	5.24	2nd Gear	.....	.....	170	49	59	28.970
41.16	2583	5.98	1752	4.00	3rd Gear	.....	.....	171	51	62	28.985
40.31	2046	7.39	1749	3.36	4th Gear	.....	.....	170	51	62	28.985
27.56	6604	1.56	1868	14.67	1st Gear	Ampli-Torc	..	170	52	62	29.000
38.19	6209	2.31	1752	12.35	2nd Gear	Ampli-Torc	..	170	52	62	29.000
39.18	4909	2.99	1750	8.52	3rd Gear	Ampli-Torc	..	170	50	60	28.970
39.48	3953	3.75	1751	6.51	4th Gear	Ampli-Torc	..	170	49	59	28.970
37.31	1507	9.28	1752	1.71	5th Gear	Ampli-Torc	..	171	51	62	28.985
MAXIMUM POWER WITHOUT BALLAST											
39.67	3189	4.66	1749	6.85	2nd Gear	.....	.....	169	50	51	28.715
VARYING DRAWBAR PULL AND TRAVEL SPEED WITH BALLAST—2nd Gear											
Pounds pull			3250	3300	3450	3550	3650	3550			
Horsepower			41.1	37.0	35.0	31.2	27.3	21.8			
Miles per hour			4.7	4.2	3.8	3.3	2.8	2.3			

Department of Agricultural Engineering

Dates of Test: April 20 to May 5, 1961

Manufacturer: MOTEC INDUSTRIES INC., HOPKINS, MINNESOTA

Manufacturer's Power Rating: Not Rated

**FUEL, OIL and TIME** Fuel commercial propane Specific gravity converted to 60°/60° 0.5103 Weight per gallon 4.25 lb Oil SAE 10W-30 API service classification MS, DM To motor 1.716 gal Drained from motor 1.298 gal Transmission and final-drive lubricant SAE 80 Type multi-purpose gear lube Total time engine was operated 42½ hours.

**ENGINE** Make Minneapolis-Moline LPG Type 4 cylinder vertical Serial No 16301504 Crankshaft mounted lengthwise Rated rpm 1750 Bore and stroke 3½" x 5" Compression ratio 8.75 to 1 Displacement 206.5 cu in Carburetor size 1" Ignition system battery Cranking system 12 volt electric Lubrication pressure Air cleaner oil washed wire screen Oil filter replaceable paper element Fuel filter screen Muffler was used Cooling medium temperature control thermostat.

**CHASSIS** Type standard Serial No 16600993 Tread width rear 56" to 88" front 50" to 74" Wheel base 93½" Center of gravity (without operator or ballast, with minimum tread, with fuel tank filled and tractor serviced for operation) Horizontal distance forward from center-line of rear wheels 28½" Vertical distance above roadway 34½" Horizontal distance from center of rear wheel tread 0" to the right/left Hydraulic control system direct engine drive Transmission fixed ratio operator controlled partial range power shifting Advertised speeds mph first 3.2 second 4.9 third 6.1 fourth 7.5 fifth 17.8 reverse 4.9 (Using Ampli-Torc) first 1.7 second 2.6 third 3.2 fourth 3.9 fifth 9.3 reverse 2.6 Clutch single plate dry disc operated by foot pedal Brakes double disc operated by two foot pedals Steering power assisted Turning radius (on concrete surface with brake applied) right 141" left 141" (on concrete surface without brake) right 153" left 153" Turning space diameter (on concrete surface with brake applied) right 294" left 294" (on concrete surface without brake) right 318" left 318" Belt pulley 1658 rpm at 1750 engine rpm diam 3⅜" face 6½" Belt speed 3635 fpm Power take-off 550 rpm at 1553 engine rpm.

**REPAIRS and ADJUSTMENTS** During the PTO runs the engine speed became unstable requiring an adjustment of the governor linkage.

**REMARKS** All test results were determined from observed data obtained in accordance with the SAE and ASAE test code.

Fifth gear was not run as it exceeded 15 mph.

We, the undersigned, certify that this is a true and correct report of official Tractor Test 790.

L. F. LARSEN

Engineer-in-Charge

L. W. HURLBUT, Chairman

G. W. STEINBRUEGGE

J. J. SULEK

Board of Tractor

Test Engineers

## TIRES, BALLAST and WEIGHT

		With Ballast	Without Ballast
Rear tires	—No, size, ply & psi	Two 13.6-38;6;20	Two 13.6-38;6;14
Ballast	—Liquid	648 lb each	None
	—cast iron	963 lb each	None
Front tires	—No, size, ply & psi	Two 6.00-16;4;28	Two 6.00-16;4;28
Ballast	—Liquid	None	None
	—cast iron	63 lb each	None
Height of drawbar		14½ inches	15 inches
Static weight	—Rear	6825 lb	3604 lb
	—Front	1620 lb	1524 lb
Total weight with operator		8620 lb	5303 lb

# EXPLANATION OF TEST REPORT

## GENERAL CONDITIONS

Each tractor is a production model equipped for common usage. Power consuming accessories can be disconnected only when it is convenient for the operator to do so in practice. Additional weight can be added as ballast if the manufacturer regularly supplies it for sale. The static tire loads and the inflation pressures must conform to recommendations in the Tire Standards published by the Society of Automotive Engineers.

## PREPARATION FOR PERFORMANCE RUNS

The engine crankcase is drained and refilled with a measured amount of new oil conforming to specifications in the operators manual. The fuel used and the maintenance operations must also conform to the published information delivered with the tractor. The tractor is then limbered-up for 12 hours on drawbar work in accordance with the manufacturer's published recommendations. The manufacturer's representative is present to make appropriate decisions regarding mechanical adjustments.

The tractor is equipped with approximately the amount of added ballast that is used during maximum drawbar tests. The tire tread-bar height must be at least 65% of new tread height prior to the maximum power run.

## BELT OR POWER TAKE-OFF PERFORMANCE

**Maximum Power and Fuel Consumption.** The manufacturer's representative makes carburetor, fuel pump, ignition and governor control settings which remain unchanged throughout all subsequent runs. The governor and the manually operated governor control lever is set to provide the high-idle speed specified by the manufacturer for maximum power. Maximum power is measured by connecting the belt pulley or the power take-off to a dynamometer. The dynamometer load is then gradually increased until the engine is operating at the rated speed specified by the manufacturer for maximum power. The corresponding fuel consumption is measured.

**Varying Power and Fuel Consumption.** Six different horsepower levels are used to show corresponding fuel consumption rates and how the governor causes the engine to react to the following changes in dynamometer load: 85% of the dynamometer torque at maximum power; minimum dynamometer torque,  $\frac{1}{2}$  the 85% torque; maximum power,  $\frac{1}{4}$  and  $\frac{3}{4}$  of the 85% torque. Since a tractor is generally subjected to varying loads the average of the results in this test serve well for predicting the fuel consumption of a tractor in general usage.

## DRAWBAR PERFORMANCE

All engine adjustments are the same as those used in the belt or power take-off tests. If the manufacturer specifies a different rated crankshaft speed for drawbar operations, then the position of the manually operated governor control is changed to provide the high-idle speed specified by the manufacturer in the operating instructions.

**Varying Power and Fuel Consumption With Ballast.** The varying power runs are made to show the effect of speed-control devices (engine governor, automatic transmissions, etc.) on horsepower, speed and fuel consumption. These runs are made around the entire test course which has two 180 degree

turns with a minimum radius of 50 feet. The drawbar pull is set at 3 different levels as follows: (1) as near to the pull at maximum power as possible and still have the tractor maintain the travel speed at maximum horsepower on the straight sections of the test course; (2) 75% of the pull at maximum power; and (3) 50% of the pull at maximum power. Prior to 1958, fuel consumption data (10 hour test) were shown only for the pull obtained at maximum power for tractors having torque converters and at 75% of the pull obtained at maximum power for gear-type tractors.

**Maximum Power with Ballast.** Maximum power is measured on straight level sections of the test course. Data are shown for not more than 12 different gears or travel speeds. Some gears or travel speeds may be omitted because of high slippage of the traction members or because the travel speed may exceed the safe-limit for the test course. The maximum safe speed for the Nebraska Test Course has been set at 15 miles per hour. The slippage limits have been set at 15% and 7% for pneumatic tires and steel tracks or lugs, respectively. Higher slippage gives widely varying results.

**Maximum Power Without Ballast.** All added ballast is removed from the tractor. The maximum drawbar power of the tractor is determined by the same procedure used for getting maximum power with ballast. The gear (or travel speed) is the same as that used in the 10-hour test.

**Varying Power and Travel Speed with Ballast.** Travel speeds corresponding to drawbar pulls beyond the maximum power range are obtained to show the "lugging ability" of the tractor. The run starts with the pull at maximum power; then additional drawbar pull is applied to cause decreasing speeds. The run is ended by one of three conditions: (1) maximum pull is obtained, (2) the maximum slippage limit is reached, or (3) some other operating limit is reached.

For additional information about the **Nebraska Tractor Tests** write to the **Department of Agricultural Engineering, University of Nebraska, Lincoln, Nebraska.**



Minneapolis-Moline 4 Star LPG