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Rules for Official Tractor Tests

Nebraska Tractor Test Lab

University of Nebraska-Lincoln, tractortestlab@unl.edu

Agricultural Experiment Station

University of Nebraska

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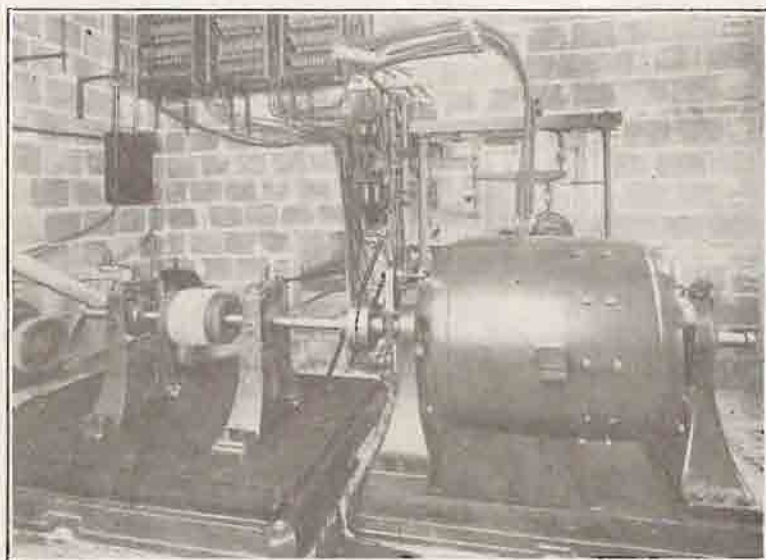
Rules for Official Tractor Tests

Agricultural Experiment Station Submitted by Larsen
Museum
University of Nebraska,

The Nebraska Tractor Law

AND

Rules for Official Tractor Tests



DYNAMOMETER FOR MAKING BRAKE HORSE-POWER TESTS OF TRACTORS

AGRICULTURAL EXPERIMENT STATION
THE UNIVERSITY OF NEBRASKA
LINCOLN

THE NEBRASKA TRACTOR LAW

AND

RULES FOR OFFICAL TRACTOR TESTS

Board of Tractor Test Engineers,
L. W. CHASE, E. E. BRACKETT, O. W. SJOGREN.

Manager of Tractor Tests,
CLAUDE K. SHEDD

I. THE LAW

PURPOSE OF THE LAW

The Nebraska Tractor Law known as House Roll 85, 37th session, which became effective July 15, 1919, was enacted to encourage the manufacture and sale of improved types of tractors and to contribute to a more successful use of the tractor for farming.

It was thought that the best method of accomplishing these objects would be to require a tractor of each model sold in the State to be tested at the State University and to have the results of these tests made public. These tests will give reliable information on the power capacity and fuel consumption of each tractor and also some information on endurance. The results of the tests will be useful to farmers and dealers in making selection of tractors. Manufacturers also will no doubt find that the results of the tests are of some value to their engineering and sales departments.

PROVISIONS OF THE LAW

Full text of the law will be found in the appendix to this bulletin, page 12. Stated briefly the provisions of the law are:

(1) That a stock tractor of each model sold in the State shall be tested and passed upon by a board of three engineers under State University management.

(2) That each company, dealer, or individual who offers a tractor for sale in Nebraska shall have a permit issued by the State Railway Commission. The permit for any model of tractor will be issued after a stock tractor of that model has been tested at the University and the performance of the tractor compared

with the claims made for it by the manufacturer. Upon application, temporary permits are issued before tractors are tested to companies who offer to submit their tractors for test. These temporary permits are good until the tests are made and after that the permanent permits will be issued for tractors which pass thru the test successfully.

(3) That a service station with full supply of replacement parts for each model of tractor shall be maintained within the confines of the State and within reasonable shipping distance of customers.

EFFECT OF THE LAW ON TRACTOR SALES

The tractor purchaser is not in a position individually to make tests to show whether or not a tractor comes up to the claims made for it. One of the difficulties in purchasing a tractor has been the fact that horse-power ratings have not always been true indications of tractor capacity. Some manufacturers have overrated their tractors; others have underrated. The result has been that farmers have sometimes secured tractors too large or too small for the work to be done, and have also secured machinery too large or too small for the tractor. The results of tractor tests under the new tractor law will give tractor purchasers the information they need regarding horse-power capacity of tractors. Manufacturers' ratings will no doubt also be changed in some instances so that ratings will become more nearly standardized.

The tractor purchaser should see that the manufacturer or dealer from whom the purchase is made is provided with the proper permit for sale. After the tests are made, tractor farmers will no doubt find it profitable to make a study of the results of tests.

Dealers should secure the required permit thru the manufacturer of the tractor. The temporary permit is not in any respect a certificate of merit in the tractor; but the permanent permit, issued after the test is made, will show that in the test the tractor came up to the advertised claims made for it by the manufacturer.

Results of tractor tests should be of considerable value to tractor dealers and salesmen. It is to be expected also that dealers and manufacturers of good tractors will be benefited by the fact that buyers will have greater confidence in tractors which successfully pass thru tests at the University Farm.

It should be kept clearly in mind that these tests are not competitive. It is not the purpose of the tests to show any one tractor as being the best. No prizes, medals, or awards of any

kind will be given other than a statement of the performance of each tractor under test.

II. RULES FOR OFFICIAL TRACTOR TESTS

1. *Outline of Test.* The board of tractor test engineers has adopted the following outline to be followed in the official tests under the law:

The complete test will consist of the following parts:

(a) Drawbar work at from one-third load to full load for 12 hours. This test gives opportunity for the tractor to "limber up."

(b) Brake horse-power test at rated load and rated speed for two hours. This test will show whether or not the tractor will carry its rated load on the belt; also show fuel consumption at rated load.

(c) Brake horse-power test at load varying from maximum to no load with all engine adjustments as in test (b) for one hour. This will show fuel consumption and speed control on varying load.

(d) Brake horse-power test at maximum load for one hour with governor set as in test (b) and carburetor adjusted to give maximum power. This will show the maximum horse power of the tractor on the belt.

(e) Brake horse-power test at one-half load for one hour with governor set as in test (b) and carburetor adjusted for most economical operation at one-half load. This test will show fuel consumption at one-half load.

(f) Drawbar horse-power test at rated load for ten hours. This test will be made on a half-mile cinder track and will show whether or not the tractor will carry its rated drawbar load continuously; also show fuel consumption on drawbar work.

(g) Maximum drawbar horse-power test. This test will be a series of short runs with an increase of load for each run until the engine is overloaded or the drive wheels slip excessively.

(h) Miscellaneous. This may include investigation of work on inclines, turning radius, effectiveness of brakes, or any other feature of the tractor which may seem to require special observation.

(i) Tractors will be under observation for endurance throughout the complete test as outlined above.

2. *Numbering Official Tractor Tests.* Each complete tractor test will be given a number (arabic numeral being used) and these numbers will run serially from one up, in the order in which tests are started. Each part of the test will be numbered

with the serial number of the complete test of which it is a part and the letter used for that part of the test in the "Outline of Test." For instance, the "limbering up" run on the first tractor tested will be test No. 1a; the ten-hour drawbar test on that same tractor will be test No. 1f. In case it is necessary for any reason to repeat any part of a test, the letter "R" will precede the original test number; that is, the ten-hour drawbar test on the first tractor, if repeated, would be numbered R1f. If repeated a second time the number would be RR1f. When two or more dynamometer charts are used in one drawbar test, the charts will be numbered serially with arabic numbers following the test number and separated from the test number by a hyphen; for example, 1f-1, 1f-2, 1f-3, etc. The successive runs in test (g) will be numbered 1g-1, 1g-2, 1g-3, etc. If it is necessary to repeat the whole series of runs in test (g), the number will be R1g-1, R1g-2, etc. If a complete test is repeated, it will be given a new serial number.

TESTING EQUIPMENT AND METHODS AND CONDITIONS OF TESTS IN DETAIL

3. *All tractors* will be delivered for test to the University Farm, Lincoln, Nebraska.

4. *Fuels.* All tests will be made on the lowest grades of fuels sold thruout Nebraska on which the tractor manufacturer claims that his tractor will operate; that is, if the manufacturer claims that his tractor will operate only on gasoline, it will be tested on the lower grades of gasoline sold within Nebraska. If the manufacturer claims that the tractor will operate on two or more distinct fuels (for instance gasoline and kerosene) it will be tested on the least volatile of these fuels, that is, kerosene. If the manufacturer so desires, the tractor will also be given test (b), par. 1, on the other fuel or fuels on which the tractor is claimed to operate.

Fuels will be supplied by the University and charged to the manufacturer at current prices.

All fuels will be tested and measured in accordance with par. 9.

5. *Lubricants.* Manufacturers will be asked to specify the kinds and grades of lubricant to be used on the different parts of each tractor tested. These lubricants will be supplied by the University and charged to the manufacturer at current prices.

All engine oils will be tested and measured in accordance with par. 9.

6. *Manufacturers' Representatives and Tractor Operators.*

The tractor manufacturer will furnish an ample number of trained operators with his tractors when they are being tested. During the "limbering up" run, (a) par. 1, the manufacturer's operator will operate the tractor and give necessary instructions to operators employed by the University who will have charge of the tractor in tests (b), (c), (d), (e), (f), (g), and (h), par. 1. The operator employed by the manufacturer should be present at all times during the test to see that the tractor is operated according to instructions and that the test is fair in every way to the tractor.

Representatives of manufacturers are welcome to be present during the test but none of them will handle the tractor nor any testing equipment during the test excepting by authority from the engineer in charge or some person designated by him.

If the manufacturer has more than one representative present during the test, he shall designate one of them as his official representative.

7. *Belt Tests.* These tests will be made with a Sprague electric dynamometer of 150 H. P. capacity. This dynamometer will be driven thru an extension shaft mounted on SKF ball bearings and carrying a paper pulley 10" in diameter and 12" face (manufactured by the Rockwood Mfg. Co., Indianapolis, Ind.). The tractor will be belted to this pulley.

The following belts are supplied by the University:

1—5" single first quality leather belt, 50 ft. long.

1—6" 5-ply "Glide" friction surface rubber belt, 60 ft. long (manufactured by Goodyear Tire and Rubber Co., Akron, Ohio).

1—8" 4-ply "Klingtite" friction surface rubber belt 80 ft. long (manufactured by Goodyear Tire & Rubber Co., Akron, Ohio).

1—10" 5-ply "Gandy" stitched canvas belt 100 ft. long (manufactured by the Gandy Belting Co., Baltimore, Maryland).

The tractor manufacturer may select any of the belts mentioned above, or may supply his own belt if he desires to do so.

Tractors will be given credit only for the power delivered to the dynamometer.

8. *Drawbar tests* will be made on a half-mile cinder track. This track is not level but has several short grades none of which is greater than $3\frac{1}{2}$ per cent. The condition of the track will be kept as nearly uniform as possible by dragging, rolling, and sprinkling when necessary.

To provide a drawbar load which can be kept constant during a test and which can be adjusted to suit different sizes of

tractors, a dynamometer car or loading machine will be used. This loading machine will consist of an Illinois tractor chassis with a Sprague electric generator mounted in place of the engine and driven by power from the drivewheels of the machine as it is pulled by the tractor under test. The drawbar load can be adjusted by adjusting the electric load taken from the generator. This loading machine will have a capacity up to about 30 drawbar horse power. For larger tractors, additional loads will be pulled behind the loading machine.

The drawbar pull will be registered by a Gulley traction dynamometer (manufactured by the Burr Co., Champaign, Ill.), which will be attached between the tractor and the dynamometer car.

9. *Measuring Fuel, Oil, and Water.* The quantity of fuel used in each part of the test (except a, par. 1) will be determined by weight and the quantity reduced to gallons at 60° F. For brake tests a tank will be placed on a scale and set at the same height as the tank on the tractor. Fuel will be drawn from this tank on the scale during the tests.

For the 10-hour drawbar test either of the following methods may be used: First method: Fill the tank to a measured level at the beginning of the test. Fill to the same level at the end of the test, weighing the fuel put in. Second method: Drain the tank at the beginning of the test. Fill the tank, weighing the fuel put in. Drain the tank again at the end of the test, weighing the fuel drawn out. One of these methods may be more convenient and accurate with some tractors and the other method with other tractors.

A sample of each order of fuel received will be tested at the Mechanical Engineering Laboratories.

The quantity of oil used will be determined with standard gallon, quart, and pint measures, or by weight when more convenient. The quantity used in the complete test (see par. 1) will be determined as accurately as possible. In most cases it will not be practicable to try to determine the amount of oil used in each separate part of the test. Samples of all engine oil used will be tested at the Mechanical Engineering Laboratories. In the case of recirculating oiling systems the oil will also be tested at the end of the tractor test or when the oil is drained.

Quantity of water used in each part of the test (except a, par. 1) will be determined by measuring the height of water in the radiator or tank at the beginning of the test and filling to the same level at the end of the test, weighing the water added. If necessary in order to secure accurate results, the water added

will be heated to the same temperature as the water in the radiator.

RULES AND DETAILED DESCRIPTION OF TESTS

(For outline of tests see par. 1.)

10. *Test (a) "Limbering up" Run.* The principal object of this run is to take out the stiffness likely to be found in a new machine. Record of any repairs or adjustments made and of oil consumption, loads carried, and actual running time will be kept by an observer.

Tractors in this run will be used to pull drags and rollers in maintaining the cinder track and for any other drawbar work that may be convenient.

The loads pulled will be: Approximately one-third load for approximately four hours, approximately two-thirds load for approximately four hours, and approximately full load for approximately four hours: A total of approximately 12 hours actual running time.

The tractor will be operated by an employee of the tractor manufacturer.

11. *Test (b) Brake Horse-power Test at Rated Load.* The object of this test is to show whether or not the tractor will carry continuously its rated load on the belt and to show fuel consumption at rated load.

The tractor will be given as nearly as possible its rated load. The governor will be set to run the engine at rated speed. If the tractor will not carry its rated load at rated speed, this test will be made at the greatest load it will carry at rated speed.

The test will begin after the temperature of the cooling fluid has become constant. The duration of the test will be two hours continuous run with no change in load or in tractor adjustments.

The tractor will be operated by an employee of the University.

12. *Test (c) Brake Horse-power Test at Varying Load.* The object of this test is to show fuel consumption and governor control when the load varies.

All adjustments are to be as in test (b), par. 11.

The time and loads will be as follows:

10 minutes at rated load (or load carried in test (b), par. 11).

10 minutes at maximum load.

10 minutes at no load.

10 minutes at $\frac{1}{4}$ load.

10 minutes at $\frac{1}{2}$ load.

10 minutes at $\frac{3}{4}$ load.

The total running time is one hour and the test will be made without any engine stop or any change of tractor adjustments.

The tractor will be operated by an employee of the University.

13. *Test (d) Brake Horse-power Test at Maximum Load.* The object of this test is to determine the greatest load the tractor will carry on the belt with the governor set for rated speed at rated load.

The brake load will be increased until the horse-power developed is greatest. The governor will be set as in test (b), par. 11. The carburetor will be readjusted if necessary to give maximum power.

The test will begin after the temperature of the cooling fluid becomes constant. The duration of the test will be one hour continuous run with no change in load or tractor adjustment.

If the speed should change during the test enough to indicate that conditions had not become constant when the test was started, the test will be repeated with the necessary change in load.

The tractor will be operated by an employee of the University.

14. *Test (e) Brake Horse-power Test at Half-load.* The object of this test is to determine fuel consumption at half-load.

The brake will be set to give one-half of the torque developed in test (b), par. 11.

The governor will be set as in test (b), par. 11. The carburetor will be readjusted if necessary to give most economical operation at this load.

The test will begin after the temperature of the cooling fluid has become constant. The duration of the test will be one hour continuous run with no change in load or tractor adjustment.

The tractor will be operated by an employee of the University.

15. *Test (f) Drawbar Horse-power Test at Rated Load.* The object of this test is to show whether or not the tractor will pull its rated drawbar load continuously and to show fuel consumption on drawbar work.

The test will be made on the cinder track described in par. 8.

The governor will be set as in test (b), par. 11. The load applied will be the rated load and the speed will be that obtained with the gears set as recommended for plowing. If this load should prove to be an overload, it will be reduced until the engine speed is up to rating and the slippage of the drivers on the ground is not more than the board of engineers considers reasonable for the cinder track.

The test will begin after the load is set and the temperature of the cooling fluid has become constant. The duration of the test will be ten hours actual running time, as nearly continuous as possible, with constant load. Record will be made of the time and reason for each stop, also of any adjustments or repairs made on the tractor.

The tractor will be operated by an employee of the University.

16. *Test (g) Drawbar Horse-power Test at Maximum Load.* The object of this test is to determine the maximum drawbar horsepower which the tractor will develop on the cinder track. Records will not be kept of fuel, oil, and water used. This test will be made on a level part of the cinder track. The engine will be thoroughly warmed up before this test starts. Record will be made of drawbar pull, rate of travel, wheel slippage and engine speed for each run of approximately 50 ft. For the first run the load pulled will be about the rated load. This will be increased for each successive run until the maximum drawbar horse-power has been determined.

The tractor will be operated by an employee of the University.

17. *Test (h) Miscellaneous.* This test will be conducted to make observation on any special features of the tractor and may include work on inclines, turning radius, effectiveness of brakes, and any other feature which may seem to require special observation.

The tractor will be operated by an employee of the University.

18. *Test (i) Endurance.* It will not be possible in any reasonable length of test to determine the efficient life of the tractor; however, it will be possible to detect any features that will give continual trouble. Observation will be made of all replacements, repairs, adjustments, and cleaning; also, of any difficulty in the operation of the lubrication, cooling, or any other part of the tractor. If an undue amount of wear is suspected in any part of the tractor, it may be taken apart for examination at the end of the test.

19. *Application for Test.* Tractor companies who desire to have tractors tested will make application on a form supplied by the Agricultural Engineering Department, University Farm, Lincoln, Nebraska. This form calls for specifications of the tractor.

Tractors will be tested in the order in which offers of the tractors for test have come to the University.

APPENDIX

TRACTOR LAW

HOUSE ROLL NO. 85

A BILL for an Act to provide for official tests for gas, gasoline, kerosene, distillate or other liquid fuel traction engines in the State of Nebraska, and to compel the maintenance of adequate service stations for same.

Be it Enacted by the People of the State of Nebraska:

Section 1. That on and after July 15, 1919, no tractor or traction company shall be permitted to sell or dispose of any model or type of gas, gasoline, kerosene, distillate or other liquid fuel tractor engine in the State of Nebraska, without first having said model tested and passed upon by a board of three competent engineers who are or shall be under the control of the State University management. Each and every tractor presented to the State University management for testing, shall be a stock model and shall not be equipped with any special appliance or apparatus not regularly supplied to the trade. Any tractor not complying with the provisions of this section shall not be tested under this act, nor the result certified.

Sec. 2. Such tests to consist of endurance, official rating of horsepower for continuous load, and consumption of fuel per hour or per acre of farm operations; the results of such tests to be open at all times to public inspection.

Sec. 3. The State University management after having duly tested any model of liquid fuel traction engine shall certify the results to the state railway commission. Prior to the issuing of a permit by said commission to any liquid fuel traction engine company to do business in the State of Nebraska, the official tests of the University shall be compared with the representations of the tractor company as to horse-power rating for not less than ten consecutive hours of continuous load, fuel used for developing such horse power, and any other representation such company shall make, and in case any such representations shall be found false, the State Railway Commission shall deny the company manufacturing or assembling such tractor, the right to do business in the State of Nebraska, except as hereinafter provided.

Sec. 4. Likewise, the State Railway Commission shall deny to any liquid fuel tractor company the right to do business in the State of Nebraska which shall be found, on complaint of two or more bona fide customers residing within the State, to fail to maintain an adequate service station with full supply of replace-

ment parts within the confines of the State and within reasonable shipping distance of said customers.

Sec. 5. Provided that if prior to July 15, 1919, the State University management shall fail to complete such aforementioned tests, a temporary permit shall be issued to any company to do business till such time as the University management shall forward to the State Railway Commission the results of the foregoing tests. But no failure on the part of a tractor company to present any model for testing, at such place as the State University management shall designate, shall constitute a valid condition under this act for the issuance by the State Railway Commission of a temporary permit for the sale of such model of tractor.

Sec. 6. Provided further, that the failure of any model of tractor to come up to the representations of the company manufacturing or assembling same, shall not prevent said company from placing on the market, other models of tractors that do comply with specifications and ratings. Any model of tractor that fails in the official test to come up to the company's own specifications, may be retested after alteration and remodeling.

Each and every permit issued under this act shall specify the model or models included in such permit to sell.

Sec. 7. The report of the official tests herein provided shall be posted in the Agricultural Engineering Department of the State University and in such other places as may be designated by the State University management. The same shall be incorporated in the annual report of the State Railway Commission.

Sec. 8. Provided that no tractor company shall use the results of said tests in such manner as would cause it to appear that the State University management intended to recommend the use of any given type or model of tractor in preference to any other type or model. It shall be unlawful for any tractor company operating in the State of Nebraska, to publish extracts from such official tests for advertising purposes, without publishing the entire report.

Any infraction of the foregoing provisions shall result in the suspension or denial to any company so offending the permission to do business in the State at the discretion of the State Railway Commission.

Sec. 9. Tractors shall be tested by the State University management in the order in which they are presented for such tests, and no discrimination shall be made for or against any tractor company in any manner whatsoever. Complaints against the

violation of this provision shall be heard and adjudicated by the State Railway Commission.

Sec. 10. After July 15, 1919, any gas, gasoline, kerosene, distillate or other liquid fuel tractor or traction company selling or offering for sale in the State of Nebraska or any automobile, implement or other company or individual operating in behalf of such tractor company or on their own behalf, who shall after the date specified, sell or offer for sale in the State any model of liquid fuel tractor engine, without having in his possession a permit from the State Railway Commission to sell such model of tractor as he is offering for sale, the same shall be deemed guilty of a misdemeanor.

On conviction such misdemeanor shall be punished by a fine of not less than \$100.00 nor more than \$500.00 for each offense, in the discretion of the court.

Sec. 11. The State Railway Commission shall have full authority to enforce the provisions of this act, both by denial of permit to do business in the State and by due process of law to compel compliance therewith.

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