

Northern Pacific All-Steel Dynamometer Car Built at Como Shops, St. Paul, Minn.

## Northern Pacific Builds New Dynamometer Car

*Unusually large and complete living quarters and working facilities provided—Car measures drawbar pull up to 250,000 lb.*

**E**ARLY in 1928, the Northern Pacific ordered a four-cylinder single-expansion locomotive developing a maximum tractive force of 153,400 lb., and it was realized that in order to test this, as well as other large locomotives, the dynamometer car then used by the Northern Pacific, with a maximum capacity of 60,000 lb., would be entirely inadequate. Accordingly, plans were initiated to design and construct a modern dynamometer car of the required capacity. As a result of experience with the previous car, it was decided that the living accommodations in the new car must be made as large and complete as possible, that a large work room should be provided, and also a large, clear-vision cupola for the chronograph table and gages.

The new-all-steel Northern Pacific dynamometer car, No. 276, which was built in Como shops, St. Paul, has a capacity to measure drawbar pull up to 250,000 lb. and buff up to 1,250,000 lb. The car is 9 ft. 3 $\frac{3}{8}$  in. wide by 70 ft. long inside and weighs 168,600 lb. This is believed to be the largest dynamometer car in the world. The car has a built-up steel underframe with fish belly center sills 28 in. deep. Six-wheel Commonwealth cast steel trucks are used with 36-in. solid steel wheels. All wheels are equipped with clasp brakes, except the rear pair of the front truck from axle of which the paper drive is taken.

The car body is of steel, well insulated and lined with tongue and groove sheathing. The car proper has a tongue and groove wood floor, all of which is covered with green and red checkered rubber tile, except the kitchen, heater room and shower. The outside is painted Pullman green, and the inside, with the excep-

tion of the kitchen, shower, heater room and space in front of the cupola, has side walls in old ivory enamel and the ceiling and lower deck in pearl gray.

### Living Accommodations for Crew

The space provided for living quarters for the crew occupies 34 ft. 7 in. of the 70-ft. car and consists of a kitchen, porter's room, operator's stateroom, clothes lockers, two berth sections, shower and lavatory.

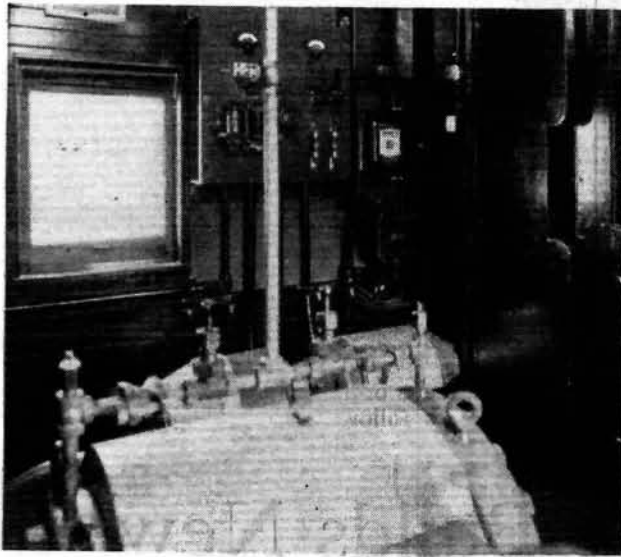
At the rear of the car is the kitchen, 7 ft. 2 $\frac{3}{8}$  in. wide and 7 ft. 3 in. long. The floor is of copper, covered with wood floor racks. The ceiling, lower deck and side walls are painted with a pale green enamel. The kitchen is equipped with a No. 18 Commander range, metal-lined coal box, Monel metal work table, Monel metal sink, large refrigerator, motor-driven exhaust fan and the usual cupboards for dishes and cooking utensils. Suspended from the ceiling in the kitchen are two copper gravity water tanks with a capacity of 126 gal. and connection to a hot water coil in the range. Two 8-in. by 24-in. windows in the side of the car and one 7-in. by 25 $\frac{1}{2}$ -in. deck window provide excellent daylight and there are the usual ceiling and wall electric lights.

A passageway 2 ft. 1 in. wide, with flat ceiling, extends along the right side of the car from the rear to the transverse aisle at the berth sections. Door openings lead from this longitudinal passageway to the kitchen, the porter's room and the operator's stateroom.

The porter's room is next to the kitchen. There is a serving door with drop leaf shelf in the partition between the kitchen and porter's room, to facilitate handling of food to the dining room. The room is

equipped with an upper and lower berth, clothes locker, folding washstand with mirror above, enclosed hopper and a 9-in. electric fan.

Adjacent to the porter's room is the operator's stateroom, equipped with an upper and lower berth, large



View of Weighing Head in the Head End of the Car—The Motor Generator Set for Charging Batteries and Charging Panel are in the Far Corner

clothes locker, flat-top desk with cabinet above, chair, folding washstand with cabinet and mirror above, an enclosed hopper and a 9-in. electric fan. In addition to serving as a bedroom, this is used by the operator as an office for working up reports and handling correspondence.

In the passageway between the porter's room and the operator's stateroom is a swinging door which serves to keep kitchen odors from getting into the main body of the car. The longitudinal passageway terminates in a transverse passage 2 ft. 2 in. wide. Built against the stateroom and facing the transverse aisle are four built-in individual clothes lockers with chest of drawers below. These lockers and drawers provide excellent space for the clothing of the crew.

Two Pullman sections located next to the transverse aisle furnish sleeping accommodations for the assistants. By the use of removable tables, this space is also utilized as a dining room during the day.

On the left side of the car next to the Pullman section is the shower room and a wash stand. The shower room has Monel metal walls and a copper floor with wood floor rack and is supplied with hot and cold water. Across the car from the shower and wash room is the toilet, which contains a wash stand, with cabinet and mirror above and a Duner hopper. There is a hinged door in the partition between the Pullman sections and the front of the car. A galvanized Geisel water cooler is readily accessible from the aisle between the shower room and the toilet.

### Heating and Lighting Equipment

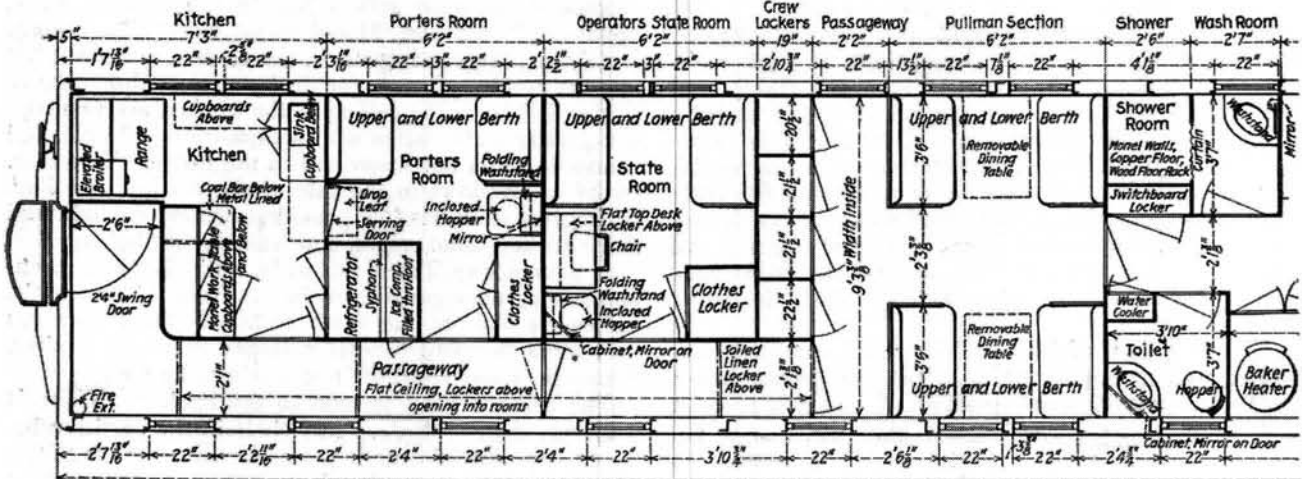
On the right side of the car next to the toilet is the heater room, lined with galvanized iron. A Baker hot water heater generates heat for the entire car, a No. 1 International laundry hot-water heater providing hot water for washing purposes.

A Safety 4-kw., 32-volt axle generator is belt-driven from the rear truck. The battery equipment consists of a 600-amp.-hr., 32-volt Exide storage battery mounted in battery boxes underneath the car. In view of the fact that the dynamometer car operates mostly in freight service, the axle generator has been arranged to cut in when a car speed of 7½ miles an hour is attained. All rooms have been amply supplied with electric lights with suitable control switches. Mounted on each side sill under the cupola is an adjustable electric light with reflector, and with the switches in the cupola, for locating mile posts at night.

Since the car may be at terminals and outlying points for several days at a time, where no facilities for charging storage batteries are available, a motor-driven generator is installed in the front left hand side of the car. This consists of a Westinghouse Type AR, single-phase, 110-volt, 60-cycle motor, operating at 1,750 r.p.m. and direct connected to a 3-kw., 40-volt, Type-SK, d.c. generator, with suitable starting compensator and charging panel. This unit operates on either 110- or 220-volt alternating current.

### Cupola

Six feet from the front of the car is the cupola. The space below the floor is totally enclosed, a door being provided at the head end and a trap door above in the floor of the cupola. This provides excellent space for storing paper and miscellaneous supplies. The ceiling of the side aisle passageway extends up into the cupola and is covered with cushions to provide seating



accommodations for visitors. A bench at the left of the cupola door and chairs furnish additional seating capacity. Beneath the cupola are four cupboards on the aisle side with doors opening from the aisle. Excellent natural illumination of the cupola is provided by one stationary and two sliding windows in each side of the car. In order to see stations and mile posts in inclement weather, a portable storm hood has been built, which fits into the opening of the sliding window on either side. This hood has glass at the front and rear and thus affords a good view both forward and backward. In the cupola are located the chronograph tables, gages, etc.

**Work Room**

The work room in this car extends from the wash room forward to the cupola and has a total length of 17 ft. 5 in. On the left side of the car, just ahead of the wash room, is a 3-ft. by 10-ft. oak work table with winding rolls at each end for handling the rolls of paper. Under the table at each end is a tier of drawers, useful for storing data, gages, planimeters, etc. Above the work table at one end is an overhead berth for emergency use. On the opposite side of the car are built-in trunk and baggage, linen, clothes and steel over-all lockers. This work room is unusually large, and the arrangement has been carefully developed so that the working up of data and reports may be handled expeditiously and with a minimum interference.

**Dynamometer Equipment**

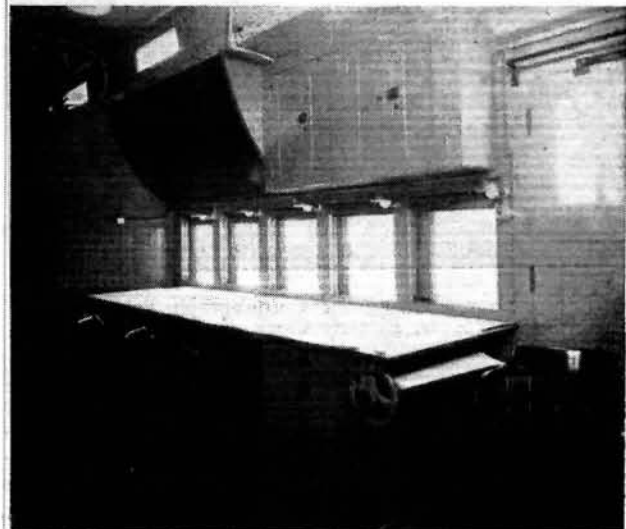
The complete dynamometer equipment, consisting of the weighing head, axle drive for the paper, chronograph table, speed recorder, integrator, electric clock, gages, etc., were purchased as a unit from the Baldwin Locomotive Works. The weighing head is located on the main floor of the car, on the center line, just ahead of the cupola, where it is rigidly bolted to the car underframe. The weighing head is of the diaphragm type with the drawbar-pull piston at the rear and the buff piston at the front. The effective area of the drawbar-pull piston is 100 sq. in. and of the buff piston 200 sq. in.

The paper drive is taken from the rear axle of the front truck through spiral gearing and a vertical shaft extending up to the speed change box on the floor of the cupola. A square jaw clutch in the axle gear case, which is controlled from the cupola, engages or disengages the paper drive. By means of the speed-change box in the cupola, three paper speeds can be ob-

tained from the axle drive, i. e., 3.30 in., 13.20 in., and 52.80 in. per minute of car travel. The intermediate speed of 13.20 in. per minute is found to be most practical for ordinary work. The motor in the cupola used in connection with the speed recorder and indicator drive can also be used for paper drive in case it is desired to take records of some events when the car is not in motion, or drive the paper at a definite number of inches per minute instead of per mile of car travel. The three paper speeds from the motor drive are at the rate of 3¾ in., 15 in. and 60 in. per minute. A small lever at the right of the operator's chair provides for neutral position, motor drive of the paper or axle drive of the paper. For general work, the axle drive at a fixed paper travel per car mile is the most convenient and practical.

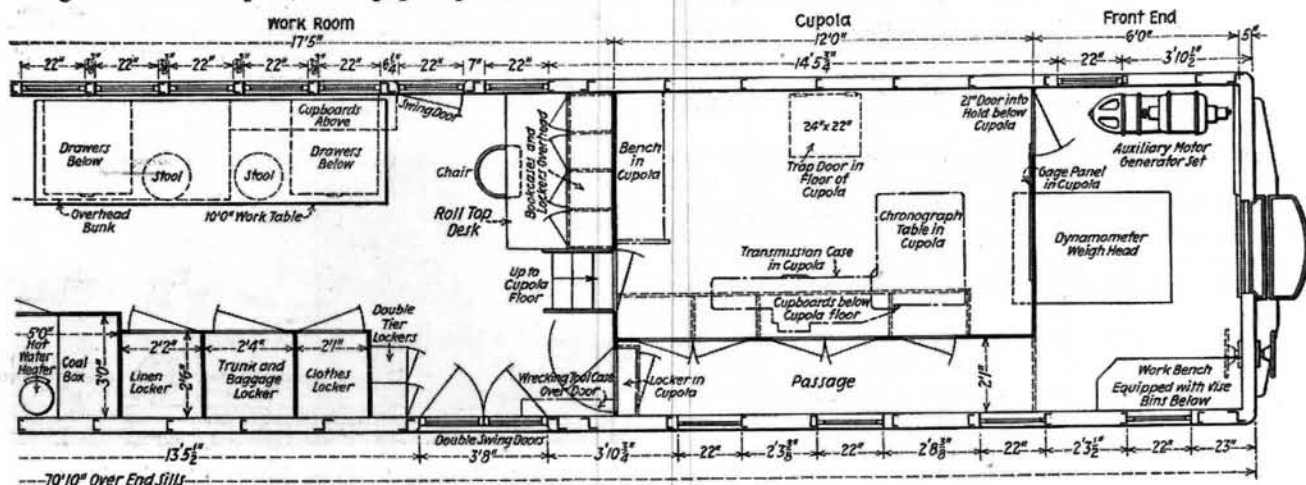
**Events Recorded by Pens**

The bridge bars spanning the table carry supports for 22 recording pens. The events recorded by these pens in consecutive order from the left to the right of the paper are as follows: six second intervals, brake-



View of the Left Side of the Work Room Showing the Work Table With Tier of Drawers at One End, and the Upper Berth and Cupboards Above

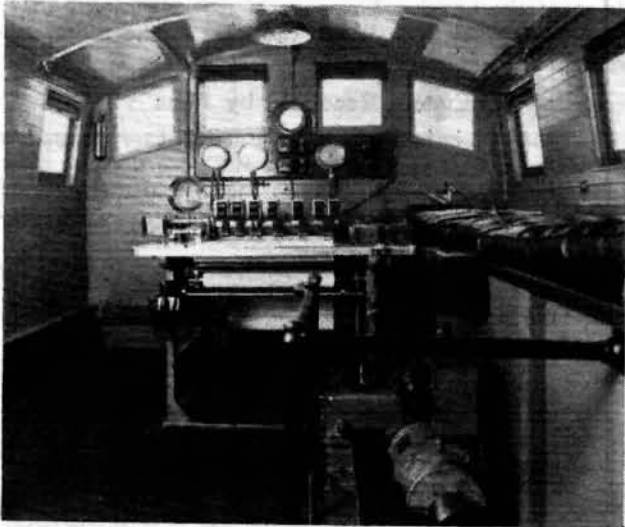
cylinder pressure, right water meter, left water meter, brake pipe pressure, front air pump, back air pump, steam pressure, coal or oil meter, feedwater pump, back pressure, locomotive indicator, integrator, drawbar pull,





buff, reverse lever, throttle, speed, distance marks, mile-post and station locations, one-minute intervals and six-second intervals.

Datum reference lines are necessary for brake-cylinder pressure, brake-pipe pressure, back pressure, steam pressure, drawbar pull, buff and speed. These datum lines are marked on the paper by aluminum rollers mounted on a shaft extending across the table at the front. These rollers have a very sharp flange, which marks the datum line, and a tread on which is a rubber stamp, designating what the line above each base line represents. Ink-



Interior View Showing the Chronograph Table, Speed Recorder, Electric Clock, Gages, etc.

ing pads are in contact with each roller at all times and the line made by the flange is very fine and comparable with that made by a pen. There is a decided advantage in recording datum lines in this manner as it removes seven pens from the main bridge bars and means less pens to watch and keep working. So far as is known, this is the first time this arrangement has been utilized in a dynamometer car.

Records of brake-cylinder pressure, brake-pipe pressure, back pressure, steam pressure and buff are obtained through steam indicators, mounted on the left top of the chronograph table. The pencil motion of each indicator is extended through levers to the proper position on the table. The drawbar-pull pen arm, the full travel of which is 3 in., derives its motion through a lever from the above piston rod. By changing springs in the drawbar-pull indicator cylinder a full 3-in. movement of the drawbar-pull pen is obtained with a pull of either 25,000, 50,000, 75,000, 100,000, 150,000, 200,000, or 250,000 lb.

The integrator is fastened on top of the chronograph table at the front and makes one revolution for each three square inches area between the datum line and the drawbar-pull line. Each revolution of the integrator is recorded on the paper as a notch, by means of a commutator on the integrator shaft, a pilot relay and pen-arm relay.

On the right top of the chronograph table are eight of the latest type Veeder electrically-operated counters. These record the number of integrator notches, number of 100-ft. distance marks, revolutions of the left water meter, revolutions of the right water meter, revolutions of the coal or oil meter, strokes of the front air pump,

strokes of the back air pump and strokes of the feed-water pump.

Near the speed-change box, on the floor of the cupola, at the right of the operator is a  $\frac{3}{4}$ -hp. 30-volt General Electric constant-speed motor for operating the speed recorder and indicator, and the paper drive when desired. On the end of the motor shaft is a governor which holds the speed very close to 1,725 r.p.m. and final adjustment of speed is by means of a face plate rheostat connected in series with the motor field. On top of the motor is a small panel on which is mounted a voltmeter and a speedometer, which shows the speed of the motor.

The speed recorder and indicator, an ingenious device developed by the Baldwin Locomotive Works, is mounted on top of the chronograph table at the right. A small lever at the right top of the table controls the speed-indicator and recorder drive. With the lever in central position, the speed device is in neutral; when moved to the left the indicator and recorder give the true car speed and when moved to the right, double the car speed is indicated and recorded. The double speed arrangement is very convenient for close readings of slow speeds, and it is quite essential in figuring indicator cards that the speed be known to as fine a degree as possible.

#### Selective Switch Box in Cupola

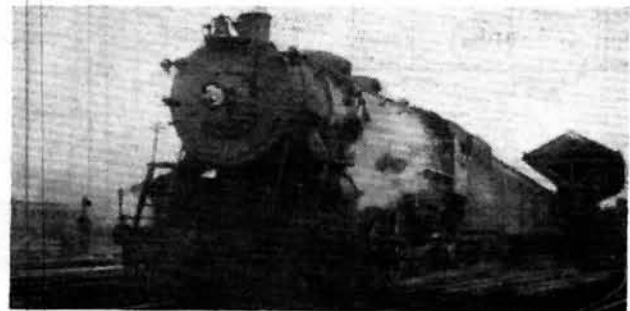
Mounted on the side of the longitudinal seat at the right side of the cupola, close to the operator's chair, is the selective switch box with a master switch and marked individual switches for each electrical circuit in the cupola and those extending in a cable from the cupola to the locomotive cab and pilot. A telephone in the cupola and one in the locomotive cab afford a means of communication between the operator and the assistant. The circuits extending from the switch box and table to the locomotive are enclosed in a cable terminating in a junction box at the left of the front door of the car.

At the front right corner of the cupola is a dead-weight gage tester for calibrating the drawbar-pull indicator and recorder as well as all other pressure-recording indicators.

On the front wall of the cupola, below the windows, is the oak gage board on which is mounted a Seth Thomas clock, duplex air gage, steam-pressure gage, drawbar-pull gage, clock relay, integrator relay and weighing-head alarm bell. The clock is so arranged that electrical contact is made every minute and this is indicated on the paper. The two six-second marks on the paper are timed from constant speed motor.

On the chronograph table and at each sliding window in the cupola is a button switch for indicating the location of stations and mile posts.

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Erie Express Train at Jersey City, N. J.