LOGGING LOCOMOTIVES

BALDWIN LOCOMOTIVE WORKS

BURNHAM, WILLIAMS & CO.

PHILADELPHIA, PA.

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CODE WORD—MANIGAUX

LOGGING IN THE NORTHWEST

AUG 21 1943

Logging Locomotives

THE locomotive has proved itself to be almost indispensable in logging work, it being economical to use steam power even where the output is comparatively small and the distance covered is short. It is estimated that under ordinary conditions the total cost of hauling by steam power, including interest and depreciation, is from thirty to sixty cents per 1000 feet of lumber cut.

In the following pages are illustrated various types of locomotives, of both broad and narrow gauges, which are particularly adapted to logging service. The principal dimensions, which are given in each instance, are intended as a guide in determining the type and class of locomotive; but modifications can be made in any of the designs shown in order to meet the special requirements of the purchaser.

In the majority of cases wood is used as fuel on logging railroads. Equipped with suitable grates, however, any of the designs presented in this catalogue may be arranged for burning bituminous coal or coke; and with the addition of the necessary appliances, petroleum may be used.

By the system of manufacture employed all important parts are accurately made to gauges and templates; they are, therefore, interchangeable throughout any number of locomotives of the same class. This system permits of any parts needed for repairs being supplied either with the locomotive or whenever subsequently required. Such parts are made to the same gauges and templates as were originally used in the construction of the locomotive, and in this manner the expense of repairs is reduced to a minimum, and the maintenance of locomotive power is attended with the least possible inconvenience and delay. It is only necessary to give the construction number of the locomotive, which is found on the builder's number plate, ordinarily attached to the sides of the smokebox, and name the particular detail which is required. It can

17896

then be furnished from the Works at the shortest notice, guaranteed to fit in place.

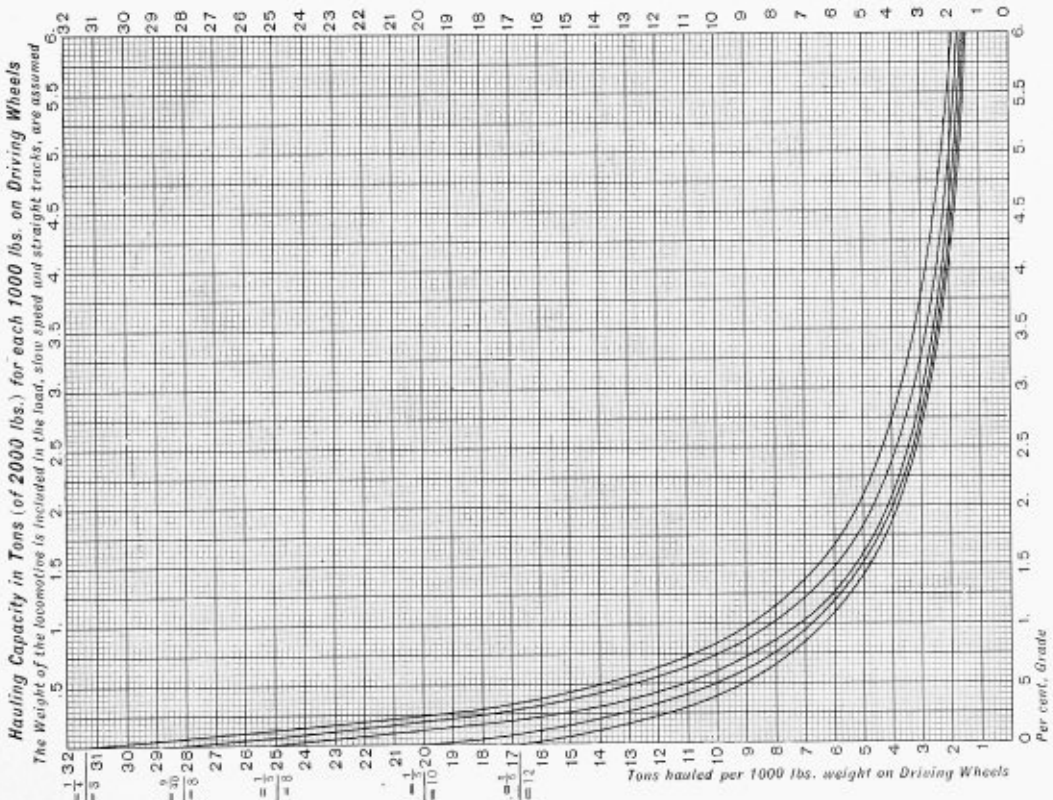
Hauling Capacity

Particulars are given in the tables of the hauling capacity of the various classes illustrated, based upon actual work done. The basis of these calculations is a factor of adhesion of $^{25}/_{40}$ of the weight on the driving wheels, and the maximum mean effective pressure on the pistons at slow speed is taken at eighty-five per cent. of the normal boiler pressure. It is assumed that the frictional resistance of the cars hauled will not exceed eight pounds per ton of 2000 pounds. These conditions are taken as those ordinarily prevailing, with track and cars in fairly good order, and exclusive of the resistance of curves. Under the most favorable conditions the performance should exceed this basis. Allowance may be made for curvature by considering each degree as equivalent to the resistance on a straight grade of one and one-half feet per mile.

The hauling capacity of a locomotive is dependent, not only upon the calculated tractive power, but also upon the steaming capacity. If the boiler power be insufficient the engine may stall, at a critical moment, owing to reduced steam pressure. In preparing these tables, care has been taken that the maximum number of square feet of heating surface is provided for each horse power developed, while the weight on the driving wheels is sufficient to prevent slipping. It is, therefore, possible to drop the reverse lever down in the corner, when the engine is working on heavy grades, and to maintain the steam pressure under these conditions.

The diagram on page 5 shows graphically the number of tons of 2000 pounds which should be hauled on grades from level to six per cent. at slow speed, by any locomotive, including the weight of the engine and tender, for each 1000 pounds weight on driving wheels. The weight of the engine and tender, in tons of 2000 pounds, must be deducted to obtain the weight of the cars and lading.

Five bases of calculation are shown by separate lines in this diagram. Under the most favorable conditions, such as well surfaced track, dry rails, well lubricated rolling stock, etc., adhesion equal to one-fourth or ten-fortieths of the weight on the driving wheels may be developed; but as these conditions cannot at all times be realized, the loads given in the following tables are


Hauling Capacity in Tons (of 2000 lbs.) for each 1000 lbs. on Driving Wheels
The Weight of the locomotive is included in the load, slow speed and straight tracks, are assumed
Adj. = 1/4 Res. = 3
Adj. = 9/40 Res. = 8
Adj. = 1/5 Res. = 8
Adj. = 1/2 Res. = 10
Adj. = 5/6 Res. = 12
Tons hauled per 1000 lbs. weight on Driving Wheels
Per cent. Grade

based on the second line for a conservative estimate. As this basis, which may be considered as representing average conditions, is more favorable than frequently prevails on lines having light rails or poorly constructed track, the other lines are added to the diagram to make provision for such cases. The selection of the basis of calculation must of course be made in each instance with reference to the actual or probable condition of the road and its rolling equipment.

In selecting a design to fulfill any particular conditions, it should be borne in mind that a surplus of power is always desirable.

Designs and estimates for any sizes or patterns of locomotives not given in the following pages will be submitted on application, or estimates given on purchaser's specifications. The delivery of locomotives at any point which can be reached by rail or vessel will be included in contracts if desired. In ordering locomotives the following particulars should be given:

1. Gauge of track—exact distance between the rails.
2. Kind of fuel which will be used.
3. Kind and height of couplings of cars.
4. Limitations, if any, in height and width, by tunnels, overhead bridges, etc.

Resistance, Locomotive and Train

The total resistance to be overcome by the locomotive includes the frictional resistance of the locomotive itself, the frictional resistance of the train, and the resistances due to grade, curves and speed. As the tractive power developed represents the total power of the locomotive, the total load, based on the tractive power, will include the engine and tender, therefore the weight of the engine and tender must be deducted in order to ascertain the weight of the cars and lading.

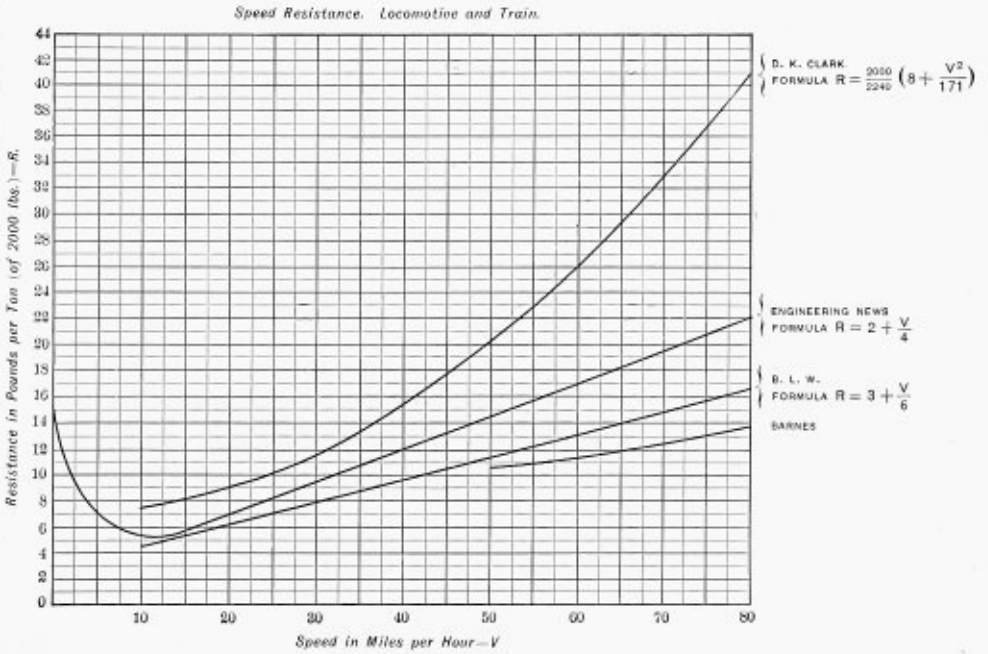
The chart on page 7 shows, by graphic curves, the resistance of locomotive and train due to speed, and the several lines are based on various formulæ in general use. That arrived at by the Baldwin Locomotive Works is: $R=3+V/6$, in which V equals the velocity in miles per hour, and R equals the resistance in pounds per ton of 2000 pounds on straight, level track. This formula is based on results shown by a large number of indicator cards taken at various speeds. It must be borne in mind, however, that these results represent sustained speed, and the element of acceleration is not taken into consideration.

Grades

When a train is hauled up a grade, the resistance due to friction is increased by that due to lifting the train against gravity. One mile equals 5280 feet; hence a ton of 2000 pounds raised one foot in one mile, represents a resistance of $\frac{2000}{5280}$, or .3788 pounds. Therefore when the grade is expressed in feet per mile, the number of feet multiplied by .3788 gives the resistance in pounds per ton of 2000 pounds. When the grade is expressed in feet per hundred or per cent., the per cent. of grade multiplied by 20 gives the resistance in pounds per ton of 2000 pounds.

The resistance due to friction must of course be added to that due to the grade, in order to find the total resistance of the train.

The accurate method of determining a grade is by means of surveyor's instruments, but if these are not



available the following method will suffice, unless the inclination is very moderate: A straight edge, 100 inches long, with one end resting on the rail, is leveled by means of a spirit level; and the vertical distance between the other end of the straight edge and the rail is measured. This distance expressed in inches, equals the grade in per cent.; and where the inclination is at all steep the result so obtained is fairly accurate.

Curves

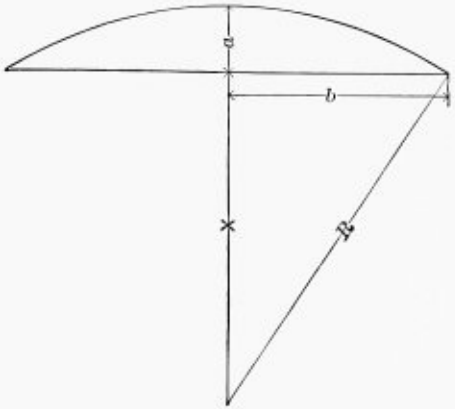
In the United States it is customary to express curvature in degrees noted by the deflection from the tangent measured at stations 100 feet apart. In other words, the number of degrees of central angle subtended by a chord of 100 feet represents the "degree curve." One degree of curvature is equal to a radius of 5730 feet. Therefore, the number of degrees divided into 5730 gives the radius in feet, or, per contra, the number of feet radius divided into 5730 gives the number of degrees. This assumes that the 100 feet are measured on the arc instead of the chord, but the error is so slight on curves commonly used that it may be ignored for ordinary calculation.

In English practice it is common to define a curve as so many chains (sixty-six feet) radius. Thus the radius of a one degree curve expressed in chains would be $\frac{5730}{66}=86.81$; therefore, 86.81 divided by the degrees equals the radius in chains; or 86.81 divided by the radius in chains equals the degrees.

In the metric system, instead of the stations being 100 feet apart, they are taken at twenty metres (65.61 feet). The central angle remaining the same, the radius must necessarily be less. This is represented by $\frac{65.61}{100}$ for a one degree curve, or, approximately five-eighths, English measurement, which can be used as a factor for converting the English to the French system.

Radius of Curves

To determine the radius of any existing curve, lay off carefully on the inside rail, by any convenient means, a chord of any desired length, as shown in the diagram on page 9. Note the center height or middle ordinate of the chord (a) in feet or fraction of a foot.



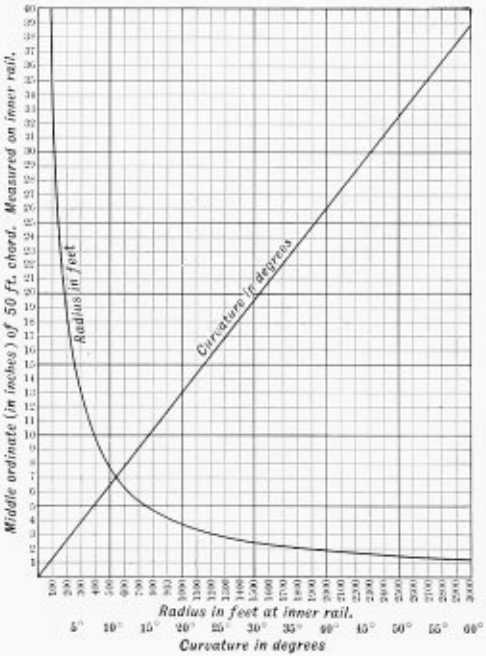
The formula is as follows:

$$R=\frac{a^2+b^2}{2a}$$ in which

R=radius of curve in feet.
a =middle ordinate in feet.
b =one-half of chord in feet.

A simple method for approximately measuring the degree of curvature is as follows: Let the chord equal two rail lengths, then half the chord, or measurement *b*, will be approximately thirty feet, and the height of the middle ordinate *a* will nearly equal the curvature in degrees.

The following diagram gives the radius in feet and the curvature in degrees, for ordinates from one to forty inches measured on a chord of fifty feet in length:



Tractive Power of Single-Expansion Locomotives

It is often desired to ascertain the amount of tractive power developed by a certain size of cylinder with a given diameter of driving wheel irrespective of the boiler pressure; in other words, to determine the tractive power per pound of mean effective pressure. This is found by multiplying the diameter of the cylinder squared, by the length of the stroke, and dividing the product by the diameter of the driving wheels in inches.

The total tractive power is ascertained by a similar process, in which the element of mean effective pressure is taken into consideration. The formula is as follows:

$$\frac{C^2 \times S \times P}{D} = T$$ in which

C=diameter of cylinder in inches.
S=stroke of piston in inches.
P=mean effective pressure in pounds.
D=diameter of driving wheels in inches.
T=tractive power in pounds.

For slow speed, not exceeding six to eight miles per hour, the mean effective pressure is assumed at eighty-five per cent. of the boiler pressure and the calculation is based on full stroke cut-off.

Reduction in Mean Effective Pressure

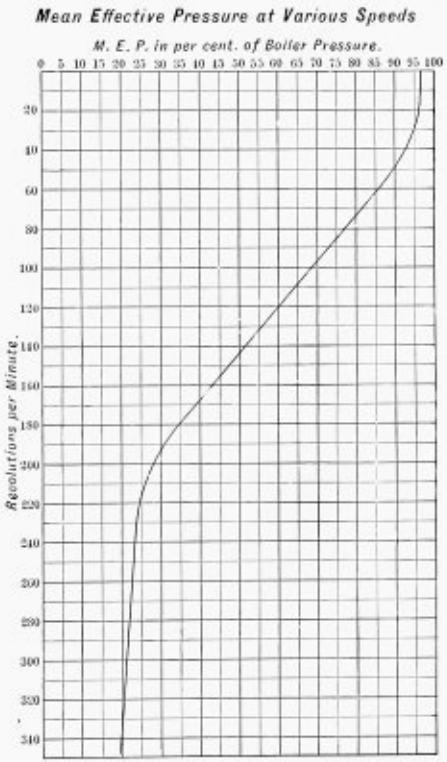
The chart on the opposite page represents the reduction which takes place, under ordinary conditions (with single-expansion cylinders), in the mean effective pressure as the speed increases.

The chart is deduced from results obtained in actual practice from a large number of indicator diagrams, taken under average working conditions with throttle wide open.

The results denote the mean effective pressure in percentage of the boiler pressure with a given speed in revolutions per minute of the driving wheels.

To find the tractive power at any given speed, substitute the number representing the M. E. P., found by the chart, for P. in the formula on this page, and the result will give the tractive power at the desired speed.

For revolutions of wheels, see table on opposite page.



Revolutions of Wheels per Minute and per Second at Various Speeds

WHEELS			For Rev. per Minute	For Rev. per Second
Diam. in Inches	Circum. in Feet	Revolutions per Mile	multiply miles per Hour by	multiply miles per Hour by
18	4.712	1119.76	18.66	.3110
20	5.236	1008.4	16.81	.2801
22	5.759	916.8	15.28	.2547
24	6.283	838.4	13.97	.2329
26	6.81	775.3	12.92	.2153
28	7.36	720.3	12.00	.2000
30	7.85	672.6	11.21	.1868
32	8.377	630.3	10.50	.1751
33	8.64	611.1	10.18	.1696
34	8.901	593.2	9.89	.1648
36	9.42	560.5	9.34	.1556
37	9.686	545.1	9.09	.1514
38	9.95	530.6	8.84	.1440
40	10.47	504.2	8.40	.1401
42	11.00	480.0	8.00	.1363
44	11.52	458.3	7.64	.1273
46	12.04	438.5	7.31	.1218
48	12.57	420.0	7.00	.1166
50	13.00	403.4	6.72	.1120
52	13.61	387.9	6.46	.1073
54	14.14	373.4	6.22	.1033
56	14.66	360.2	6.00	.1000
58	15.18	347.8	5.79	.0965
60	15.71	336.1	5.60	.0933
62	16.23	325.3	5.42	.0903
64	16.75	315.2	5.25	.0875
66	17.28	305.5	5.09	.0848
68	17.80	296.6	4.94	.0823
70	18.36	288.1	4.80	.0798
72	18.85	280.1	4.67	.0778
78	20.42	258.6	4.31	.0718
84	21.99	240.1	4.00	.0666
90	23.56	224.1	3.73	.0622
96	25.16	210.1	3.50	.0586

Horse Power

The term horse power was first established by James Watt, who ascertained that a strong London draught horse was capable of doing work for a short interval of time equivalent to lifting 33,000 pounds one foot high in one minute.

This value was used by Watt in expressing the power of his engines, and has since been universally adopted in mechanics. The expression foot-pounds is used to denote the unit of work, and is the force required to lift a weight of one pound through a space of one foot.

Horse power is the measure of the rate at which work is performed, and is equal to 33,000 pounds lifted one foot in one minute, or one pound lifted 33,000 feet in one minute, or one pound lifted 550 feet in one second; therefore, one horse power equals 550 foot-pounds per second.

The general formula for ascertaining the horse power of a locomotive is as follows:

$$\frac{P \times L \times A \times N}{33{,}000} = \text{H. P.,}$$ in which

P=mean effective pressure in pounds per square inch.
L=length of stroke in feet.
A=area of the piston in square inches.
N=number of strokes (four times the number of revolutions) per minute.
H. P.=indicated horse power.

By cancellation and substituting the diameter of the driving wheels, the formula may be reduced to the following:

$$\frac{C^2 \times S \times P \times (\text{M. P. H.})}{D \times 375} = \text{H. P.,}$$ in which

C=diameter of cylinder in inches.
P=mean effective pressure at given speed.
S=length of stroke in inches.
M. P. H=miles per hour.
D=diameter of driving wheel in inches.
H. P.=horse power.

The tractive power of a locomotive, multiplied by the speed in miles per hour, divided by 375, gives horse power.

Speed

No particular mention has been made in regard to the resistance encountered by locomotives at high speed. In a work of this character it is not thought necessary or advisable to do so, as a rule or formula covering this

subject properly would necessarily be complicated. It is assumed that the locomotives will start the loads attributed to them in the tables and keep them moving at a speed of at least eight to ten miles per hour.

Gauge of Track

The measurement for track gauge is understood to represent the distance between the inside edges of the heads of the rails, as shown on the accompanying sketch, and the distance over the flanges represents the gauge less the required amount of play or clearance between the flange of the wheel and the rail.

When the rails are not laid, and it is undecided what gauge to make the track, the following suggestions will be found useful:

If the line is to connect with any standard gauge road, the track should correspond and be of the standard broad gauge, which is four feet eight and one-half inches.

If such connection is unlikely and narrow gauge is considered preferable, the standard narrow gauge should be adopted, which is three feet.

The advantage of adopting one of these standard gauges is that, should it be desirable at any time to sell the equipment, a ready market can be found.

For logging railroads the standard gauge of four feet eight and one-half inches is generally preferable, as the cars can then have long bolsters and be heavily loaded without piling the logs too high.

While some roads use the same gauge in curves as on tangents, it is desirable in order to insure easy riding and reduce wear, to widen the gauge in the curves. It is stated in Trautwine's "Engineer's Pocket Book," that the gauge is usually widened by from one-thirty-second inch to one-eighth inch for each degree of curvature, the maximum amount seldom exceeding one inch.

Rails

The number of driving wheels required is determined by the weight which they must necessarily carry, and the strength of the rail or permanent way. As an approximate calculation it may be assumed that steel rails, properly supported by crossties, can sustain, as a

maximum, a weight per wheel of 225 to 300 pounds for each pound per yard of rail. It is, therefore, easy to ascertain the load which any given rail section will support. If the weight so found will not afford adequate adhesion with two pairs of driving wheels others must be added until the distributed weight will be sufficient for the required adhesion without overloading the track. Example. With a rail section of 40 pounds per yard the maximum weight for each wheel will be 40 x 300= 12,000 pounds. This with a locomotive having two pairs of driving wheels will equal an available weight on driving wheels of 48,000 pounds, or with the three pairs of driving wheels, of 72,000 pounds.

To ascertain the weight of rails per mile of single track to be laid of any given section, the following formula may be used:

$$\frac{\text{Weight per yard of rail} \times 11}{7} = \text{Tons of 2240 pounds}$$

Example. For a road equipped with 40-pound rails the number of tons required per mile will be:

$$\frac{40 \times 11}{7} = 62.8 \text{ tons per mile}$$

The following table is deduced from the preceding formula:

Amount in Tons of Rails of Various Weights

To Lay One Mile of Track

Weight per Yard	Tons per Mile	Weight per Yard	Tons per Mile
8 pounds	12.57	65 pounds	102.14
9 "	14.14	66 "	103.71
10 "	15.71	67 "	105.28
12 "	18.85	68 "	106.85
14 "	22.	70 "	110.
16 "	25.14	71 "	111.57
20 "	31.43	72 "	113.14
25 "	39.28	73 "	114.71
30 "	47.14	75 "	117.85
35 "	55.	78 "	122.57
40 "	62.85	80 "	125.71
45 "	70.71	82 "	128.85
48 "	75.43	85 "	133.57
50 "	78.57	88 "	138.28
52 "	81.71	90 "	141.43
56 "	88.	92 "	144.57
57 "	89.57	95 "	149.28
60 "	94.28	98 "	154.
61 "	95.85	100 "	157.14
63 "	99.		

Spikes

The following table, giving data referring to railroad spikes, is taken from the hand book of the Cambria Steel Company, Johnstown, Penna.:

Size Measured under Head. Inches	Average Number per Keg of 200 Pounds	Quantity of Spikes per mile of Single Track. Ties 2 feet C. to C. 4 spikes per tie		Rail Used. Weight per Yd. Pounds
		Pounds	Kegs	
5½ x ⅝	300	7040	35⅕	75 to 100
5½ x 9/16	375	5870	29⅓	45 " 75
5 x 9/16	400	5170	26	40 " 56
5 x ½	450	4660	23⅓	35 " 40
4½ x ½	530	3960	20	30 " 35
4 x ½	600	3520	17⅔	25 " 35
4½ x 7/16	680	3110	15½	20 " 30
4 x 7/16	720	2910	14¼	20 " 30
3½ x 7/16	900	2350	11	16 " 25
4 x ⅜	1000	2090	10½	16 " 25
3½ x ⅜	1190	1780	9	16 " 20
3 x ⅜	1240	1710	8½	16 " 20
2½ x ⅜	1342	1575	7⅞	8 " 16

Number of Splice Bars and Splice Bar Bolts Required per Mile of Single Track

Length of Rails. Feet	No. of Single Splice Bars	No. of Bolts. 4 Bolts for Each Joint	Length of Rails. Feet	No. of Single Splice Bars	No. of Bolts. 4 Bolts for Each Joint
20	1056	2112	28	752	1504
24	880	1760	30	704	1408
26	812	1624			

Crossties

A crosstie 9 x 7 inches and 8½ feet in length contains 3.719 cubic feet. If placed 2 feet apart, from center to center, it will take 2640 per mile. If placed 2½ feet, 2112; and if placed 3 feet, 1760.

Fuel Consumption

Assuming that one-half stroke cut-off represents the average work of the cylinders for a given run, the water consumption will be about twenty-five pounds, or three gallons per horse power per hour, and the consumption of coal about one pound per gallon of water, or three pounds per horse power. (For horse power see page 12.)

Wood as Fuel

On logging railroads wood is almost universally used as fuel for locomotives.

The following data regarding the heating value and composition of various woods has been selected from Kent's "Mechanical Engineer's Pocket Book."

HEATING VALUE OF WOOD—The weight of one chord of different woods (thoroughly air dried) is about as follows:

Hickory or Hard Maple	4500	pounds	equal	to	1800	pounds	coal
White Oak	3850	"	"	"	1540	"	"
Beech, Red and Black Oak	3250	"	"	"	1300	"	"
Poplar, Chestnut and Elm	2350	"	"	"	940	"	"
The Average Pine	2000	"	"	"	800	"	"

From the above it is safe to assume that two and one-quarter pounds of average dry wood are equal to one pound of the average quality of soft coal, and that the fuel value of the same weight of different woods is very nearly the same—that is a pound of hickory is worth no more for fuel than a pound of pine, assuming both to be dry. It is important that the wood be dry, as each ten per cent. of water or moisture in wood will detract about twelve per cent. from its value as fuel.

The following table gives the composition of several kinds of wood :

Woods	Carbon Per Cent.	Hydrogen Per Cent.	Oxygen Per Cent.	Nitrogen Per Cent.	Ash Per Cent.
Beech . .	49.36	6.01	42.69	0.91	1.06
Oak	49.64	5.92	41.16	1.29	1.97
Birch	50.29	6.20	41.62	1.15	0.81
Poplar . . .	49.37	6.21	41.60	0.96	1.86
Willow . . .	49.96	5.96	39.56	0.96	3.37
Average Per Cent.	49.70	6.06	41.30	1.05	1.80

Smoke Stacks

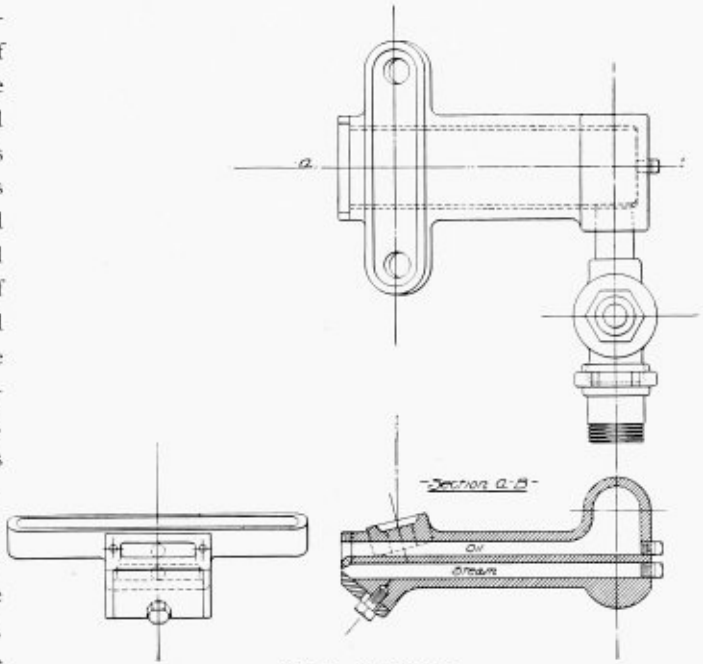
The Radley and Hunter stack is a device which has been extensively used on wood burning locomotives, and has proved to be a most efficient spark arrester. This stack is provided with a straight inside pipe, over which is placed a cast iron cone having volute flanges on its under side. Surrounding the cone is a casing about three and one-half inches less in diameter than the outside stack, and provided with suitable openings. The sparks, which are given a rotary motion when they strike the cone, pass through the openings in the casing and are deflected downward by means of baffle plates, their course being such that, before they reach the top of the stack, they are broken up and extinguished. Any refuse collecting in the bottom of the outside casing is removed through a cleaning hole. As a further precaution, netting is provided, through which the products of combustion must pass before escaping from the stack.

In some instances wood burning locomotives are fitted with a straight open stack. An extended smoke-box, equipped with fine netting and deflecting plates, should then be used.

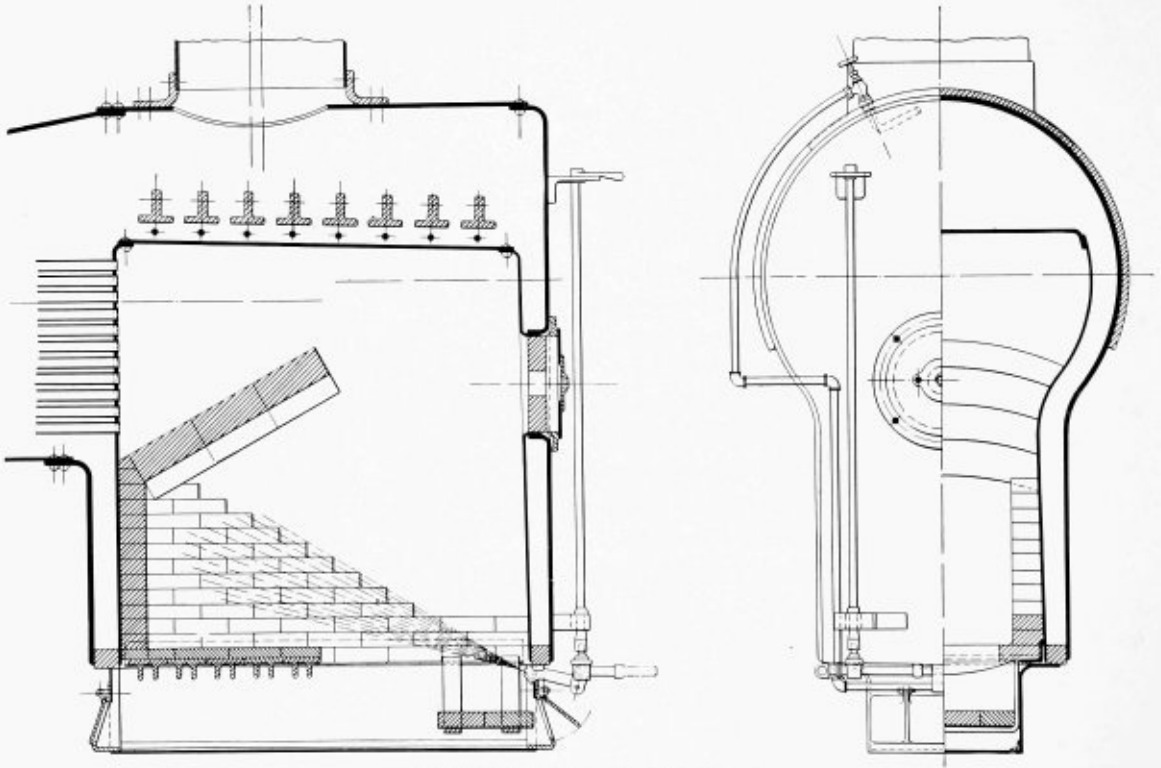
Oil Fuel for Locomotives

The rapid development, during recent years, of the oil fields of Texas and Southern California, has greatly increased the available supply of petroleum for fuel purposes, and has resulted in the extensive introduction of oil burning locomotives on railways located in the sections referred to. The possibility of using oil as fuel on logging roads situated near the source of supply is not remote, and petroleum possesses certain advantages which render its use desirable where it can be obtained at less cost than other forms of fuel. One pound of oil possesses nearly as much heating power as two pounds of coal, and probably as much as four pounds of wood, and the ease with which the fuel may be handled and the fire regulated to suit conditions of working, results in considerable economy where an abundant supply is available.

A convenient arrangement of apparatus, which has been extensively used for burning fuel oil, is shown in the accompanying illustrations. The burner is located in the rear of the firebox under the mud ring, and is pointed upward at a slight angle. It is essential to have an arrangement that will break up and atomize the oil, as without these conditions the combustion will not be complete, and smoke and loss of economy will result. The burner is rectangular in cross section, with two separated ports or chambers (one above the other) running its entire length. Into the upper of these ports



DETAIL OF BURNER



GENERAL ARRANGEMENT FOR BURNING OIL

the oil is fed through suitable pipes. Steam is admitted to the lower part of the burner through a pipe connected to the boiler, and as the oil flows out it is met by the jet of steam which atomizes it and sprays it into the firebox. The flow of oil is regulated by a plug cock in the feed pipe, provided with an operating handle placed within easy reach of the fireman. The arrangement of the fire bricks and ash pan is clearly shown in the sections through the firebox. A proper regulation of the quantity of air admitted through the dampers is of importance, in order to secure perfect combustion, and the dampers are arranged to close air tight and have substantial rigging to operate them. The fire door is also air tight, and is provided with a peep hole for observing the condition of the fire. But little change is necessary in the construction of the tender, the oil tank being placed in the fuel space. In cold climates a coil of steam pipes is placed in the oil tank, in order to keep the fuel sufficiently liquid to flow readily.

The best adjustment of the diaphragm plates in the smokebox, and of the regulating plate for the steam jet in the burner, is found by experiment, and further change of these parts need not be made except for cleaning or repairs. If the apparatus is in good working condition, engines after standing all night with stack covered, and dampers closed, will have sufficient steam pressure in the morning to start the oil fire without using wood or coal.

Miscellaneous

Weights of Various Materials

WATER—One cubic inch weighs .036 pounds. One cubic foot at 32° F. weighs 62.4 pounds and contains 7.4 United States gallons.

One gallon United States Standard contains 231 cubic inches and weighs 8⅓ pounds.

One gallon, Imperial, contains 277¼ cubic inches and weighs 10 pounds.

LOGS—1000 feet of green logs weigh 8,000 to 10,000 pounds.

GRAVEL—One cubic foot weighs 125 pounds.

One cubic yard weighs 3350 pounds.

LUMBER—Weight of one cubic inch:

Seasoned Oak . . . . . .025 pounds.

Seasoned Pine . . . . . .018 pounds.

COAL—Average weight of one cubic foot:

Bituminous, large size,	52 pounds.
Bituminous, run of mine,	54 pounds.
Anthracite, large size,	54 pounds.
Anthracite, buckwheat,	52 pounds.

Average weight of one bushel containing 2500 cubic inches:

Bituminous	75 pounds.
Anthracite	78 pounds.

Specific gravity:

Bituminous	1.40
Anthracite	1.60

Average bulk of one ton (2240 pounds):

Bituminous	43 cubic feet.
Anthracite	41.5 cubic feet.

Coal—Grade Divisions

In designing a locomotive for a particular quality of coal, the question is likely to arise as to what is anthracite or what is bituminous. The division between the different grades is largely empirical. That given by Kent has been adopted by the Baldwin Locomotive Works as generally satisfactory, and is as follows:

ANTHRACITE—all coal with less than 7.5 per cent. volatile matter in combustible.

SEMI-ANTHRACITE—all coal with 7.5 per cent. to 12.5 per cent. volatile matter in combustible.

SEMI-BITUMINOUS—all coal with 12.5 per cent. to 25 per cent. volatile matter in combustible.

BITUMINOUS—all coal with 25 per cent. to 50 per cent. volatile matter in combustible.

LIGNITE—all coal with more than 50 per cent. volatile matter in combustible.

When coal is of a doubtful quality a sample can be forwarded for analysis and specifications will be furnished for a locomotive guaranteed to meet the requirements and burn the coal to advantage.

Weight and Volume of Crude Petroleum

POUND	U. S. LIQUID GAL.	BARREL	GROSS TON
1.	.13158	.0031328	.0004464
7.6	1.	.02381	.003393
319.2	42.	1.	.1425
2240.	294.72	7.017	1.

Cable Codes

The cable address is "Baldwin, Philadelphia." Each of the following tables has a code word in the line opposite the class numbers, the use of which indicates that a locomotive of the class and general dimensions shown on the line referred to is required. The following codes are used: Lieber's A1; A-B-C, fourth edition; Western Union, Vanguard, Baldwin Locomotive Works Private Code.

Information Blank

To aid in determining the size and type of the locomotive, reference is made to the insert sheet at the back of this volume. If the questions proposed are fully answered, it will be of great assistance in the selection and preparation of a proper design, and the locomotive will be guaranteed to do the required work. If more convenient, the blanks can be filled in and the sheet itself returned.

Locomotive Types

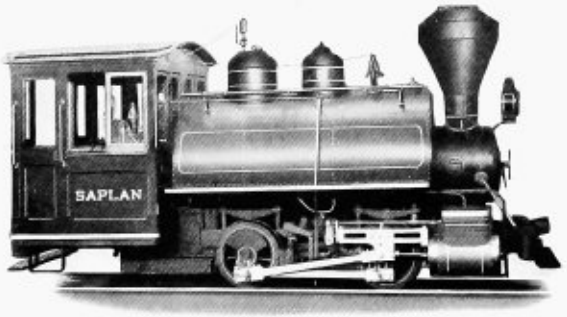
Four Coupled Switching

The four-wheeled type is the simplest form of locomotive construction. All the weight is on the driving wheels and utilized for adhesion. The sharpest curves can be passed without difficulty on account of the short wheel base. Curves of fifty feet radius may be easily traversed by the smaller classes, while seventy-five to ninety feet radius can be set down as a minimum for the larger classes. Engines of this type can be run equally well in either direction. When the run is short a sufficient supply of fuel and water can be carried on the engine. For longer runs, where a larger amount of fuel and water is required, a separate tender is supplied. If desired, the tender tank is made with a sloping back.

The tables give particulars regarding standard gauge tank and tender engines, and narrow gauge tank engines.

Class 4-C

Type 0-4-0



Four Coupled Locomotives

With Saddle or Side Tanks

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base	Capacity of Tank for Water 8½-lbs. Gallons	Weight in Working Order, Pounds	Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
								On a Level	On a Grade per Mile of					
									52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Maniglion	4-10½ C	8 x 12	28	3′ 10″	200	20,000	3,480	415	110	60	40	28	21	16
Manignone . . .	4-11 C	9 x 14	30	4′ 6″	250	24,000	4,800	575	155	85	55	40	30	23
Manigoldo . . .	4-12 C	9 x 16	33	5′ 0″	300	28,000	4,980	600	164	90	59	43	32	25
Manigraphe . . .	4-14 C	10 x 16	33	5′ 0″	400	30,000	6,150	740	205	110	75	55	40	30
Manigua	4-16 C	11 x 16	33	5′ 6″	450	34,000	7,450	900	245	135	90	65	50	40
Maniguazo . . .	4-18 C	12 x 16	33	6′ 0″	500	42,000	8,860	1070	295	160	105	80	60	45
Maniguiere . . .	4-20 C	13 x 18	38	6′ 0″	600	48,000	10,150	1230	335	185	125	90	70	55

Class 4-C

Type 0-4-0

Four Coupled Locomotives

With Saddle or Side Tanks

Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base	Capacity of Tank for Water. 8½-lbs. Gallons	Weight in Working Order. Pounds	Tractive Power	LOAD IN TONS OF (2000 POUNDS) OF CARS AND LADING						
								On a Level	On a Grade per Mile of					
									52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manihot	4-10½ C	8 x 14	30	4′ 8″	200	22,000	4,060	485	130	70	45	32	25	20
Manikup	4-11 C	9 x 14	30	5′ 0″	300	26,000	5,140	615	165	90	57	40	32	24
Manilahanf	4-12 C	9 x 16	33	6′ 0″	350	31,000	5,340	645	170	95	60	43	33	25
Manilarga	4-14 C	10 x 16	36	6′ 0″	400	36,000	6,040	730	190	100	65	47	35	28
Manilargos	4-16 C	11 x 16	38	6′ 0″	450	40,000	6,920	835	220	120	75	55	41	32
Manilarohr	4-18 C	12 x 18	38	6′ 0″	500	48,000	9,270	1125	300	165	105	75	57	45
Manilhadlo	4-20 C	13 x 20	44	6′ 6″	600	52,000	10,440	1270	340	185	120	85	65	52
Manilheiro	4-22 C	14 x 22	44	7′ 0″	700	62,000	13,320	1625	435	240	160	115	85	70
Manilio	4-24 C	15 x 24	44	7′ 0″	900	75,000	16,690	2035	550	300	200	145	110	88
Maniliorum	4-26 C	16 x 24	44	7′ 0″	1000	88,000	18,990	2320	630	350	235	170	130	100
Manilius	4-28 C	17 x 24	44	7′ 6″	1200	100,000	21,440	2620	710	395	265	190	145	115
Manillage	4-30 C	18 x 24	44	7′ 6″	1500	112,000	24,030	2935	800	440	295	215	165	130

9/10 and 8

Class 4-C Type 0-4-0

Four Coupled Locomotives

With Separate Tender

Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

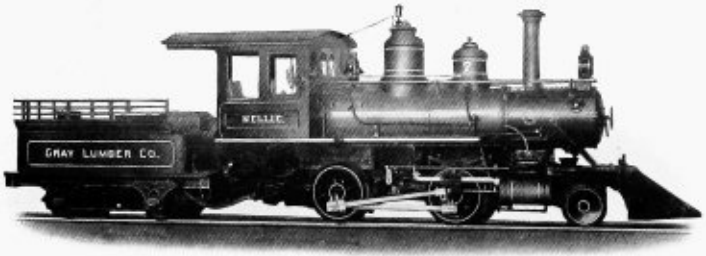
CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base	Capacity of Tender for Water 8½ lb. Gallons		Weight in Working Order. Pounds	Tractive Power	LOAD IN TONS OF (2000 POUNDS) OF CARS AND LADING						
					4-Wheel	8-Wheel			On a Level	On a Grade per Mile of					
										52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Maniller . . .	4-10½ C	8 x 14	30	4′ 8″	500		20,000	4,060	480	125	65	40	30	20	15
Manimorcia .	4-11 C	9 x 14	30	5′ 0″	600		24,000	5,140	610	160	85	55	37	27	19
Maninelo . . .	4-12 C	9 x 16	33	6′ 0″	700		26,000	5,340	635	165	90	57	39	28	20
Maningen . .	4-14 C	10 x 16	36	6′ 0″	800		30,000	6,040	720	180	95	62	41	30	22
Maniobrado .	4-16 C	11 x 16	38	6′ 0″	900	1200	34,000	6,920	825	210	110	70	47	33	23
Maniobreis . .	4-18 C	12 x 18	38	6′ 0″	1000	1400	42,000	9,270	1115	290	150	97	67	48	35
Manioc . . .	4-20 C	13 x 20	44	6′ 6″	1200	1600	48,000	10,440	1255	325	170	110	75	53	39
Maniokbrij . .	4-22 C	14 x 22	44	7′ 0″		1800	58,000	13,320	1610	420	225	145	100	73	55
Maniokbrot .	4-24 C	15 x 24	44	7′ 0″		2000	72,000	16,690	2020	530	285	185	130	95	70
Maniokmehl .	4-26 C	16 x 24	44	7′ 0″		2200	84,000	18,990	2230	590	320	205	145	108	81
Manioksaft . .	4-28 C	17 x 24	44	7′ 6″		2400	94,000	21,440	2520	670	365	235	165	122	92
Maniolae . . .	4-30 C	18 x 24	44	7′ 6″		2600	104,000	24,030	2800	740	405	265	188	138	105

⅞ and 8 T x 20

Four Coupled with Two-Wheeled Front Truck

Engines of this type are provided with separate tenders, and are suitable for road service where train loads are moderate. Two pairs of wheels are equalized together, either the driving wheels with each other or the front pair of driving wheels with the pony truck. The truck has a swinging bolster and radius bar, enabling these locomotives to readily traverse curves of short radius; while at the same time, the wheel base is long enough to prevent rocking or plunging at high speeds.

Class 6-C Type 2-4-0



Four Coupled Locomotives

With Two-Wheeled Front Truck

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base		Capacity of Tender for Water. 8½-lb Gallons	Weight in Working Order. Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Maniolarum	6-10 C	8 x 12	33	10′ 3″	5′ 0″	400	19,000	15,000	2,950	345	90	45	28	19	13	9
Maniopoei	6-11 C	9 x 14	37	10′ 8″	5′ 0″	500	21,000	17,000	3,900	460	120	65	40	27	19	13
Maniopoeos	6-12 C	9 x 16	37	11′ 3″	5′ 6″	600	25,000	20,000	4,440	525	140	70	45	31	22	15
Maniosi	6-14 C	10 x 16	37	11′ 7″	5′ 6″	700	30,000	25,000	5,490	655	170	90	55	38	27	20
Maniosorum	6-16 C	11 x 16	37	11′ 9″	5′ 6″	800	36,000	30,000	6,640	790	210	110	70	48	35	25
Maniosos	6-18 C	12 x 18	42	13′ 0″	6′ 0″	900	42,000	35,000	7,820	930	245	130	80	55	40	30
Maniosum	6-20 C	13 x 18	42	13′ 6″	6′ 6″	1000	48,000	40,000	9,200	1065	280	150	95	65	47	35

⁹⁄₁₀ and 8 T x 20

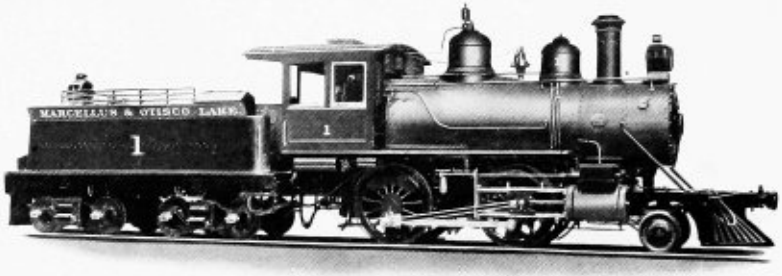
Class 6-C

Type 2-4-0

Four Coupled Locomotives

With Two-Wheeled Front Truck

Gauge, 4 feet 8½ inches or over



Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tender for Water, 8½-lb. Gallons		Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels	4-Wheel	8-Wheel	Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
												52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Maniota . .	6-12 C	9 x 16	33	11′ 9″	6′ 0″	700		28,000	23,000	5,340	605	155	80	50	35	25	18
Maniplaris .	6-14 C	10 x 16	36	12′ 5″	6′ 6″	800		32,000	26,000	6,040	700	175	90	58	40	28	20
Maniplus .	6-16 C	11 x 16	38	13′ 0″	6′ 6″	1000		38,000	30,000	6,920	795	205	105	65	45	32	23
Manipolano	6-18 C	12 x 18	38	14′ 0″	7′ 0″	1200		46,000	38,000	9,270	1010	265	140	85	60	40	30
Manipolare .	6-20 C	13 x 20	44	14′ 8″	7′ 4″	1400	1600	52,000	44,000	10,440	1170	305	160	100	65	45	33
Manipolava .	6-22 C	14 x 22	48	15′ 2″	7′ 6″		1800	58,000	50,000	12,210	1330	345	180	115	75	55	35
Manipolo .	6-24 C	15 x 24	50	15′ 2″	7′ 6″		2000	70,000	60,000	14,680	1590	420	220	140	95	65	45
Manipresto .	6-26 C	16 x 24	50	15′ 8″	7′ 6″		2200	84,000	71,000	16,720	1880	495	265	165	115	80	55

¾0 and 8 T x 20

Four Coupled with Two-Wheeled Rear Truck

This type is particularly serviceable for operating short lines, where limited water and fuel capacity will answer. These locomotives have their driving wheels equalized together, the truck being center-bearing, with swinging bolster and radius bar. Having a comparatively long total wheel base and a short, rigid wheel base, they are steady, and ride smoothly, without plunging, curve readily, and cause little wear of track. The fuel is carried on the engine frames at the back; the water is carried either in a saddle tank on the boiler, or in side tanks on each side of the boiler.

The weight is well distributed, the principal portion being carried on equalizing levers between the driving wheels. The pony truck carries the weight of the fuel with a part of the weight of the overhanging firebox. These locomotives will run in either direction without turning.

Class 6⅓-C

Type 0-4-2

Four Coupled Locomotives

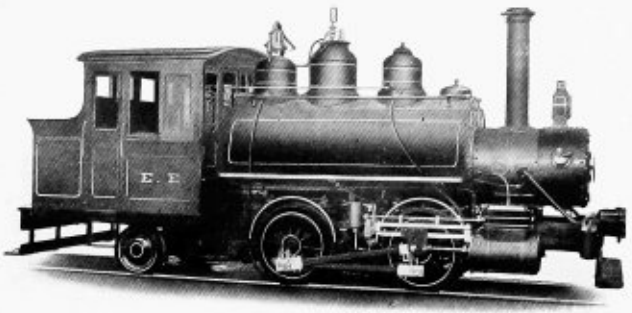
With Two-Wheeled Rear Truck
Tank on Boiler

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base		Capacity of Tank for Water. 8½-lb. Gallons	Weight in Working Order. Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manipretia . . .	6-10⅓ C	8 x 12	30	9′ 7″	3′ 9″	250	20,000	17,000	3,250	385	105	55	35	25	20	15
Manipueira . . .	6-11⅓ C	9 x 14	33	10′ 0″	4′ 0″	350	25,000	21,000	4,360	520	140	75	50	35	25	20
Manipulado . . .	6-12⅓ C	9 x 16	33	10′ 9″	4′ 6″	400	29,000	25,000	4,980	595	160	85	57	40	30	24
Manipular	6-14⅓ C	10 x 16	36	10′ 9″	4′ 6″	450	33,000	28,000	5,640	675	180	100	65	45	35	27
Manipule	6-16⅓ C	11 x 16	36	11′ 6″	5′ 0″	500	37,000	32,000	6,830	825	225	120	80	55	42	32
Manipuleis . . .	6-18⅓ C	12 x 16	36	11′ 9″	5′ 0″	550	44,000	38,000	8,120	980	265	145	95	70	52	40
Manipulons . . .	6-20⅓ C	13 x 16	36	12′ 6″	5′ 6″	600	50,000	44,000	9,530	1150	315	170	115	80	62	48

⅜0 and 8



Class 6⅓-C

Type 0-4-2

Four Coupled Locomotives

With Two-Wheeled Rear Truck
Tank on Boiler

Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

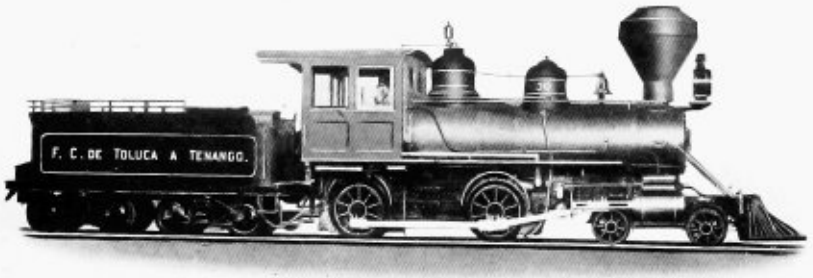
CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tank for Water, 8½-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manipulum	6-10⅓ C	8 x 12	33	9′ 0″	4′ 0″	250	21,000	18,000	3,165	380	95	50	32	22	16	12
Maniqueas	6-11⅓ C	9 x 14	33	9′ 6″	4′ 6″	300	26,000	22,000	4,670	565	150	80	52	38	28	21
Maniquete	6-12⅓ C	9 x 16	33	10′ 0″	4′ 9″	350	30,000	25,000	5,340	645	170	90	58	42	31	24
Manirroto	6-14⅓ C	10 x 16	36	10′ 7″	4′ 9″	400	34,000	29,000	6,040	730	190	100	65	47	35	28
Maniscalco	6-16⅓ C	11 x 16	38	11′ 6″	5′ 0″	450	38,000	33,000	6,920	835	220	120	75	55	42	33
Manisuride	6-18⅓ C	12 x 18	38	11′ 9″	5′ 0″	500	46,000	41,000	9,270	1105	295	160	105	75	57	45
Manitrunk	6-20⅓ C	13 x 20	44	13′ 0″	6′ 0″	550	52,000	46,000	10,440	1230	330	180	120	85	65	52
Manivacia	6-22⅓ C	14 x 22	44	14′ 0″	6′ 6″	600	65,000	58,000	13,320	1570	420	230	155	112	84	68
Manivacios	6-24⅓ C	15 x 24	50	15′ 3″	7′ 0″	700	74,000	66,000	14,680	1780	485	265	175	125	95	75
Maniveau	6-26⅓ C	16 x 24	50	16′ 6″	7′ 0″	900	84,000	76,000	16,720	2030	550	305	200	145	110	85
Manivelle	6-28⅓ C	17 x 24	50	17′ 6″	7′ 0″	1200	94,000	85,000	18,860	2300	625	345	230	165	125	100

9/10 and 8

Four Coupled with Four-Wheeled Front Truck

American type locomotives having four coupled wheels and a four-wheeled leading truck are suitable for passenger, freight and mixed service, where the run is of such length as to require a separate tender, or for short lines intended ultimately to be extended. The name "American" type was given for the reason that for many years these locomotives were used universally for nearly every variety of service throughout the United States.

Class 8-C Type 4-4-0



American Type Locomotives

With Separate Tender

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tender for Water, 85%-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manjadoura	8-12 C	9 x 16	37	15′ 3″	5′ 9″	800	32,000	20,000	4,440	520	135	65	40	25	16	10
Manjares	8-14 C	10 x 16	37	17′ 3½″	6′ 5″	1,000	36,000	24,000	5,490	625	160	80	50	30	20	12
Manjaricao	8-16 C	11 x 16	37	17′ 10″	6′ 9″	1,100	42,000	27,000	6,640	705	180	90	55	35	23	14
Manjarona	8-18 C	12 x 16	41	18′ 3″	7′ 2″	1,200	47,000	30,000	7,130	785	200	100	60	38	25	16
Manjolaba	8-18½ C	12 x 18	43	18′ 7″	7′ 6″	1,400	52,000	33,000	7,650	865	220	110	66	42	27	17
Manjolamos	8-20 C	13 x 18	45	19′ 3″	7′ 10″	1,500	56,000	36,000	8,580	945	240	120	72	47	30	19
Manjolar	8-22 C	14 x 18	48	20′ 1″	8′ 2″	1,600	62,000	40,000	9,330	1050	270	135	80	52	35	22

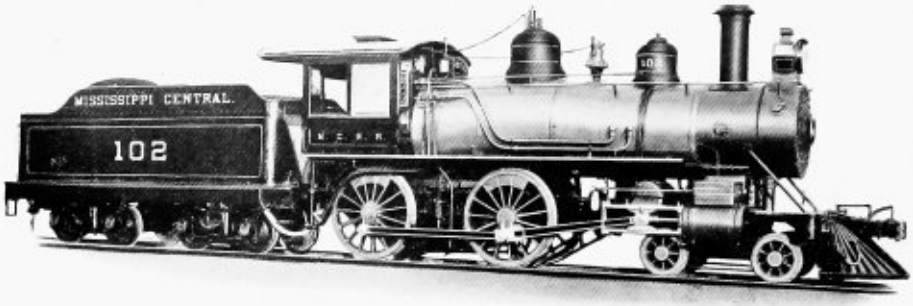
⅞ and 8 T x 20

Class 8-C Type 4-4-0

American Type Locomotives

With Separate Tender

Gauge
4 feet 8½ inches or over



Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches.	Wheel Base		Capacity of Tender for Water. 8½-lb. Gallons	Weight in Working Order. Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	396.8 ft. or 6%
Manjolaron .	8-18 C	12 x 18	42	19′ 1″	6′ 6″	1800	52,000	34,000	8,390	895	225	115	70	42	25	14
Manjolases .	8-20 C	13 x 20	46	20′ 5½″	7′ 0″	2000	65,000	42,000	10,000	1105	280	140	85	52	32	19
Manjorrada .	8-22 C	14 x 22	50	21′ 3½″	7′ 8″	2200	75,000	48,000	11,730	1265	315	160	95	57	37	22
Manjua . . .	8-24 C	15 x 24	56	22′ 8″	8′ 6″	2400	86,000	55,000	13,120	1450	365	185	110	69	44	28
Mankad . .	8-26 C	16 x 24	56	22′ 9″	8′ 6″	2600	92,000	60,000	14,930	1590	405	205	125	78	51	32
Mankement .	8-28 C	17 x 24	56	23′ 1″	9′ 1″	2800	104,000	68,000	16,840	1800	460	235	140	90	58	38

9/40 and 8 T x 20

Four Coupled with Four-Wheeled Rear Truck

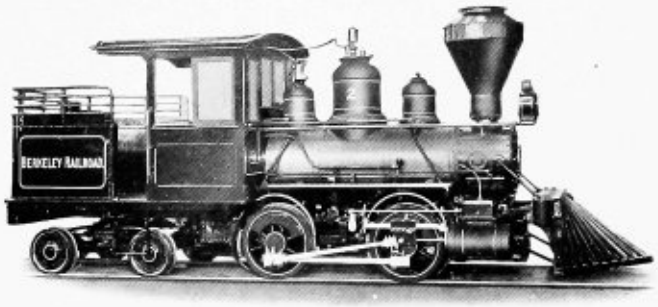
Forney type locomotives having two pairs of coupled wheels and a four-wheeled rear truck, are compact and powerful for their aggregate weight, and are suitable where the run is not long enough to necessitate a separate tender. The constant weight of the boiler and machinery is on the driving wheels, whilst the variable weight of fuel and water is on the truck. Locomotives of this type are used as double-enders being run either forward or backward. The driving wheels are equalized together; the truck is center-bearing and has a swinging bolster. These locomotives readily traverse curves of short radius. The fuel and water are carried at the rear of the cab.

Class 8⅓-C Type 0-4-4

Four Coupled
Forney Type Locomotives

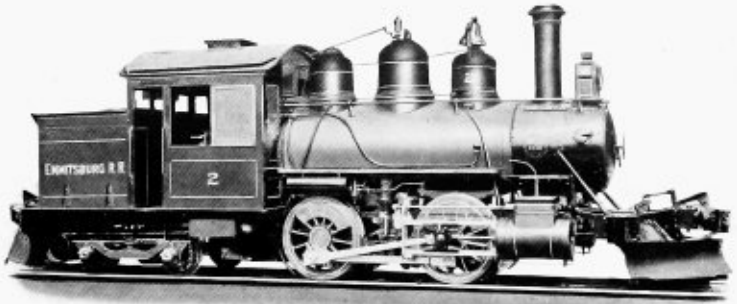
With Four-Wheeled Rear Truck
Tank at Rear

Gauge, 3 feet and upward



Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tank for Water, 8⅓-lb. Gallons.	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mankheid	8-10⅓ C	8 x 12	30	12′ 3″	3′ 9″	500	26,000	15,000	3,250	380	100	52	33	23	17	12
Manless . .	8-11⅓ C	9 x 14	33	14′ 2″	4′ 0″	550	32,000	20,000	4,360	520	135	72	47	32	24	18
Manlessly .	8-12⅓ C	9 x 16	33	14′ 7″	4′ 6″	600	35,000	22,000	4,980	580	155	80	53	37	27	20
Manlianam .	8-14⅓ C	10 x 16	36	15′ . ″	4′ 6″	650	38,000	24,000	5,640	635	170	90	58	41	30	22
Manliani .	8-16⅓ C	11 x 16	36	16′ 4″	5′ 0″	700	42,000	28,000	6,830	745	200	105	70	48	35	27
Manlianos .	8-18⅓ C	12 x 16	36	17′ 2″	5′ 0″	750	50,000	34,000	8,120	905	245	130	85	60	45	34
Manlike . .	8-20⅓ C	13 x 18	42	18′ 4″	5′ 6″	800	57,000	40,000	9,200	1085	290	155	100	170	53	40



Class 8½-C Type 0-4-4

Four Coupled
Forney Type Locomotives

With Four-Wheeled Rear Truck
Tank at Rear

Gauge, 4 feet 8½ inches or over

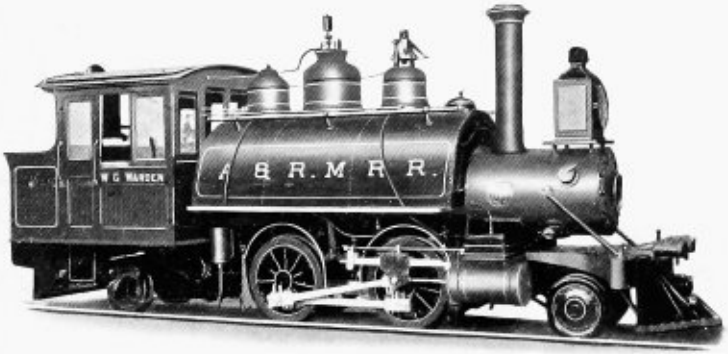
Weight and Hauling Capacity Based on
160 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tank for Water 8½-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manliness	8-14½ C	10 x 16	36	16′ 6″	6′ 0″	400	40,000	26,000	6,040	695	185	100	65	45	33	25
Manly	8-16½ C	11 x 16	38	16′ 6″	6′ 0″	500	44,000	30,000	6,920	800	215	115	75	53	40	30
Mannoedig	8-18½ C	12 x 18	38	16′ 8″	6′ 0″	600	56,000	40,000	9,270	1080	285	150	100	72	54	42
Mannaboom	8-20½ C	13 x 20	44	17′ 5″	6′ 0″	700	62,000	46,000	10,440	1225	325	175	118	83	63	50
Mannabrot	8-22½ C	14 x 22	44	18′ 6″	6′ 6″	800	73,000	57,000	13,320	1540	410	220	145	105	80	63
Mannaernte	8-24½ C	15 x 24	50	20′ 8″	7′ 0″	900	82,000	62,000	14,680	1670	450	245	160	115	85	66
Mannaesche	8-26½ C	16 x 24	50	21′ 4″	7′ 0″	1200	92,000	70,000	16,720	1880	505	275	180	130	95	75
Mannagras	8-28½ C	17 x 24	50	22′ 0″	7′ 6″	1400	102,000	80,000	18,860	2160	580	315	205	150	110	85

Four Coupled Double-Ender

Tank locomotives having four coupled wheels and a truck at each end, are suitable where it is desired to run forward or backward without turning, and where the run is not long enough to necessitate a separate tender. The front truck is of the two-wheeled type, while the rear truck may have either two or four wheels. When both trucks have two wheels, the front is center-bearing and is equalized with the first pair of driving wheels; while the rear truck is side-bearing, and is equalized with the second pair of driving wheels. Each truck has a swinging bolster and radius bar. With this wheel arrangement the water supply is carried on the boiler, in saddle or side tanks. If desired, however, the water tank may be placed back of the cab, and in this case, a four-wheeled rear truck is used.

The short rigid wheel base in proportion to the total wheel base, enables locomotives of this type to traverse curves of short radius, while at the same time they ride steadily on an uneven track.



Class 8¼-C Type 2-4-2

Four Coupled Double-Ender Locomotives

With Two-Wheeled Front and Rear Trucks
Tank on Boiler

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels Inches	Wheel Base		Capacity of Tank for Water 85-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannaia	8-10¼ C	8 x 12	33	15′ 0″	4′ 0″	350	25,000	15,000	2,950	345	90	45	30	20	14	10
Mannaietta	8-11¼ C	9 x 14	36	15′ 10″	4′ 6″	400	30,000	19,000	4,000	475	125	65	40	30	21	15
Mannaiola	8-12¼ C	9 x 16	36	16′ 4″	4′ 6″	450	34,000	22,000	4,570	545	145	75	50	35	25	18
Mannaione	8-14¼ C	10 x 16	36	18′ 2″	5′ 0″	500	40,000	27,000	5,640	675	180	95	60	43	31	23
Mannaklee	8-16¼ C	11 x 16	38	18′ 6″	5′ 0″	550	47,000	32,000	6,470	775	205	110	70	49	36	27
Mannakorn	8-18¼ C	12 x 18	42	20′ 0″	5′ 8″	600	54,000	37,000	7,820	940	250	135	85	60	45	34
Mannaoogst	8-20¼ C	13 x 18	42	20′ 4″	5′ 8″	700	64,000	42,000	9,200	1085	285	155	100	70	50	38
Mannapeer	8-22¼ C	14 x 18	42	20′ 11″	5′ 8″	800	72,000	49,000	10,660	1225	325	175	112	80	58	43

Class 8¼-C Type 2-4-2

Four Coupled Double-Ender Locomotives

With Two-Wheeled Front and Rear Trucks
Tank on Boiler

Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base		Capacity of Tank for Water. 8⅓-lb. Gallons	Weight in Working Order. Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannaregen.	8-14¼ C	10 x 16	36	16′ 5″	5′ 0″	500	48,000	32,000	6,040	720	190	100	65	44	32	22
Mannarese .	8-16¼ C	11 x 16	38	17′ 3″	5′ 6″	600	54,000	36,000	6,920	830	215	115	70	50	36	26
Mannarolo .	8-18¼ C	12 x 18	38	19′ 4″	6′ 0″	700	62,000	42,000	9,270	1120	295	160	100	72	53	40
Mannasap .	8-20¼ C	13 x 20	44	19′ 11″	6′ 0″	800	68,000	48,000	10,440	1260	335	180	115	82	60	45
Mannastof .	8-22¼ C	14 x 22	44	21′ 7″	7′ 0″	900	82,000	60,000	13,320	1615	430	225	150	105	80	60
Mannelijk .	8-24¼ C	15 x 24	50	21′ 7″	7′ 0″	1200	92,000	68,000	14,680	1770	475	255	165	115	85	65
Mannenhuis.	8-26¼ C	16 x 24	50	22′ 4″	7′ 6″	1500	100,000	76,000	16,720	2025	545	295	195	140	105	80
Mannenkoor.	8-28¼ C	17 x 24	50	24′ 8″	7′ 6″	1800	112,000	85,000	18,860	2990	615	335	220	155	115	90

Class 10¼-C Type 2-4-4

Four Coupled Double-Ender Locomotives

With Two-Wheeled Front and Four-Wheeled Rear Truck
Tank at Rear

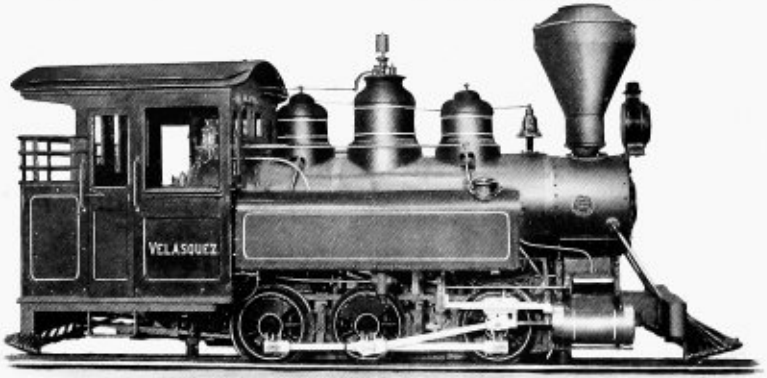
Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base		Capacity of Tank for Water. 8½-lb. Gallons.	Weight in Working Order. Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannenmoed,	10-14¼ C	10 x 16	42	23′ 0″	5′ 6″	600	46,000	22,000	5,180	575	150	75	45	30	20	15
Mannenstem .	10-16¼ C	11 x 16	42	24′ 0″	6′ 0″	700	54,000	27,000	6,260	710	185	95	60	40	25	19
Mannentaal .	10-18¼ C	12 x 20	44	24′ 6″	6′ 0″	800	68,000	36,000	8,900	950	250	130	80	55	40	27
Mannenwerk .	10-20¼ C	13 x 22	50	25′ 6″	6′ 6″	900	78,000	43,000	10,110	1140	300	160	100	65	48	35
Mannerino . .	10-22¼ C	14 x 22	50	26′ 7″	7′ 0″	1000	90,000	50,000	11,730	1325	350	185	115	80	55	40
Mannerists . .	10-24¼ C	15 x 22	50	28′ 6″	7′ 0″	1200	102,000	56,000	13,450	1490	390	205	130	90	62	45
Mannerly . .	10-26¼ C	16 x 24	54	29′ 0″	7′ 0″	1350	115,000	63,000	15,480	1680	440	230	145	100	70	50
Mannesehre .	10-28¼ C	17 x 24	54	30′ 0″	7′ 6″	1500	125,000	72,000	17,470	1920	205	270	170	118	85	60

Six Coupled Switching

Six coupled locomotives are especially suitable where the conditions are such as to make it advisable to distribute the weight over more than two pairs of driving wheels. Where the run is short a tender is unnecessary and the tank can be placed on the top or at the sides of the boiler. For longer runs the separate tender is more convenient, as it affords a greater supply of fuel and water. In the heavier classes, for narrow gauge, the separate tender is preferable, as it avoids raising the center of gravity of the locomotive.



Class 6-D Type 0-6-0

Six Coupled Locomotives

With Tank on Boiler

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diameter of Driving Wheels. Inches	Wheel Base	Capacity of Tank for Water. 8½-lb. Gallons	Weight in Working Order. Pounds	Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
								On a Level	On a Grade per Mile of					
									52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannesmuth . .	6-10 D	8 x 12	30	5′ 5″	250	20,000	3,250	385	105	55	35	25	20	15
Mannesrock . .	6-11 D	9 x 14	33	5′ 8″	300	24,000	4,360	520	130	75	50	35	27	21
Manneswort . .	6-12 D	9 x 16	33	6′ 9″	350	27,000	4,980	600	160	85	58	42	32	25
Mannetjes . . .	6-14 D	10 x 16	36	7′ 1″	400	31,000	5,640	675	185	100	65	48	36	28
Manngrab . . .	6-16 D	11 x 16	36	7′ 7″	450	36,000	6,830	825	225	120	80	58	45	35
Manngueter . .	6-18 D	12 x 18	38	8′ 1″	500	44,000	8,660	1050	285	155	105	75	55	45
Mannhaft . . .	6-20 D	13 x 18	38	9′ 0″	550	50,000	10,150	1230	335	185	120	90	68	53
Mannhafter . . .	6-22 D	14 x 18	42	9′ 6″	600	54,000	10,660	1295	350	195	128	94	72	56
Mannhof	6-24 D	15 x 18	42	9′ 6″	700	62,000	12,240	1490	405	220	145	105	82	64

⅞ and 8

Class 6-D Type 0-6-0

Six Coupled Locomotives

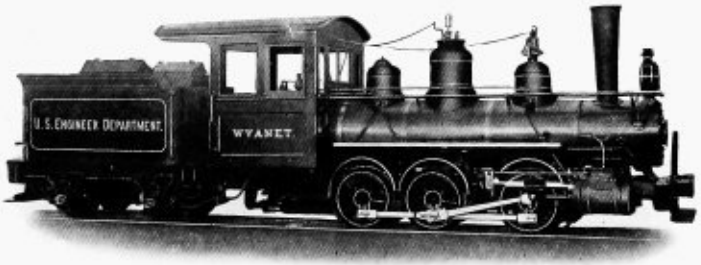
With Tank on Boiler

Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diameter of Driving Wheels. Inches	Wheel Base	Capacity of Tank for Water. 8½-lb. Gallons	Weight in Working Order. Pounds.	Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
								On a Level	On a Grade per Mile of					
									52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannhofes	6-12 D	9 x 16	33	6′ 9″	350	32,000	5,340	645	170	90	58	42	31	24
Mannigfach	6-14 D	10 x 16	36	7′ 7″	400	38,000	6,040	730	190	100	65	47	35	28
Mannikins	6-16 D	11 x 16	38	8′ 0″	500	42,000	6,920	835	220	120	75	55	41	32
Mannipare	6-18 D	12 x 18	38	8′ 1″	600	48,000	9,270	1125	300	165	105	75	57	45
Mannish	6-20 D	13 x 20	44	8′ 10″	700	60,000	10,440	1265	335	180	118	83	64	50
Mannishly	6-22 D	14 x 22	44	9′ 6″	800	70,000	13,320	1620	430	235	155	112	84	68
Mannitate	6-24 D	15 x 24	44	9′ 6″	900	80,000	16,690	2035	550	300	200	145	110	88
Mannitique	6-26 D	16 x 24	44	9′ 9″	1000	90,000	18,990	2320	625	345	230	165	127	100
Mannitose	6-28 D	17 x 24	44	9′ 9″	1200	102,000	21,440	2620	710	390	260	190	145	115
Mannloewe	6-30 D	18 x 24	46	10′ 6″	1500	115,000	22,980	2805	755	415	275	200	150	120
Mannochia	6-32 D	19 x 24	46	10′ 6″	1800	124,000	25,600	3130	850	470	310	230	175	135

Class 6-D Type 0-6-0



Six Coupled Locomotives

With Separate Tender

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base	Capacity of Tender for Water. 8½-lb. Gallons		Weight in Working Order. Pounds	Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
					4-Wheel	8-Wheel			On a Level	On a Grade per Mile of					
										52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannorum	6-10 D	8 x 12	30	5′ 5″	500		18,000	3,250	380	100	50	30	22	15	11
Mannpferd	6-11 D	9 x 14	33	5′ 8″	550		21,000	4,360	515	135	70	46	32	23	17
Mannrecht	6-12 D	9 x 16	33	6′ 9″	600		24,000	4,980	595	155	80	54	38	28	20
Mannsbild	6-14 D	10 x 16	36	7′ 1″	700	1000	28,000	5,640	670	175	95	60	42	30	22
Mannsdick	6-16 D	11 x 16	36	7′ 7″	800	1100	32,000	6,830	815	215	112	72	50	37	27
Mannserbe	6-18 D	12 x 18	38	8′ 1″	900	1200	39,000	8,660	1040	275	145	95	65	47	35
Mannshaupt	6-20 D	13 x 18	38	9′ 0″	1000	1400	46,000	10,150	1220	325	175	110	75	55	40
Mannshemd	6-22 D	14 x 18	42	9′ 6″		1500	50,000	10,660	1280	340	182	115	80	59	43
Mannsinn	6-24 D	15 x 18	42	9′ 6″		1600	55,000	12,240	1475	390	210	135	95	68	50

9½0 and 8 T x 20

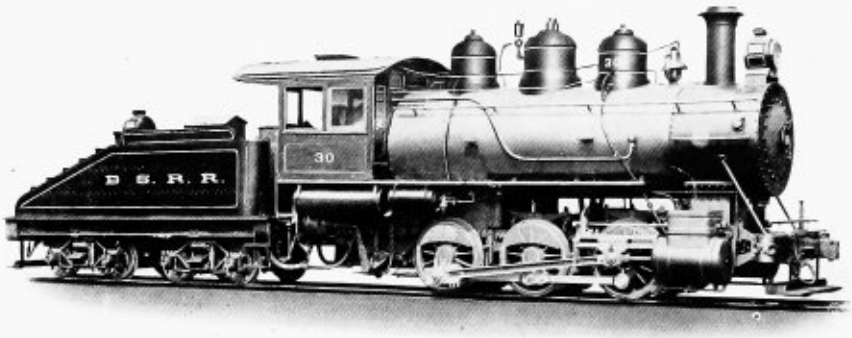
Class 6-D Type 0-6-0

Six Coupled Locomotives

With Separate Tender

Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure



CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base	Capacity of Tender for Water 8½-lb. Gallons		Weight in Working Order. Pounds	Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
					4-Wheel	8-Wheel			On a Level	On a Grade per Mile of					
										52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannskleid	6-12 D	9 x 16	33	6′ 9″	700		24,000	5,340	640	165	85	53	37	26	20
Mannsleute	6-14 D	10 x 16	36	7′ 7″	900		32,000	6,040	720	185	95	60	41	30	21
Mannsmahd	6-16 D	11 x 16	38	8′ 0″	1000		36,000	6,920	825	210	110	70	45	34	24
Mannsname	6-18 D	12 x 18	38	8′ 1″	1200	1500	42,000	9,270	1115	290	155	95	67	48	34
Mannsrolle	6-20 D	13 x 20	44	8′ 10″		1800	52,000	10,440	1250	325	170	108	74	52	37
Mannsschuh	6-22 D	14 x 22	44	9′ 6″		2000	60,000	13,320	1605	420	225	145	100	72	53
Mannstreu	6-24 D	15 x 24	44	9′ 6″		2200	72,000	16,690	1940	515	275	175	125	92	68
Mannsvolk	6-26 D	16 x 24	44	9′ 9″		2400	82,000	18,990	2205	585	315	205	143	105	78
Mannszeug	6-28 D	17 x 24	44	9′ 9″		2600	92,000	21,440	2470	665	355	230	165	120	90
Mannszucht	6-30 D	18 x 24	46	10′ 6″		2800	104,000	22,980	2780	735	395	255	180	130	98
Manntiger	6-32 D	19 x 24	46	10′ 6″		3000	115,000	25,600	3100	820	440	285	200	147	110

[1] 9/40 and 8 T x 20

Six Coupled with Two-Wheeled Front Truck

The Mogul type, having three pairs of coupled wheels and a two-wheeled leading truck, is primarily designed for road service, and is suitable where a four coupled design would not afford sufficient power, or where the requisite weight on the driving wheels, if carried on only two pairs, would be greater than the rails could safely bear. The front and rear driving wheels are flanged; the middle pair has no flanges. The pony truck has a swinging bolster and radius bar.

The engines illustrated have deep fireboxes between the main and rear driving axles, this design being suitable for burning wood. If desired the driving wheels may be grouped closer together, and the firebox placed entirely behind them. This is sometimes an advantage, especially in a narrow gauge engine, as the grate may be widened and the firebox at the same time be made of ample depth.

Class 8-D Type 2-6-0

Mogul Type Locomotives

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on
150 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tender for Water, 85%-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannuli . . .	8-12 D	9 x 16	36	13′ 7″	8′ 6″	800	26,000	21,000	4,570	540	140	72	45	30	20	14
Mannulorum .	8-14 D	10 x 16	36	16′ 2″	10′ 4″	900	32,000	25,000	5,640	655	170	90	55	37	25	18
Mannulos . . .	8-16 D	11 x 16	36	16′ 10″	10′ 9″	1000	36,000	30,000	6,830	795	205	110	65	45	32	24
Mannulum . .	8-18 D	12 x 18	38	17′ 8″	11′ 8″	1200	44,000	38,000	8,660	1010	265	140	90	60	40	30
Mannus	8-20 D	13 x 18	38	17′ 10″	12′ 0″	1400	52,000	43,000	10,150	1215	300	155	100	67	47	34
Mannweib . .	8-22 D	14 x 18	41	18′ 4″	12′ 0″	1500	56,000	46,000	10,930	1310	320	170	107	72	51	37
Mannweiber. .	8-24 D	15 x 18	41	19′ 0″	12′ 6″	1600	65,000	54,000	12,540	1440	380	200	125	85	60	42
Mannwolf . . .	8-26 D	16 x 20	44	19′ 6″	13′ 0″	1800	74,000	62,000	14,780	1650	435	230	145	97	70	50

¾₀ and 8 T x 20

Class 8-D Type 2-6-0

Mogul Type Locomotives

Gauge
4 feet 8½ inches or over

Weight and Hauling Capacity
Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tender for Water, 8½-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mannwolfes	8-16 D	11 x 16	38	15′ 6″	9′ 4″	1200	38,000	30,000	6,920	800	195	105	67	43	32	22
Manobra	8-18 D	12 x 18	38	16′ 2″	10′ 0″	1500	48,000	39,000	9,270	1060	275	145	90	63	44	31
Manobreiro	8-20 D	13 x 20	44	16′ 6″	10′ 4″	1800	54,000	45,000	10,440	1190	315	160	100	68	47	34
Manocage	8-22 D	14 x 22	44	17′ 0″	11′ 0″	2000	68,000	57,000	13,320	1505	395	210	135	90	65	46
Manoeuvre	8-24 D	15 x 24	44	20′ 6″	13′ 2″	2400	83,000	71,000	16,690	1890	495	265	170	116	83	60
Manofatto	8-26 D	16 x 24	44	21′ 6″	14′ 2″	2600	94,000	81,000	18,990	2175	570	305	195	135	96	71
Manoforte	8-28 D	17 x 24	44	22′ 8″	15′ 0″	2800	104,000	90,000	21,440	2405	630	340	215	150	110	80
Manojo	8-30 D	18 x 24	46	22′ 8″	15′ 0″	3000	110,000	96,000	22,980	2580	680	365	235	165	118	86
Manolho	8-32 D	19 x 24	46	23′ 6″	15′ 2″	3200	120,000	106,000	25,600	2850	750	405	260	182	133	98

9/40 and 8 T x 20

Six Coupled with Two-Wheeled Rear Truck

Six coupled locomotives with two-wheeled rear truck are suitable where the runs are not long enough to require a separate tender. The addition of a truck avoids the plunging or galloping motion to which short wheel base locomotives are subject when run at more than a moderate speed.

The increased space back of the cab permits of greater coal capacity and more room for the enginemen than is practicable without the truck. Three pairs of driving wheels are equalized together; the truck is center-bearing and has a swinging bolster and radius bar.

Class 8⅓-D

Type 0-6-2

Six Coupled Locomotives

With Two-Wheeled Rear Truck
Tank on Boiler

Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tank for Water, 8½-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manometer	S-10½ D	8 x 12	28	11′ 3″	5′ 5″	400	24,000	18,000	3,480	410	112	60	38	25	20	15
Manometric	S-11½ D	9 x 14	30	11′ 9″	5′ 11″	450	30,000	23,000	4,800	570	150	80	50	35	26	20
Manometro	S-12½ D	9 x 16	33	13′ 1″	6′ 10″	500	34,000	26,000	4,980	595	160	86	55	40	29	22
Manomisero	S-14½ D	10 x 16	33	13′ 6″	7′ 0″	550	38,000	29,000	6,150	735	200	105	70	50	37	28
Manomisi	S-16½ D	11 x 16	33	14′ 7″	7′ 6″	600	45,000	35,000	7,450	895	240	130	85	60	45	35
Manopla	S-18½ D	12 x 18	37	15′ 6″	7′ 10″	650	54,000	43,000	8,900	1075	290	155	100	70	55	40
Manorial	S-20½ D	13 x 18	37	16′ 5″	8′ 0″	700	62,000	50,000	10,430	1260	340	185	120	85	65	50
Manorina	S-22½ D	14 x 18	37	16′ 10″	8′ 0″	800	68,000	56,000	12,110	1425	385	210	135	100	75	58

Six Coupled with Four-Wheeled Front Truck

The ten-wheel type, having three pairs of coupled wheels and a four-wheeled leading truck, is suitable where a locomotive of the American type would not afford sufficient power, or where the requisite weight, if carried on only two pairs of driving wheels, would be greater than the rails could safely bear. The greater length of these locomotives admits of a longer boiler, consequently, greater heating surface. The front and rear driving wheels are, preferably, flanged, and the truck made with swinging bolster.

Class 10-D Type 4-6-0

Ten-Wheel Type Locomotives

Gauge, 3 feet and upward

Weight and Hauling Capacity
Based on 150 pounds Boiler Pressure

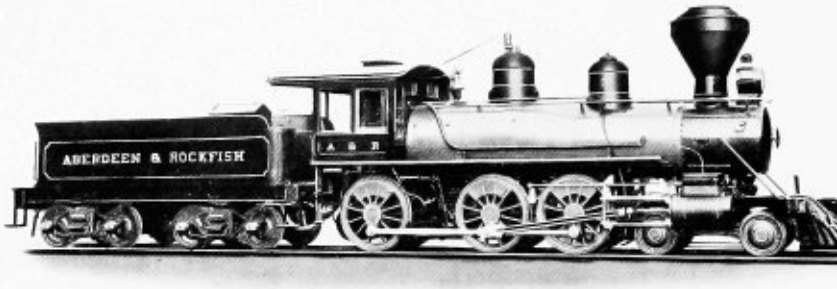
CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base		Capacity of Tender for Water. 8½-lb. Gallons	Weight in Working Order. Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manoscope .	10-18 D	12 x 18	37	21′ 0″	12′ 0″	1400	52,000	38,000	8,900	1000	260	135	80	55	35	25
Manoscopio.	10-20 D	13 x 18	37	21′ 0″	12′ 0″	1600	58,000	44,000	10,430	1165	300	150	95	65	45	30
Manoseadas.	10-22 D	14 x 20	44	21′ 5″	12′ 5″	1800	65,000	49,000	11,330	1350	335	175	105	70	49	34
Manoseado .	10-24 D	15 x 20	44	21′ 9″	12′ 9″	2000	74,000	56,000	12,980	1550	385	200	125	80	57	40
Manosear . .	10-26 D	16 x 20	44	22′ 0″	13′ 0″	2200	82,000	63,000	14,780	1675	435	225	140	95	65	45

9½0 and 8 T x 20

Class 10-D Type 4-6-0

Ten-Wheel Type Locomotives

Gauge
4 feet 8½ inches or over



Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tender for Water, 8½-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manosearon	10-18 D	12 x 18	42	20′ 3″	11′ 0″	1800	55,000	40,000	8,390	990	250	125	75	48	30	18
Manoseeis	10-20 D	13 x 20	46	20′ 6″	11′ 3″	2000	65,000	45,000	10,000	1185	300	150	90	60	38	25
Manoseos	10-22 D	14 x 22	46	20′ 9″	11′ 3″	2200	75,000	55,000	12,730	1460	375	190	115	75	51	35
Manoso	10-24 D	15 x 24	50	22′ 8″	12′ 6″	2400	85,000	60,000	14,680	1590	405	210	125	83	55	37
Manotadas	10-26 D	16 x 24	50	23′ 0″	12′ 10″	2600	95,000	70,000	16,710	1860	470	245	150	100	67	46
Manoteaban	10-28 D	17 x 24	50	23′ 0″	12′ 10″	2800	105,000	80,000	18,860	2130	550	285	180	120	83	57
Manoteados	10-30 D	18 x 24	50	24′ 2″	14′ 0″	3000	120,000	90,000	21,150	2400	620	325	200	135	95	66
Manoteais	10-32 D	19 x 24	50	24′ 9″	14′ 0″	3200	130,000	100,000	23,560	2670	690	360	225	153	107	75

*9/10 and 8 T x 20

Six Coupled Double-Ender

Locomotives having three pairs of driving wheels, with two-wheeled front and rear trucks, are built either with or without separate tenders. Engines of this type are flexible and easy on the rail, and are particularly desirable on roads having many curves. The presence of a truck at each end reduces flange wear, and enables the engine to readily enter switches and sharp curves when running in either direction. The front truck is center-bearing, and the rear side-bearing, each having a radius bar. If the run is short, the water may be carried on the boiler in saddle or side tanks, the fuel supply being carried back of the cab. For longer runs a separate tender is provided. A large number of engines of this type have been built for logging roads, and in such service are giving most satisfactory results.

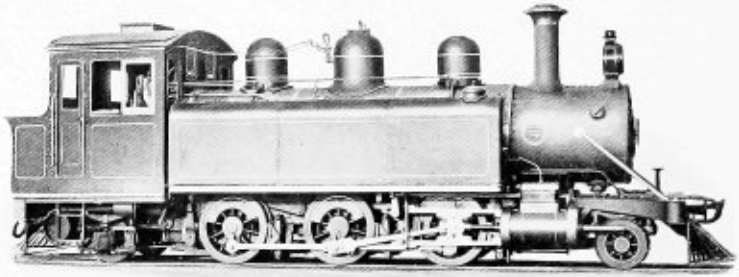
Class 10¼-D Type 2-6-2

Six Coupled Double-Ender Locomotives

With Two-Wheeled Front and Rear Trucks
Tank on Boiler

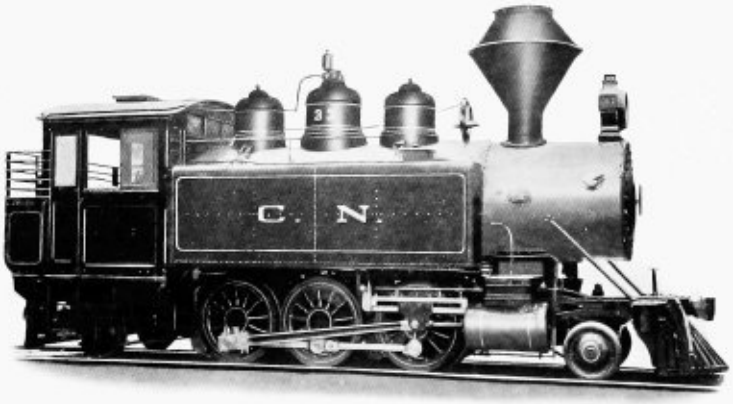
Gauge, 3 feet and upward

Weight and Hauling Capacity Based on 150 pounds Boiler Pressure



CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base		Capacity of Tank for Water. 8½-lb. Gallons	Weight in Working Order. Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manouvrier . .	10-10¼ D	8 x 12	28	16′ 4″	5′ 5″	400	28,000	18,000	3,480	410	110	55	35	25	18	13
Manovale . . .	10-11¼ D	9 x 14	30	17′ 2″	6′ 5″	450	36,000	24,000	4,800	570	150	80	48	34	24	17
Manovella . . .	10-12¼ D	9 x 16	33	18′ 4″	6′ 10″	500	40,000	28,000	4,980	595	158	84	51	37	26	19
Manovery . . .	10-14¼ D	10 x 16	33	19′ 6″	7′ 0″	550	44,000	31,000	6,150	735	195	105	65	45	35	25
Manovrammo .	10-16¼ D	11 x 16	33	20′ 6″	7′ 4″	600	50,000	36,000	7,450	895	240	130	180	58	43	32
Manovrando . .	10-18¼ D	12 x 18	37	22′ 6″	8′ 4″	700	58,000	44,000	8,900	1070	285	155	100	70	52	40
Manovrassi . .	10-20¼ D	13 x 18	37	22′ 10″	8′ 4″	800	66,000	50,000	10,430	1255	335	180	115	82	61	46
Manovrato . .	10-22¼ D	14 x 18	41	24′ 2″	9′ 0″	900	70,000	54,000	10,930	1320	355	190	125	88	66	50
Manovrava . .	10-24¼ D	15 x 18	41	24′ 6″	9′ 0″	1000	78,000	60,000	12,540	1515	405	220	145	100	75	58
Manovrerai . .	10-26¼ D	16 x 20	44	25′ 0″	9′ 4″	1200	90,000	68,000	14,780	1690	450	245	160	110	84	64

9/10 and 8



Class 10¼-D Type 2-6-2

Six Coupled Double-Ender Locomotives

With Two-Wheeled Front and Rear Trucks
Tank on Boiler

Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on
160 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tank for Water, 8½-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manpleaser	10-20¼ D	13 x 20	44	22′ 9″	8′ 0″	800	74,000	54,000	10,440	1260	335	180	115	80	58	43
Manquames	10-22¼ D	14 x 22	44	23′ 6″	9′ 2″	900	88,000	66,000	13,320	1610	430	230	150	105	78	58
Manquao	10-24¼ D	15 x 24	44	23′ 9″	9′ 2″	1000	108,000	82,000	16,690	2020	540	290	190	135	100	75
Manqueaba	10-26¼ D	16 x 24	44	25′ 3″	10′ 0″	1200	114,000	88,000	18,990	2305	620	335	220	155	115	90
Manqueamos	10-28¼ D	17 x 24	44	26′ 7″	10′ 6″	1400	126,000	98,000	21,440	2605	700	380	250	180	135	104
Manqueando	10-30¼ D	18 x 24	46	27′ 2″	11′ 0″	1500	136,000	104,000	22,980	2795	750	410	270	192	144	111
Manquearon	10-32¼ D	19 x 24	46	27′ 6″	11′ 3″	1800	150,000	115,000	25,600	3110	830	450	300	215	160	123

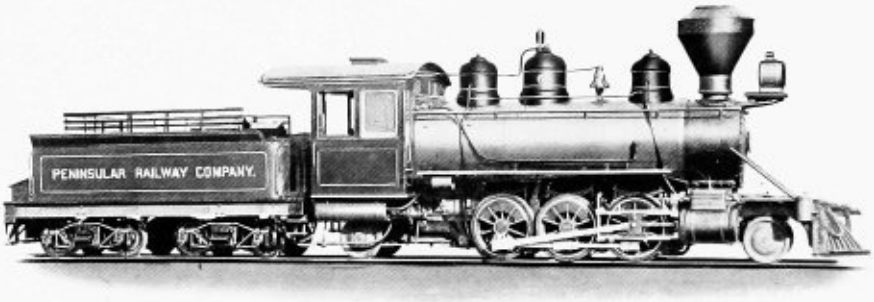
Class 10¼-D Type 2-6-2

Six Coupled Double-Ender Locomotives

With Two-Wheeled Front and Rear Trucks

Separate Tender

Gauge
4 feet 8½ inches or over



Weight and Hauling Capacity
Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tender for Water, 85½ lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manquecer	10-20¼ D	13 x 20	44	22′ 9″	8′ 0″	2000	68,000	50,000	10,440	1240	315	160	95	62	40	25
Manqueira	10-22¼ D	14 x 22	44	23′ 6″	9′ 2″	2200	84,000	60,000	13,320	1590	410	210	130	85	57	38
Manquement	10-24¼ D	15 x 24	44	23′ 9″	9′ 2″	2400	98,000	72,000	16,690	1925	500	260	165	110	77	54
Manquer	10-26¼ D	16 x 24	44	25′ 3″	10′ 0″	2600	105,000	80,000	18,990	2150	560	295	185	130	90	65
Manqueriez	10-28¼ D	17 x 24	44	26′ 7″	10′ 6″	2800	120,000	92,000	21,440	2450	640	350	215	148	105	75
Manquions	10-30¼ D	18 x 24	46	27′ 2″	11′ 0″	3000	130,000	98,000	22,980	2630	685	370	230	160	112	80
Manresana	10-32¼ D	19 x 24	46	27′ 6″	11′ 3″	3200	140,000	108,000	25,600	2905	755	405	255	175	127	90

⅞ and 8 T x 20

Eight Coupled with Two-Wheeled Front Truck

The Consolidation type, having four pairs of driving wheels and a two-wheeled leading truck, is suitable where adequate adhesion cannot be obtained without overloading the rails by the use of a locomotive having only three pairs of driving wheels. The front and rear pairs of driving wheels are flanged; the intermediate pairs are without flanges. The pony truck has a swinging bolster and radius bar.

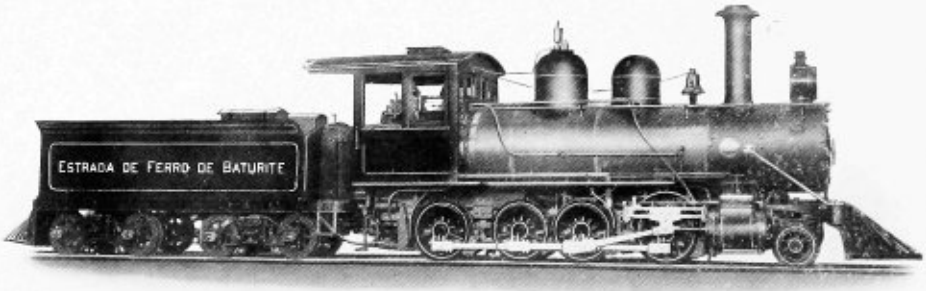
As usually built for standard gauge roads, engines of this type have the firebox over the rear driving axle, as shown in the illustration. This plan has given satisfactory results on wood burning locomotives. A similar design for narrow gauge roads is also illustrated.

If desired, narrow gauge consolidation locomotives may be designed with a deep and wide firebox placed entirely behind the driving wheels. This gives ample depth of furnace for burning wood, while the same plan answers equally well for bituminous coal.

Class 10-E Type 2-8-0

Consolidation Type Locomotives

Gauge, 3 feet and upward

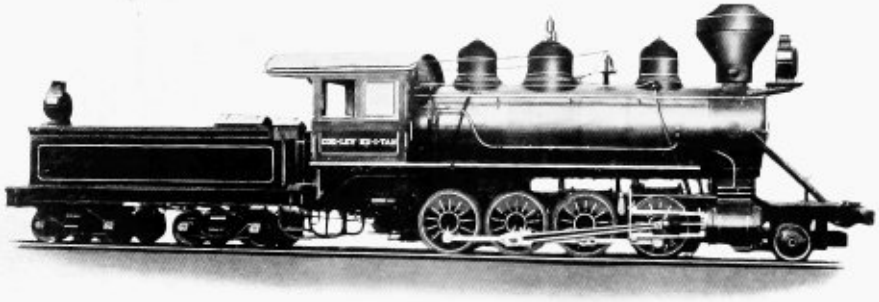


Weight and Hauling Capacity
Based on 150 pounds Boiler Pressure

CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tender for Water, 8½-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manresanos	10-20 E	13 x 18	37	15′ 10″	9′ 8″	1500	57,000	49,000	10,430	1250	325	170	105	70	50	35
Manrique	10-22 E	14 x 18	37	16′ 5″	9′ 9″	1600	63,000	55,000	12,110	1450	385	200	130	85	60	45
Mansalva	10-24 E	15 x 18	37	16′ 7″	10′ 8″	1600	70,000	62,000	13,900	1675	445	235	150	105	75	55
Mansamente	10-24½ E	15 x 20	37	17′ 0″	10′ 9″	1800	76,000	68,000	15,430	1815	480	255	165	115	82	60
Mansarrao	10-26 E	16 x 20	41	17′ 11″	11′ 6″	1800	85,000	76,000	15,850	1910	505	268	170	119	86	63
Mansbewind	10-28 E	17 x 20	41	18′ 0″	11′ 6″	2000	90,000	82,000	17,900	2160	570	305	195	135	100	70
Mansbloed	10-30 E	18 x 20	41	18′ 0″	11′ 6″	2200	100,000	92,000	20,070	2420	640	345	220	155	110	80

[1] 9½0 and 8 T x 20

Class 10-E Type 2-8-0



Consolidation Type Locomotives

Gauge
4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

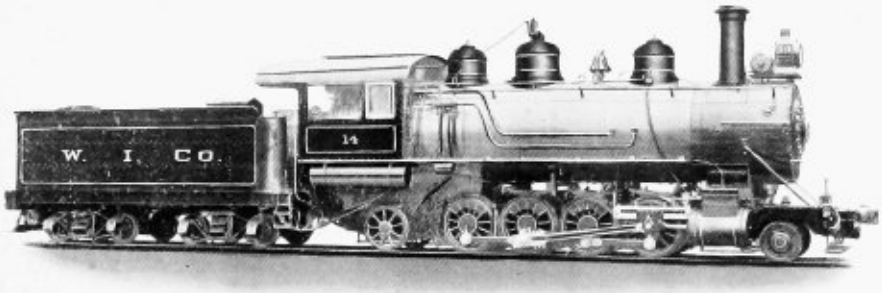
CODE WORD	Class	Cylinders, Diameter Stroke, Inches	Diam. of Driving Wheels, Inches	Wheel Base		Capacity of Tender for Water, 8½-lb. Gallons	Weight in Working Order, Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Mansejon . .	10-26 E	16 x 24	44	19′ 4″	12′ 6″	2500	92,000	82,000	18,990	2200	575	310	200	138	98	74
Manselles . .	10-28 E	17 x 24	44	21′ 5″	13′ 8″	2600	102,000	92,000	21,440	2465	650	355	225	155	114	85
Manserim . .	10-30 E	18 x 24	46	21′ 6″	14′ 0″	2800	110,000	98,000	22,980	2640	695	375	240	168	123	90
Mansfeni . .	10-32 E	19 x 24	46	21′ 6″	14′ 0″	3000	124,000	110,000	25,600	2980	785	420	270	190	138	102
Mansgewaad,	10-34 E	20 x 24	46	21′ 6″	14′ 0″	4000	135,000	121,000	28,380	3250	850	455	285	200	147	107
Mansgoed . .	10-36 E	21 x 24	46	21′ 6″	14′ 0″	5000	150,000	134,000	31,290	3550	925	490	315	215	155	113

8¾0 and 8 T x 20

Eight Coupled with Two-Wheeled Front and Rear Trucks

Locomotives having four pairs of driving wheels, with two-wheeled front and rear trucks, are particularly suitable for heavy freight service on roads having many grades and curves, and where adequate adhesion cannot be obtained by the use of three pairs of driving wheels. The presence of a truck at each end reduces flange wear, and enables the locomotive to enter sharp curves and switches when running in either direction.

The front truck has a center bearing, and is equalized with either one or two pairs of driving wheels; while the rear truck is side-bearing, and is equalized with the remaining pairs. If desired the firebox can be placed entirely behind the driving wheels, and made of greater depth than would otherwise be admissible. This also makes possible the use of longer tubes than can be employed in Consolidation engines, thus increasing the heating surface.



Class 12¼-E Type 2-8-2

Eight Coupled Double-Ender Locomotives

With Two-Wheeled Front and Rear Trucks

Gauge, 4 feet 8½ inches or over

Weight and Hauling Capacity Based on 160 pounds Boiler Pressure

CODE WORD	Class	Cylinders. Diameter Stroke. Inches	Diam. of Driving Wheels. Inches	Wheel Base		Capacity of Tender for Water. 8½-lb. Gallons	Weight in Working Order. Pounds		Tractive Power	LOAD IN TONS (OF 2000 POUNDS) OF CARS AND LADING						
				Total	Of Driving Wheels		Total	On all Driving Wheels		On a Level	On a Grade per Mile of					
											52.8 ft. or 1%	105.6 ft. or 2%	158.4 ft. or 3%	211.2 ft. or 4%	264.0 ft. or 5%	316.8 ft. or 6%
Manshart . .	12-26¼ E	16 x 24	44	24′ 4″	12′ 6″	2600	106,000	82,000	18,990	2190	570	300	190	130	90	65
Manshemden	12-28¼ E	17 x 24	44	26′ 5″	13′ 8″	2800	120,000	92,000	21,440	2450	640	350	215	145	104	75
Manshoofd .	12-30¼ E	18 x 24	46	26′ 5″	14′ 0″	3000	130,000	98,000	22,980	2630	685	360	230	158	112	80
Manshoogte .	12-32¼ E	19 x 24	46	26′ 5″	14′ 0″	3600	145,000	110,000	25,600	2960	770	405	255	172	122	86
Mansilha . .	12-34¼ E	20 x 24	46	27′ 0″	14′ 3″	4000	155,000	121,000	28,380	3240	840	445	275	190	137	97
Mansinho . .	12-36¼ E	21 x 24	46	27′ 0″	14′ 3″	5000	170,000	134,000	31,290	3540	915	480	305	205	145	103

9/40 and 8 T x 20

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Manshoogte	12-32¼ E	4′ 8½″	64
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Baldwin Locomotive Works

Philadelphia, Pa., U. S. A.

Builders of Single Expansion and Compound

Passenger Locomotives — Freight Locomotives — Switching Locomotives

Logging Locomotives — Plantation Locomotives

Locomotives for Rack Railroads — Locomotives for Mills or Furnaces

Heavy Locomotives for Special Service

Electrical Locomotives — Trucks — Mine Locomotives

Oil-Burning Locomotives — Compressed-Air Locomotives

Specifications, proposals and full particulars furnished upon application

The Edgell Press
Philadelphia
8-06

BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA, PA.,.....19.....

ELECTRIC TRUCK MEMORANDUM SPECIFICATION

GENERAL

Truck class..... Name of Road.....

Number of trucks wanted..... Motor trucks..... Trailer trucks.....

Delivery date..... Delivery point.....

Kind of service..... Car builder.....

Will car body be built to suit trucks?..... Is car single or double ended?.....

Maximum speed.....m. p. h. Radius of minimum curve for light car.....

Radius of minimum curve for loaded car..... Trolley or third rail.....

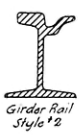
Number of seated passengers in car..... Wheel base of truck.....

DETAILS

Style of rail-T rail..... Girder rail style No. 1..... Girder rail style No. 2.....


T-Rail


Girder Rail Style #1


Girder Rail Style #2

Rail section number..... Weight per yard.....lbs. Rail maker.....

WHEELS

Kind of wheels..... If forged rolled steel wheels, thickness of rim.....in.

If cast iron wheels, whether spoke, single or double plate centers.....

Approximate weight of cast iron wheels.....lbs. Diameter of wheel.....

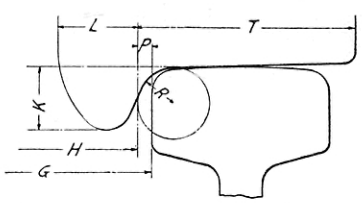
Gauge of wheels, as per B. L. W. standard method of gauging, as shown below:-

G—Gauge of track.....

H—Gauge of wheels (measured on tangent line to curve of radius R).....

P—Clearance each side between flange and rail, or half the track play.....

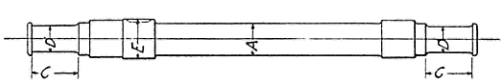
L—Width of flange.....



K—Depth of flange..... **R**—Radius of flange fillet..... **T**—Width of tread.....

AXLES

Journals **D**.....in. x **C**.....in. Diam. at motor bearing **A**.....in. Diam. at gear seat **E**.....in.



MOTORS

Type..... Make..... Gear ratio..... Weight of motor.....lbs.

Number of motors per truck ..... Motors inside or outside hung.....

GEARS

Solid or split..... Furnished by B. L. W.....

When used with forged rolled steel wheels or steel tired wheels, gears if solid should be shipped direct to Standard Steel Works Co., Burnham, Pa. (If cast iron wheels are specified to be used in connection with solid gears, gears to be shipped direct to B. L. W., Philadelphia, Pa.)

WEIGHTS

Weight of car body only.....lbs. Carbody electrical apparatus.....lbs.

Car body air brake equipment.....lbs. Maximum passenger or freight load.....lbs.

Maximum load on each center plate.....lbs

PRINTS

The following prints should be sent to Baldwin Locomotive Works:-

Carbody underframing. Third rail shoe print, showing shoe and location of third rail. Indorsed motor print, if General Electric motors are specified. Print of gear, if to be furnished by Baldwin Locomotive Works.

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