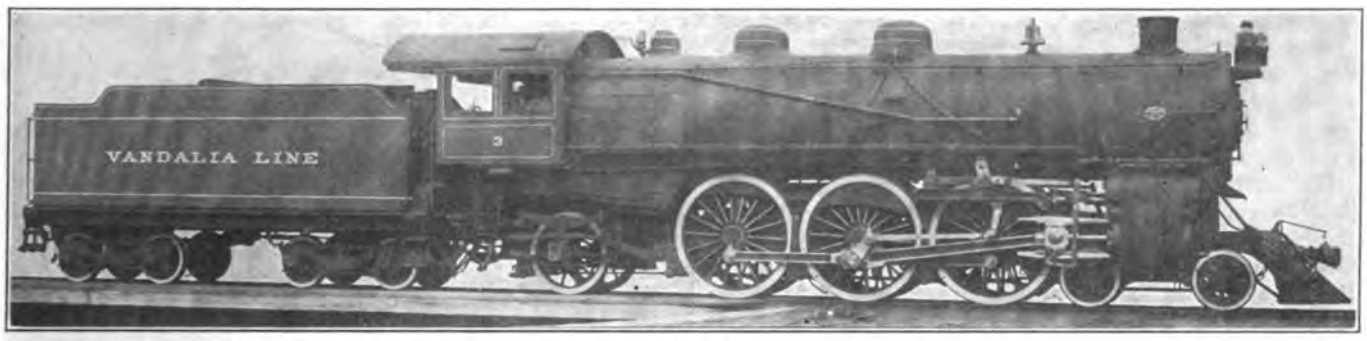
Heavy Pacific Type Locomotives

VANDALIA LINE.

Until recently an Atlantic type locomotive having a total weight of 185,000 lbs., weight on drivers of 107,500 lbs., cylinders 21 x 26 in., and a maximum tractive power of 24,650 lbs., has been the standard class of passenger locomotive used on the Vandalia Line. During the past few years, however, the requirements in passenger service have increased to such an extent that a heavier locomotive than can be provided in the Atlantic type is now needed to handle certain of the trains. In consequence, in ordering new passenger equipment from the American Locomotive Company in December, 1909, it was decided to include four heavy locomotives of the Pacific type to be used on some of the most important trains.



LOCOMOTIVE THAT PULLS A TWELVE-CAR TRAIN AT 65 MILES PER HOUR.

Prior to the advent of these engines, the Vandalia was one of the few important roads in the country on which the Pacific type locomotive had not been adopted for at least the most difficult passenger service. In fact, because of the favorable service conditions on this line, both the freight and passenger traffic have hitherto been handled altogether by the lighter classes of motive power. The Mogul type of engines is at present the standard class for freight service, and the equipment includes the heaviest examples of this type so far constructed. The last Mogul engines built for this road by the American Locomotive Company had a total weight of 187,000 lbs., 159,300 lbs. on driving wheels, 21 x 28 in. cylinders, and a maximum tractive power of 33,300 lbs.

The engines here illustrated have now been in service for two months on the St. Louis Division. Although designed for fourteen car trains, they have not up to date had occasion to handle more than twelve cars to a train. Officials of the road report that the service with the trains of that size have been very satisfactory and gives every indication that there will be no difficulty in meeting the more severe requirements which will be put upon them in the winter time. In their report, the officials make particular mention of the easy riding qualities of the engines, stating that they ride remarkably well at a high rate of speed (60 miles per hour and upward). They are operating under easy grade and curvature conditions. There are, to be sure, a number of portions of the road of from three to ten miles long where the curves are numerous; but the sharpest curve on the division is only 3 deg. 48 min., and there are long straightaway stretches with very few curves.

As to the grades, the total rise between St. Louis and Summit, a distance of 217.8 miles, is only 474 ft. This rise, which is against eastbound traffic, is accomplished by a series of short, easy ascents over rolling territory with long stretches of practically level track in between. Practically the only grade of any consequence against eastbound traffic lies between Reelsville and Almeda, Ind., where in a distance of approximately 8 miles, the total rise is 216 ft., giving an average gradient of 0.503 per cent. Going in the other direction, the grade conditions are still easier, there being several long, easy slopes in favor of westbound traffic.

The following table gives a record of eight typical runs of some of the most important trains between Indianapolis and Terre Haute, and the latter place and St. Louis:

Train	Date.	Terminals of Run.	Dist. Mi.	No. of cars.	(Tons) Tot. wt. train, incl. eng.	Sched. time, incl. stops	Run. time, incl. stops	Tot. water used. Gals.	Approx Tot. coal used. lbs.	Coal used per hr. lbs.	Lbs. of coal sq. ft. grate area pr. hr.	Highest. speed M.H.P.	Exhaust tip Diam.	Remarks.
21	7-12 10	Indpls. to Terre Haute.	73	10	800	1 hr. 42 min.	1 hr. 40 min.	5700	7000	4200	74.5	60	6″	Eng. steamed poorly. In diana coal, heavy rain.
14	7-13 10	Terre Haute to Indpls.	73	10	825	1 hr. 50 min.	1 hr. 50 min.	5700	7000	3818	67.5	60	6″	Indiana coal.
21	8-3 10	Indpls. to Terre Haute.	73	12	825	1 hr. 42 min.	1 hr. 46 min.	6000	7000	3965	70.2	65	6¼″	Indiana coal.
14	8-4 10	Terre Haute to Indpls.	73	11	875	1 hr. 50 min.	1 hr. 48 min.	5700	5200	2885	51.0	60	6¼″	Indiana coal, heav fog and mist
21	8 4 10	Indpls. to Terre Haute.	73	8	715	1 hr. 42 min.	1 hr. 34 min.	5100	6000	3830	67.8	65	6¼″	Indiana coal, fine and dirty, heavy quartering wind.
7	8-12 10	Terre Haute to St. Louis.	175	7	650	4 hrs. 30 min.	4 hrs. 13 min.	12400	13000	3065	54.6	75	6¼″	Indiana coal.
20	8-13 20	T Louis to o rre Haute.	175	8	740	4 hrs. 11 min.	4 hrs. 11 min.	14200	15500	3720	65.9	75	6¼″	Hard Running Train Ill. Coal.
21	8-18 10	Indpls. to Terre Haute.	73	9	710	1 hr. 42 min.	1 hr. 36 min.	5900	6000	3750	66.3	75	6¼″	Indiana coal, rain and quartering wind.

When the engines were first put into service it was necessary to make some minor changes in the front end arrangement, which was the Vandalia standard. After that the engines steamed freely and no trouble was experienced.

"Schedule Time" and "Running Time" in the above table includes in each case all stops. Trains 21 and 14 between Indianapolis and Terre Haute make three and two regular stops, respectively. While between Terre Haute and St. Louis train No. 7 makes four regular stops, and train No. 20 three. From this table it is apparent that these engines have no difficulty in maintaining the train schedules.

An examination of the figures for the coal consumption indicates that the engine was not pushed to the limits of its capacity on any of the runs. From this table it will be noticed that the highest rate of coal consumption per square foot of grate area per hour (which was calculated from the data furnished by the railroad company) is only 74.5 lbs. The figures for the total amount of coal used per trip, in view of the tonnage and speed maintained, are also very creditable.

Although the design incorporates no new or unusual features, it is an excellent example of a straightforward, well proportioned design carefully worked out to meet the particular conditions of service for which the engines were intended. That the engines are well adapted to meet the requirements, is shown by the train records in the above table. The design is entirely new and follows in general the builders' standard practice.

As far as the cylinders and running gear are concerned, it is practically identical with the engines of the same type built by the American Locomotive Company for the Pennsylvania Railroad,* the use of which on the Vandalia road was prohibited by the limit of 55,000 pounds for the allowable load per driving exle. The principal differences between the two designs are a reduction of the boiler pressure from 210 to 200 lbs. and use of a smaller boiler and firebox, the boiler of the Vandalia locomotive being 76½ in. in diameter outside at the first ring; while this dimension in the Pennsylvania locomotives is 79¾ in. The boilers of both locomotives are of the straight top type, and the tubes in each case are 21 feet long.

In regard to the firebox, that of the engines here illustrated is 108⅛ in. long by 75¼ in. wide, having a grate area of 56½ sq. ft.; while that of the Pennsylvania locomotive is 111 in. long by 80¼ in. wide, and has a grate area of 61 8/10 sq. ft.

These modifications in design result in a reduction of 14,000 lbs. in the total weight of the locomotive. The Vandalia engines have a total weight of 256,000 lbs. as compared with a total weight of 270,000 lbs. for the Pennsylvania locomotives.

Although the reduction of 10 lbs. in the boiler pressure reduces the maximum tractive effort of the engines here illustrated 2,600 lbs., as compared with that of the locomotive built for the Pennsylvania, at 60 miles per hour there is only 600 lbs. difference between the tractive efforts of the two locomotives calculated in accordance with the builders' formula.

The general design is shown in the accompanying illustrations and the general dimensions and principal ratios are given in the following table:

GENERAL DATA.

Gauge	4 ft. 8½ in.
Service	Passenger
Fuel	Bit. Coal
Tractive effort	31,800 lbs.
Weight in working order	256,000 lbs.
Weight on drivers	162,000 lbs.
Weight of engine and tender in working order	401,900 lbs.
Wheel base, driving	13 ft. 10 in.
Wheel base, total	35 ft. 2½ in.
Wheel base, engine and tender	66 ft. 5 in.

RATIOS.

Weight on drivers ÷ tractive effort	5.10
Total weight ÷ tractive effort	8.05
Tractive effort × diam. drivers ÷ heating surface	580.00
Total heating surface ÷ grate area	77.50
Firebox heating surface ÷ total heating surface, per cent	4.43
Weight on drivers ÷ total heating surface	37.00
Total weight ÷ total heating surface	58.50
Volume both cylinders, cu. ft	13.60
Total heating surface ÷ vol. cylinders	322.00
Grate area ÷ vol. cylinders	4.15

CYLINDERS.

Kind	Simple
Diameter and stroke	24 x 26 in.

VALVES.

Kind	Piston
Diameter	14 in.
Greatest travel	6½ in.
Outside lap	1¼ in.
Inside clearance	⅛ in.
Lead at 6½ in. cut off	¼ in.

WHEELS.

Driving, diameter over tire	80 in.
Driving, thickness of tire	4 in.
Driving journals, main, diameter and length	10½ x 14 in.
Driving journals, others, diameter and length	10 x 14 in.
Engine truck wheels, diameter	36 in.
Engine truck, journals	6½ x 12 in.
Trailing truck wheels, diameter	55 in.
Trailing truck, journals	8 x 14 in.

BOILER.

Style	Straight
Working pressure	200 lbs.
Outside diameter of first ring	76½ in.
Firebox, length and width	108⅛ x 75¼ in.
Firebox plates, thickness	⅜ and ½ in.
Firebox, water space	4½ in.
Tubes, number and outside diameter	383—2 in.
Tubes, length	21 ft.
Heating surface, tubes	4,195 sq. ft.
Heating surface, firebox	194 sq. ft.
Heating surface, total	4,389 sq. ft.
Grate area	56½ sq. ft.
Smokestack, diameter	20 in.
Smokestack, height above rail	14 ft. 10¼ in.

TENDER.

Tank	Waterbottom
Frame	10 and 12 in. channels
Wheels, diameter	36 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	7,500 gals.
Coal capacity	12 tons

* See AMERICAN ENGINEER, July, 1907, p. 267.

THE STANDARDIZATION OF MOTOR DRIVES FOR MACHINE TOOLS.

At the Rochester convention of the National Machine Tool Builders' Association the Committee on the Standardization of Motor Drives for Machine Tools made a report of progress of its negotiations with the committee of the American Association of Electric Motor Manufacturers. Seven points have been agreed upon, but the final adoption of the new standard practice by the two associations has not yet come up for formal action. The schedule as agreed upon is as follows:

1. *Horsepowers.*—It is thought that the following horsepowers will meet practically all the requirements of electric drives for machine tools: 1, 1½ (for D. C. only), 2, 3, 5, 7½, 10, 15, 20 and 25. Though it was agreed that horsepowers more than 25 and less than 1 are used, it was not thought advisable to embody them at the present in the attempted standardization, but it was held out that they might be embodied some time in the future among the standardized sizes.

2. *Voltage.*—It is recommended that for D. C. motors 115 and 230 volts be adopted as standard, and for A. C. motors 110 and 220 volts.

3. *Horsepower Ratings for Drives.*—It is recommended that the horsepower ratings for machine tool drives be the standard ratings of the American Association of Electric Motor Manufacturers—*i. e.*, (a) that motors be given the continuous constant horsepower rating where approximately standard load conditions exist; (b) for adjustable speed motors used for intermittent service the standard two-hour continuous duty rating be used for ordinary shop conditions, and that the name plates of such motors indicate the time as well as horsepower ratings of the motor, and further that the horsepower be figured at the high as well as the low speed for adjustable speed service.

4. *D. C. Motors.*—It is the recommendation of the joint committee that constant speed motors, adjustable speed with a range of 2 to 1, and adjustable speed motors with a range of 3 to 1, be included in the attempt at standardization. It is the opinion that this will cover practically all the requirements of the majority of machine tool manufacturers, and these ratios are recommended for the guidance of tool and motor designs.

This does not exclude the occasional use of motors with a different speed range, such as 4 to 1, or even more, but it was the opinion of the committee that motors with a higher range of speed than 3 to 1 are not used to a sufficient extent and are not so absolutely necessary for machine tool construction, as to